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SUNGAI BATU ARCHAEOLOGICAL COMPLEX AS AN ICONIC HERITAGE TOURISM SITE: EVIDENCE OF ANCIENT TRADE IN THE NORTHERN PART OF PENINSULAR MALAYSIA

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Abstract: The research at the Sungai Batu Archaeological Complex (SBAC) aimed to document the original river jetty structure and port management of ancient Kedah, which dates back to the 6th and 5th centuries BC. It was built on the riverbank, while port management was built at the back of the river jetty structure. The existence of the river jetty and port management structure in SBAC is clear evidence of the international trade process that has occurred in this area between the ancient Kedah Kingdom and foreign traders. For primary data recording in the field, several methodologies have been used, which include excavation, and analysis. The results revealed evidence of in situ river jetty and port management structures built using bricks. The architecture was also found to be complete with floor, wall, corridor and staircase structures for the river jetty, while the port management structure revealed the architecture of the floor, wall, corridor and administration space. The evidence of in situ architecture allows for the first time the outstanding universal value (OUV) of the river jetty and port management site to be clearly determined based on academic studies. It is the most complete river jetty architectural form of early world civilisation since the 6th century B.C., ii) the most complete iron ingot export river jetty of early world civilisation and iii) the most complete ancient Kedah port complex. The OUV for port management sites was determined to be i) the earliest civilisations reveal the clearest and most complete evidence of port management architecture since the 5th century BC and ii) the first discovery of the architecture for managing iron export facilities in early world civilisations. This makes the archaeological evidence at SBAC the only one in Southeast Asia that is unique and can be nominated as a UNESCO World Heritage site for the World Heritage Site (WHS) category. To achieve this goal, the process of empowering the heritage tourism sector is actively carried out in collaboration between stakeholders and the local community so that it can produce a total of 17 identity tourism packages in the Kuala Muda district, Kedah, Malaysia. The involvement of stakeholders and local communities in tourism activities is a positive step to ensure that the heritage tourism sector in SBAC can be preserved and sustained.

Keywords: SBAC, heritage site, iconic tourism product, tourism

* * * * * *

INTRODUCTION

The development of the Sungai Batu Archaeological Complex (SBAC) as a sustainable tourism site has been discussed scientifically by Abd Halim et al. (2024a) and Abd Halim et al. (2025a), which cover the offering of tour packages, the availability of tour guides and the application of digital technologies. The development of this area as a heritage tourism location is closely related to the very special outstanding universal value (OUV) revealed through academic studies.

In fact, based on these factors, SBAC was recognised as a national heritage site in 2012 (Ali et al., 2021 a,b) and developed as a heritage tourism site in Malaysia. Its recognition as a national heritage site has led to the establishment of a more structured tourism development and marketing plan to empower the heritage tourism sector. This allows for the first time in Kedah, Malaysia; there has been a systematic tourism development movement complete with living culture gallery facilities that include poster information, iron smelting demonstrations, hands-on excavations, and hands-on ancient brick, roof tiles and bead making (Abd Halim et al., 2024b). In addition, with the application of digital technologies such as AR, VR, hologram fans, and QR codes (Abd Halim et al., 2024a) also demonstrates the positive commitment played by stakeholders in ensuring that tourism sites in SBAC are conserved just like heritage tourism sites in other parts of the world (Hasan Khan, 2020; Labadi et al., 2021; Abdul Huq & Puthuvayi, 2024; Van der Zed et al., 2024; Abd Halim & Saidin, 2026). All these tourism marketing moves can be carried out based on systematic studies conducted at iron smelting workshop sites that represent evidence of the industry (Mohd Mokhtar, 2012: 2019; Abd Halim et al., 2025b), river jetty (Abd Halim et al., 2025c), and port management (Aminuddin, 2015; Ahmad, 2016; Yusof, 2016; Abd Halim, 2019) as evidence of trade, as well as ritual and Buddhist monuments (Abd Halim & Saidin, 2025a) as evidence of belief and religion in SBAC. This shows that archaeological studies in SBAC are special because it is the only area in the world that reveals clear and complete evidence of

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industry, trade and religious beliefs in an area of only about 4 km² (Abd Halim & Saidin, 2025a). To balance the marketing of tourism, the availability of tourism infrastructure is also given priority. The availability of transportation infrastructure (Figure 1) and accommodation (Figure 2) to the heritage tourism area is seen to be on a good track and able to attract tourists to travel to this area (Yu et al., 2023; Zunic et al., 2023; Arsh et al., 2024). This is expected to be a trigger for the development of tourism activities that take place at SBAC, which is also able to maximise the tourist experience at a tourist location.

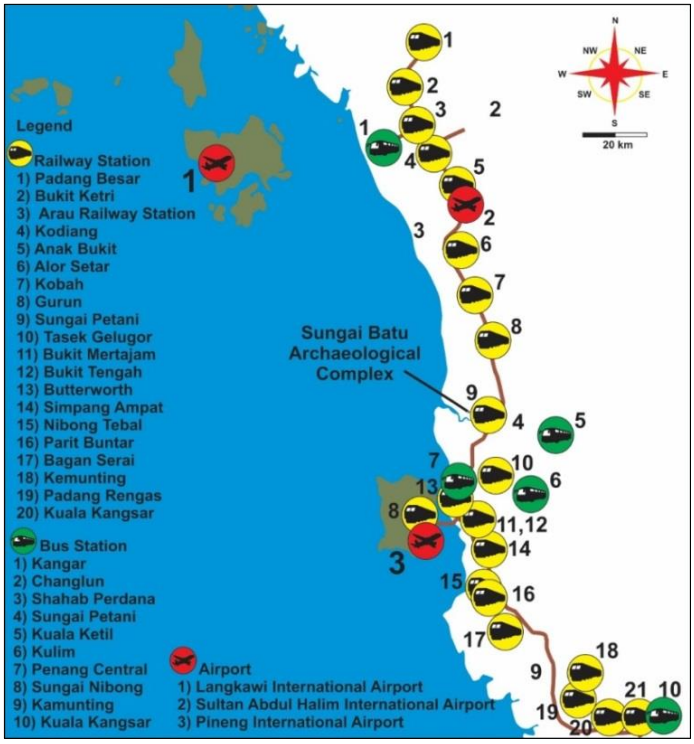


Figure 1. Availability of transportation systems to SBAC areas capable of developing tourism activities (Source: The authors)

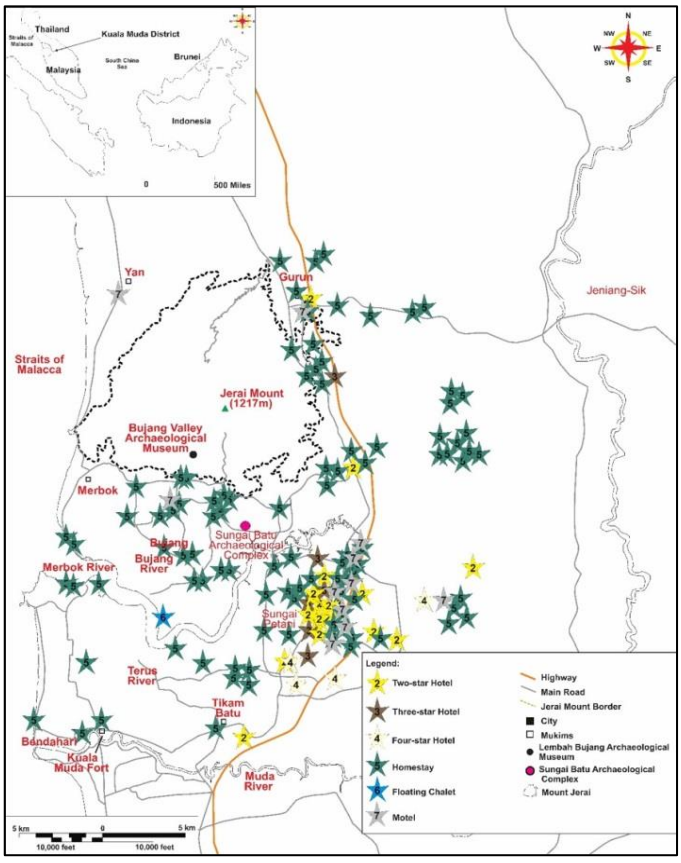


Figure 2. The availability of various types of accommodation in the nearby SBAC area is also able to offer more accommodation options to tourists (Source: The authors)

Additionally, there are eight border crossings near SBAC that have the potential to attract more tourists to the area (Figure 3). Some of the border gates include i) Wang Kelian-Wang Prachan border, ii) Padang Besar border, Perlis, iii) Bukit Kayu Hitam-Sadao border, Kedah, iv) Pengkalan Kubor-Tak Bai border, v) Rantau Panjang-Sungai Golok border, vi) Bukit Bunga-Buketa border, vii) Durian Burung-Ban Prakob border, Kelantan, and viii) Pengkalan Hulu-Betong border, Perak, Malaysia. Even with the role of stakeholders who formulate various programmes throughout the year to visit Kedah, 2025 is also expected to be able to attract domestic tourist visits (Nizam, 2024) in addition to being able to boost the influx of international tourists to tourist sites in Kedah (Hamid, 2024). This shows that the existence of special world-class heritage tourism sites with outstanding universal value and high value coupled with the availability of the best tourism infrastructure can be a catalyst for the development of heritage tourism, especially in ancient Kedah tourism sites. This is clearly recorded in other tourist sites that record the increase in the number of tourist arrivals to tourist areas due to tourism facilities that have been available (Gossling et al., 2018; Lei et al., 2023; Apriyanti et al., 2024; Hidalgo, 2024).



Figure 3. The border gate located in the northern part of Peninsular Malaysia has the potential to attract more tourists from Thailand (Source: The authors)

Tourism Marketing

According to Thomas & Langlitz (2018), John & Supramaniam (2024), and Basumatary & Sarma (2025), tourism marketing is a unique and methodological way to empower the tourist sector. This is because tourist sites are very close to local communities, so every element related to the development, empowerment, and marketing of a tourist location must include community involvement to ensure sustainability and success (Gubam & Nomishan, 2020). This approach is seen as a proactive step to maximise the empowerment of the tourism sector in an area (Ryan, 2002).

To achieve this goal, Poon (1993), Mendoncia et al., (2015) and Wang (2024) have outlined several issues related to integration, collaboration and networking activities at the local level as policy issues that need to be arranged and coordinated at the grassroots level to achieve the end goal of marketing a heritage tourism locality. After the issue is given special attention at the grassroots level, there is a need for a location that provides a tourism information centre which is used as an area that manages and monitors all activities related to packages and tourism, such as the recommendations of Ludmila & Kristina (2018) and Rachmawati et al. (2023). The purpose of its establishment is to centralise the tourism marketing process carried out while acting as an initial step to provide information related to tourist destinations directly to tourists so that the selection of tour packages becomes more effective. For these needs, tourism marketing in SBAC also involves the provision of a one-stop tourism centre in Sungai Merbok (Figure 4) which is available for various tourism facilities. To ensure that tourism marketing is able to attract tourists, especially for tour packages to heritage tourism sites, the provision of certified tour guides is a very necessary step (Rabotic, 2010; Setiawan & Wiweka, 2018). This is because a tour package to a heritage site is not a tour program to a tourist site other than because it is in the category of knowledgeable tourism, so the provision of a certified special tour guide is the most important asset in preserving the tourist location (Rabotic, 2018).



Figure 4. The One Stop Tourism Centre serves as a tourist information centre in Sungai Merbok (Source: The authors using a drone, 2021)

Therefore, UNESCO (2018); Bayram (2020); Malelak et al. (2022); and Dung (2024) stated that the local heritage has a direct connection with the community, so the provision of certified tour guides from among the local community is important to emphasise. This can also emphasise the principle of leaving no one behind in tourism marketing (Trupp & Dolezal, 2020; Butcher et al., 2021; de Jong & Vijgeberg, 2024; Abd Halim et al., 2025a; Priatmoko et al., 2025).

SBAC Authentic Data Research

Archaeological studies conducted at SBAC since 2009 have been able to record evidence of trade in this area based on the findings of the river jetty and port management structure. Although the archaeological study at SBAC has recorded the discovery of 11 river jetties structures and 18 port management sites, to complete this study, only archaeological evidence at the river jetty SB2J and port management SB2G sites (Figure 5) will be discussed more carefully to clarify the architecture, analysis of artefacts carried out and interpretations submitted.

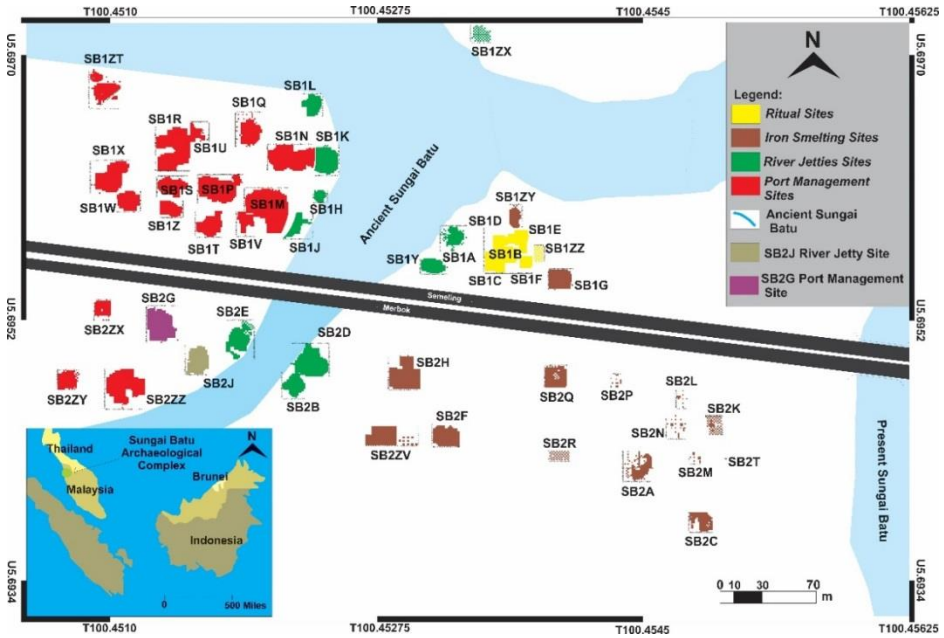


Figure 5. Location of SB2J river jetty and SB2G port management site in SBAC (Source: The authors)

SB2J River Jetty Structure

The SB2J site [05°41'42.0" N and 100°27'05.2" E] is located approximately 15 metres northeast of SB2E, 30 metres northwest of SB2G and 26 metres southwest of SB2ZZ (Figure 5). Excavations at the SB2J site have found bricks that

suggest bricks have been used as the raw material for the construction of monument structures at the SB2J site. The excavation process at the SB2J site involved a total of 173 squares, measuring 1x1 square meter (m²). After the excavation process was completed, digital photo recording at the SB2J (Figure 6) site was taken.

Digital photo recording was taken to be the main reference during the sketching process and the production of architecture plans for the appearance of the monument at the SB2J site. For the purpose of simplifying the process, Figure 7 is the floor map plan for the SB2J site. Excavations carried out at the SB2J site have involved an area of 247 m². Trench K19 and N10 are stratigraphic reference trenches for SB2J and have not been excavated. The stratigraphic layers in both trenches suggest that the monument structures at the SB2J site remain intact.



Figure 6. The side view of the SB2J site includes 173 squares, covering a total area of approximately 247 m² (Source: The authors)

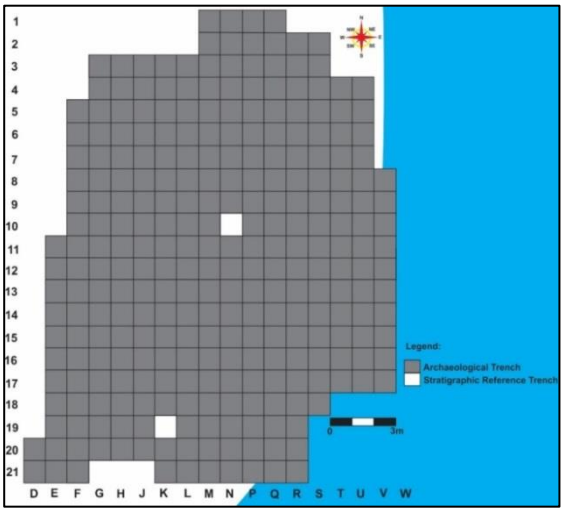


Figure 7. Floor map plan of SB2J (Source: The authors)

Researchers also conducted a study of the stratigraphic layers of the SB2J site (Figure 8). The researchers selected the walls of the site, located in the eastern part of the nearby ancient Sungai Batu, for the study of the stratigraphic layers. The results of the study also found that the SB2J site is still in situ and is not disturbed by human activities. Stratigraphic layers in the area with evidence of brick finds reveal a layer of clay. The SB2J site's clay layer serves as the base layer, indicating the absence of architectural structures beneath it.

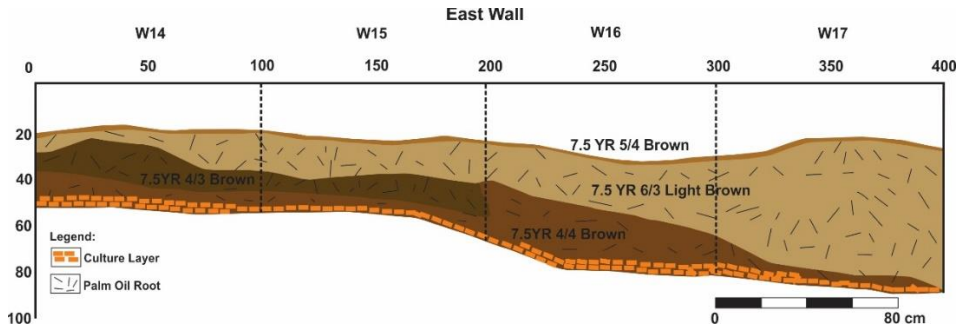


Figure 8. Stratigraphic layers at SB2J sites that are still in situ (Source: The authors)

The excavation results at the SB2J site have revealed the structure of floors, walls, corridors, staircase and roof tiles (Figure 9) as proof that the site is roofed. Based on the location and structure of the building, which was built sloping towards the ancient river, the site also plays the role of a river jetty in SBAC. The monument structure of the SB2J site was also built on land reclaimed in advance with brick fragments. The floor structure is in the central part of the site (Figure 9a). The horizontal construction of this part of the floor utilises bricks with an average size of 27x17x5 cm.

The area of this section is estimated at about 11 x 7 square metres. The arrangement of the floors on the site is clearly visible in the eastern part. The floor structure at this site also has similarities with other jetty sites, which are built orientated north–south and have a small strip of about 15 cm between each floor brick arrangement. The wall structure (Figure 9b) is found at the north and south ends of the main floor structure of the SB2J building.

The structure is intended to serve as a space separator between the floor structure and the corridor on the site. The length of the ruins of this wall structure measures 11 metres. The average brick size used to build the wall structure is around 17x16x5 cm, which consists of two layers of bricks. The SB2J site's main floor structure features corridor structures on its north, south, and west sides (Figure 9c). The corridor structure in the North and South is proposed to be the same length as the main structure of the SB2J monument, which is 11 metres long and about three metres wide, while the corridor structure in the western part measures 16x2.5 metres. The corridor structure at this site is built with an

average brick size of 18x17x5 cm and arranged in a stretchable manner between each brick arrangement. The proposal is to locate the floor staircase (Figure 9d) in the southern part of the SB2J site.

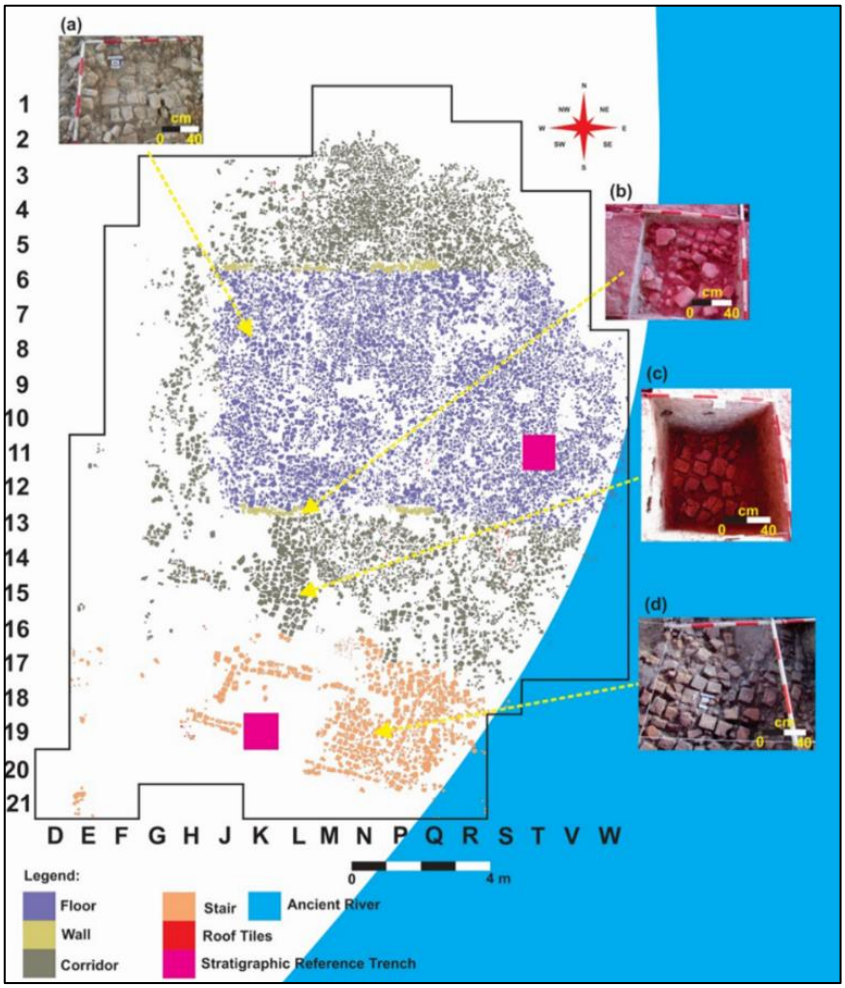


Figure 9. The architectural sketch plan of the SB2J river jetty at SBAC showcases the in situ structure, including the floor (a), wall (b), corridor (c), and staircase (d), making it the most complete ancient river jetty made of brick in Southeast Asia (Source: The Authors; small picture: The Authors, January 10, 2025)

The structure of the staircase was built with a 25° gradient towards the ancient river. The structure of the staircase at the SB2J jetty site was found to be connected to the corridor structure in the main building. The proposed structure will measure approximately 4 meters in length and 2.5 meters in width. The structure of the alternative pathways, which slopes towards the ancient river, consists of at least eight stacks of brick strips. The alternative route's floor features a brick arrangement that spans approximately 15 cm per row.

Based on the study of the architectural form of the SB2J site, Figure 10 is a reconstruction plan of the monument at the SB2J site. Based on the sketch, the SB2J site has similarities with the SB2E river jetty site, which has an alternative pathways structure to fluctuate from the river to the mainland. Excavations at the SB2J site also revealed the discovery of a pillar base in trench J5, spit 2, which suggested the existence of a roof structure at the site (Figure 11). This is reinforced by the discovery of the distribution of roof tiles on the north and south of the SB2J monument. Based on the pillar base found at the end of the floor structure, there are at least four pillars that support the roof structure at this site. Because there is no record of the discovery of the roof tiles on the altenative pathways, that suggests the structure is not roofed.

In addition, contour mapping carried out at the SB2J site also showed that the main monument structure of the site was built horizontally. However, in the southern part of the site, there is evidence of structures sloping towards the ancient river (Figure 12). It is likely that the structures built on the southern side of the SB2J site had a more obvious function with the ancient river.Pottery fragments were also found at the SB2J site, which is evidence of material culture in SBAC. A total of four brick samples were taken to obtain chronometric dating for the SB2J site. The four brick samples were taken from several different architectural structures, such as floors and staircase. The trench involved in the brick sampling process are L14 (Spit 5), P18 (Spit 8), N20 (Spit 9) and Q18 (Spit 4).

Charcoal samples from trench L14 (Spit 5) and P18 (Spit 8) were selected to obtain data on activities taking place at the site. However, until now only chronometric dating data from the trench L14 (floor structure) and P18 (staircase) have been obtained, which describe the site was built since the 4th to 6th century AD. This means that the river jetty floor structure was built since 518 AD (1.5±0.1), while the staircase structure was built since 318 AD (1.7±0.1).

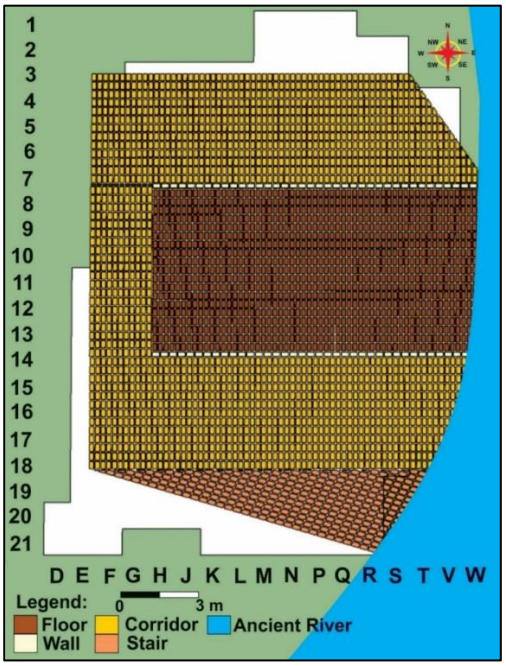


Figure 10. The SB2J site's proposed reconstruction architecture plan reveals that an ancient river served as the foundation for the main building structure

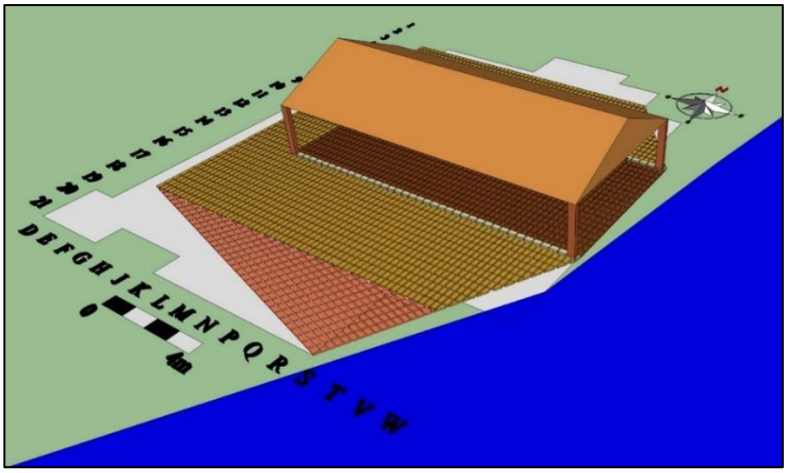


Figure 11. The proposed reconstruction architecture plan for the monument at the SB2J site is based on the findings of the floor structure, corridors, walls, staircase, roof tiles, and pillar base (Source: The authors)

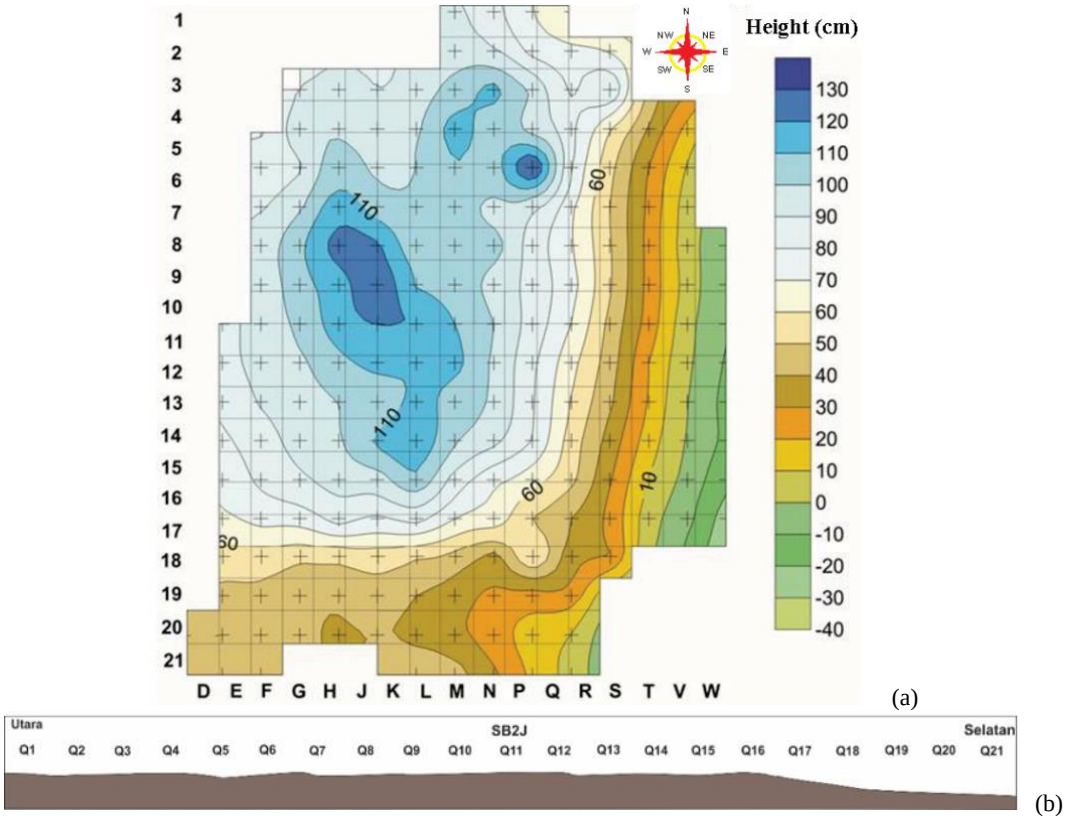


Figure 12. Contour mapping results (a) showing the structure at the SB2J site sloping towards the ancient Sungai Batu in the eastern. The cross-sectional results also indicate that the built structures at the SB2J site began to slope towards the ancient river in the southern part of the site (b) (Source: The authors)

SB2G Port Management Structure

In 2010, excavation took place at SB2G site, located at 05°41'42.2" N & 100°27.04.4 E (Figure 5). The mapping results revealed that the SB2G site was located 35 metres east of the SB2E site, 15 metres southeast of the SB2J site and 25 metres southwest of the SB2ZZ site. The SB2G site is behind the SB2E site, which is on the west bank of the ancient Sungai Batu.

After the excavation process was completed, a side view of the SB2G site was also taken (Figure 13). Digital photography for the SB2G site is intended to be used as a reference during the sketching process carried out there. In order to facilitate the work during the field study, the SB2G floor map plan has been produced (Figure 14). Based on the SB2G site plan, trench P45, R35-36, S35-36, S26-27, T26-27, B31-32, A41, B41, C31-32 and Y39 were not excavated, as the trench were used as stratigraphic reference trench for the SB2G site apart from the presence of oil palm tree stumps in the area.



Figure 13. View site of SB2G. A total of 407 trenches have been excavated at this site, involving an area of 513 m² (Source: The authors)

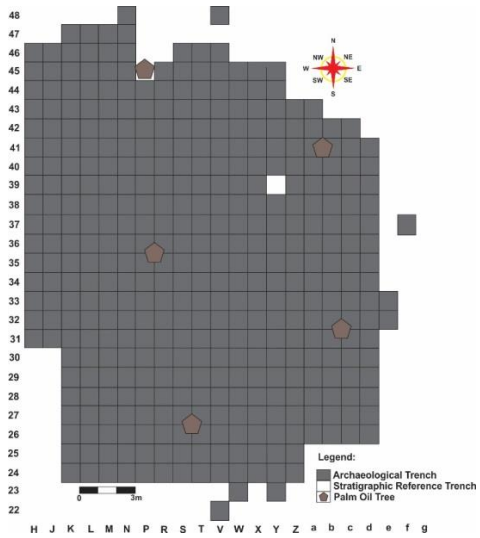


Figure 14. SB2G floor map plan involving 407 trenches with a total area of 513 m² (Source: The authors)

The stratigraphic data recording process was also conducted at the SB2G site. Stratigraphic data is important to examine to confirm that the SB2G site is still in situ and undisturbed during the last time it was abandoned by the community at SBAC. The results of a study of the soil stratigraphy of the SB2G site clearly show that it is not disturbed by human activities (Figure 15).

The building is therefore an undisturbed and still *in situ* structure. In addition, the results of contour mapping found that the main monument structure of the SB2G site was not built in a sloping condition (Figure 16). It is built horizontally.

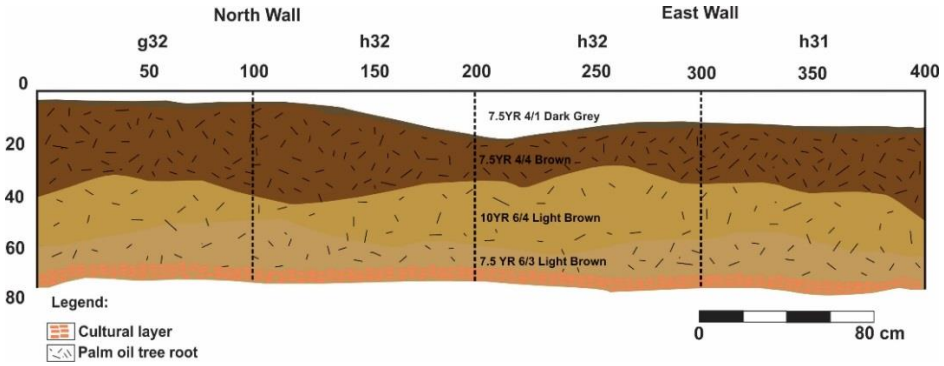
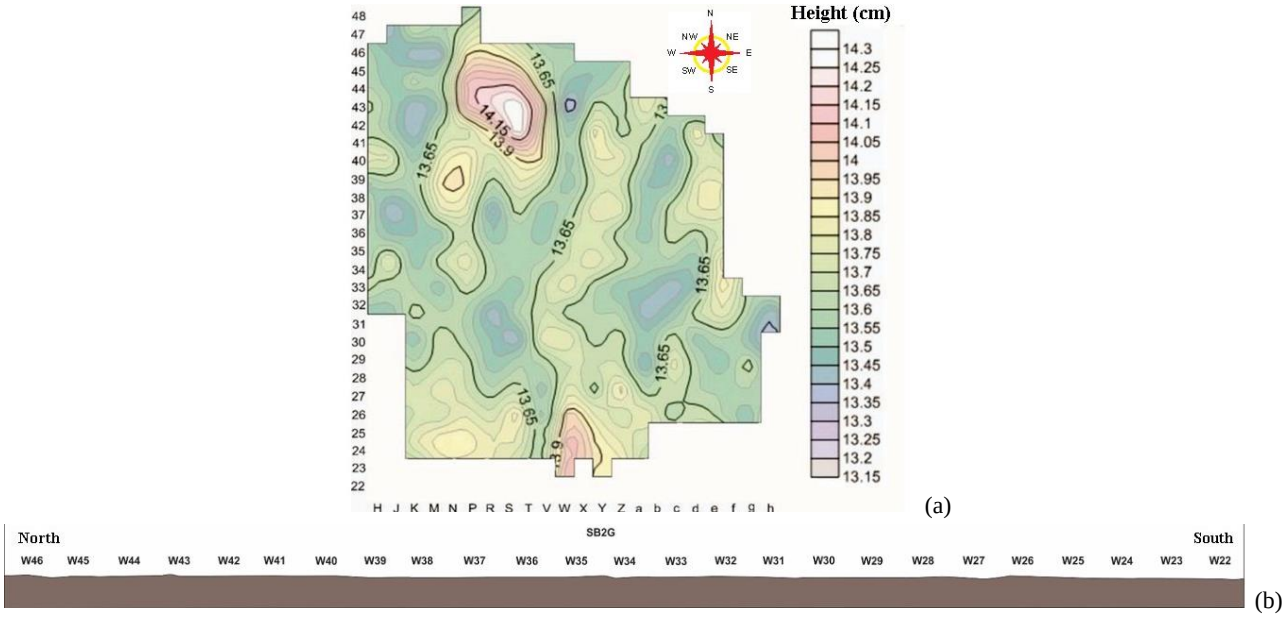


Figure 15. The SB2G sites exhibit stratigraphic layers. The cultural layer is found in the fourth layer, characterised by the discovery of bricks that represent the built structures of the site (Source: The authors)



(a)

(b)

Figure 16. The result of contour mapping (a) and cross-section (b) at the SB2G site clearly shows that the main monument is built horizontally, which is different from the river jetty site in SBAC (Source: The authors)

So the excavation process carried out at the SB2G site has revealed the structure of the floor, room space (administration), walls, roof tiles and pillar bases as evidence that it was roofed (Figure 17) and built on reclaimed land with broken bricks. The SB2G building's main floor structure faces north-south and features small, 15 cm-wide strips between each floor arrangement. The average brick size used to represent the floor structure is 27x16x5 cm. There are at least 45 strips of floor brick arrangement at the SB2G site that form the floor structure (Figure 17c).

The brick arrangement of the floor structure was found to have similarities with the river jetty floor and slightly sloping towards the ancient river in the eastern part. The arrangement suggests its function as a river jetty structure at the beginning and when the river level is shallow until the land is formed, causing it to change its function as an administrative space. Additionally, the left and right sides of the main floor structure do not serve as visible wall structures for space separation. The brick arrangement's orientation indicates the difference in space and function. The main building structure spans at least 13 metres in length and five metres in width. The corridor structures at the SB2G site are located on the north, south and west sides of the site (Figure 17a).

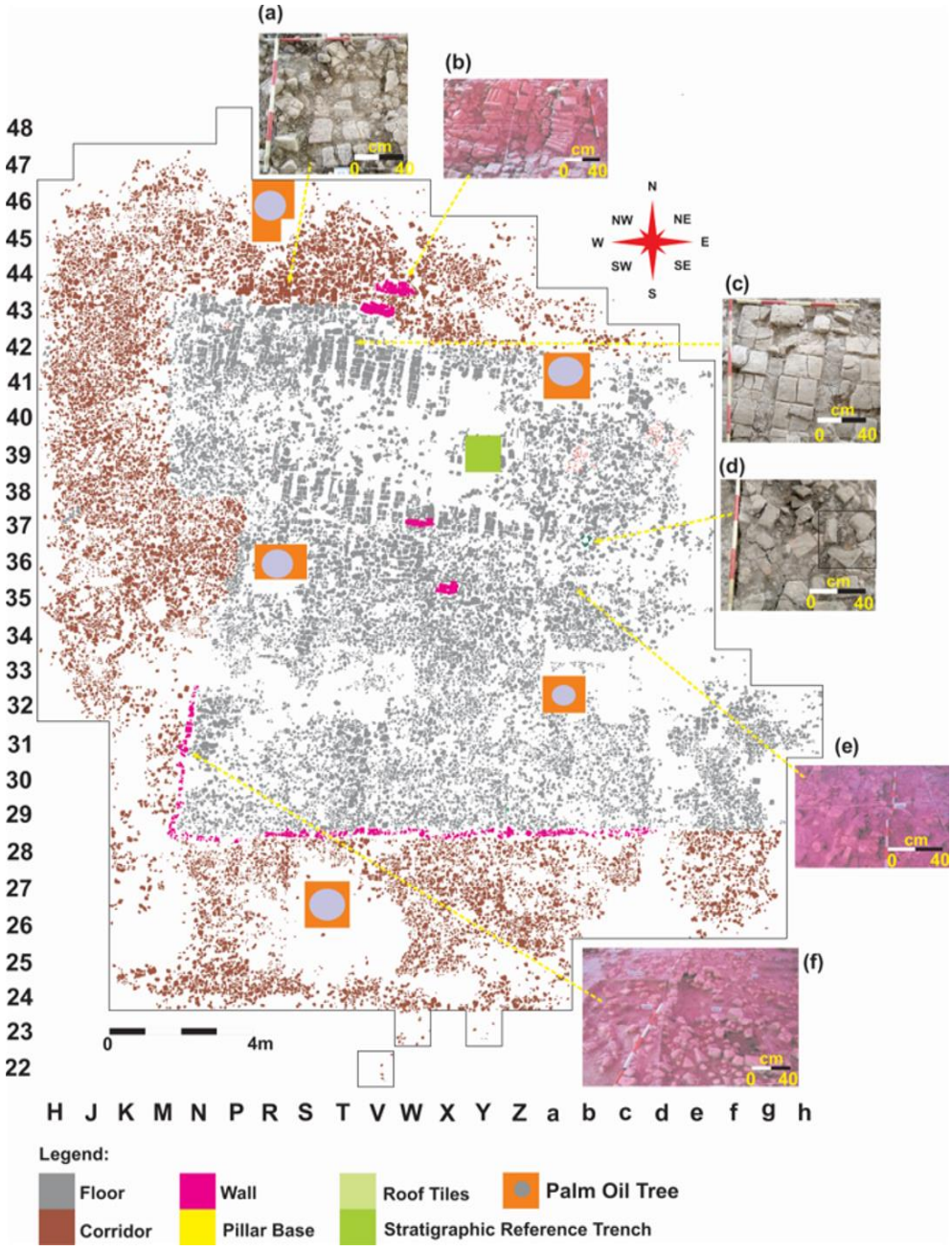


Figure 17. The architectural sketch plan of the SB2G port management site at SBAC showcases the in situ structure, including the corridor (a), wall (b), floor (c), pillar base (d), administrative space (e) and wall (f) making it the most complete ancient port management made of brick in Southeast Asia (Source: The Authors; small picture: The Authors, January 10, 2025)

The SB2G site arranges its corridor structure in an unsystematic manner, setting it apart from the main floor structure. This structure is expected to be a altenative route to the support monument, which is on the south side of the main structure of the site. This is because there is a wall structure that separates the corridor from the administrative building. The corridor

structures in the northern and southern sections measure 13 metres long and 1.2 metres wide, while those in the western section measure 2 metres wide. The size of the bricks used to represent the corridor structure at the SB2G site is 18x15x5 cm.

The discovery of stacked brick rubble believed to be a brick entrance gate structure (Figure 17b) was also found at the SB2G site. The brick entrance gate structure is in the corridor area at the north and south of the SB2G site. This brick entrance gate measures 130 cm long by using an average brick size of 17x16x5 cm. As there are two brick entrance gate, each pair on the north and south sides of the SB2G site suggests it is part of the brick entrance gate evidence of the SB2G monument structure. The southern end of the corridor structure at the SB2G site is proposed to be a rectangular structure that is proposed as an administrative space to the SB2G (Figure 17e). The port management structure measures 22x11 metres. A wall structure consisting of two layers of brick separates the administrative space from the corridor in this section (Figure 17f). So Figure 18a,b is a reconstruction plan and the appearance of the monument for the SB2G site, which has an earliest river jetty area of 6x17 m² in the north, while the second room has an area of about 22x11 m² in the south for the administrative area, as well as corridors in the north, south and west. The evidence of room space indicates that the SB2G monument initially functioned as a river jetty and later transitioned to port management in SBAC when the river became shallow. Excavations at the site also revealed 115 pieces of earthenware, which support the interpretation of the area as a river jetty and port management structure. The excavation also found a pillar base (Figure 17e) and roof tiles distribution (Figure 19), which allows interpretations to be submitted related to the architectural form of the pillar at the SB2G site. Pillar base at the SB2G site were recorded in trenches B37 and M38 at the end of the room structure at the SB2G site. Wooden poles are proposed to be used as roof supports at this site due to their flexible ability to accommodate heavy loads (Wiyana, 2016).

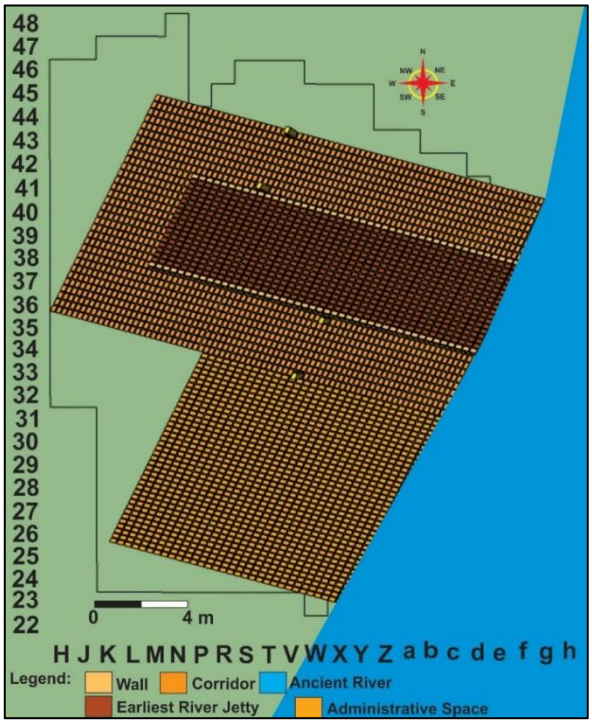


Figure 18a. The SB2G proposal plan was produced based on the remains of in-situ architecture at the site. The results of the study have confirmed its appearance as a river jetty and port management in SBAC (Source: The authors)

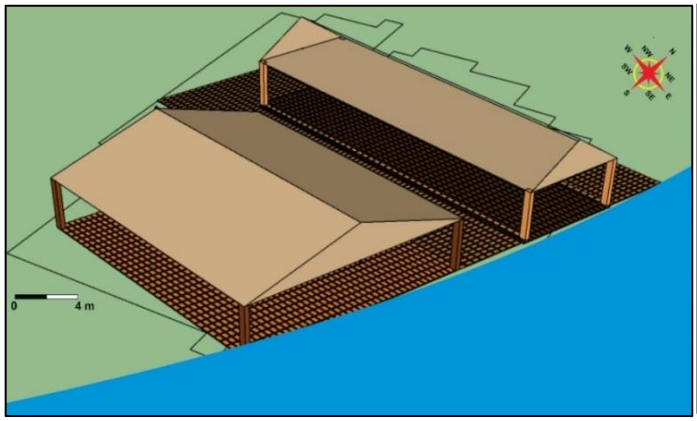


Figure 18b. The reconstruction plan for the SB2G monument is based on the findings of the river jetty floor, corridors, walls, administrative space, roof tiles, and pillar base structures (Source: The authors)



Figure 19. The distribution of roof tiles at the SB2G site in the northern part reinforces the related interpretation of the existence of roof structures at the SB2G site (Source: The authors)

However, the excavation results at the SB2G site did not record the discovery of the pillar structure because it was likely that it had been weathered. Based on the in-situ findings of the pillar base structure, it is proposed that the river jetty and port management monument at the SB2G site have four pillar base structures as roof supports. Therefore, Figure 16 shows the architectural form of SB2G, which has pillars and roofs based on the location of the pillar bases and the distribution of roof tiles at the site.To obtain data on the chronometric dating of the monument, a total of 11 brick samples were taken to obtain dating data. The sample brick will use the OSL method. The brick samples involved were d37 (Spit 3), d38 (Spit 3), d39 (Spit 3), e38 (Spit 6), X25 (Spit 3), M34 (Spit 3), M43 (Spit 3), N41 (Spit 4), P40 (Spit 4), X23 (Spit 3) and Z38 (Spit 3). The brick samples represent the floor, corridors, and administrative room structures at the SB2G site. However, until now, only two samples have provided dating data: sample d37 (Spit 3), which represents the corridor structure and indicates an age of about the 1st century BC, and sample d38 (Spit 3), which represents the floor structure and reveals that it was built in the 5th century BC. This construction occurred around the 5th century BC (Abd Halim & Saidin, 2025b). This site has functioned as a river jetty and port management on the riverbanks of the river, and when the sea level dropped, it caused land to form, causing the site to move away from the river. Consequently, the riverbank area underwent the construction of a new river jetty structure to facilitate effective trade activities. This coincides with the dating of the SB2E site on the banks of Sungai Batu (Figure 5), which was built in the 3rd century BC after the flow of the river decreased and was in the area concerned. This is reinforced based on geophysical mapping in the port management area in the northern part of SBAC, which was also built in the 5th century BC, which has revealed evidence of ancient river flow based on a low resistivity value of < 50Ωm (Ahmad, 2016).

Outstanding Universal Value (OUV)

Archaeological excavations carried out at the river jetty and port management site at SBAC have so far been able to reveal an exceptional outstanding universal value (OUV) that qualifies it to be nominated as a UNESCO World Heritage site. Table 1 summarises data relating to the OUV of the river jetty and port management sites, which to date have not been recorded in any other archaeological study in other parts of the world.

Based on the data, it is clear that SBAC has met the criteria for nomination as a UNESCO World Heritage site, although currently it is only recognised as a national heritage site in 2012 (Abd Halim et al., 2025a), in addition to being recognised as the oldest civilisation in Southeast Asia in 2016 during the Kedah Tua Festival held by five early world civilisation experts from Mesopotamia, Indus, Mesoamerica, China, and Greek-Rome (Anonymous, 2016).

Table 1. Outstanding universal value of river jetty and port management sites at SBAC (Source: The authors)

Site Classification	OUV	Description
River Jetty	Evidence of the most complete river jetty architectural form of early world civilisation since the 6th century B.C.	Based on the architectural appearance of the river jetty at SBAC, it has been suggested that it is the most complete structure that has ever been the subject of archaeological studies in the early civilisations of the world. Until now, archaeological studies at the world level have not recorded the existence of river jetty architectural structures that are still in situ structures of floors, walls, corridors, stairs, walkways, pillar bases and roof tiles in their architectural form.
	The most complete iron ingot export river jetty of early world civilisation	The dating of the river jetty structure corroborates the radiocarbon dating of the SB2H iron smelting site, which provides dating data to around the 6th century BC (Abd Halim et al., 2025b). Based on the dating data, it is clear that the Sungai Batu river jetty structure were erected for the purpose of exporting ancient Kedah iron ingots, especially since the 6th century BC (Abd Halim et al., 2025d). A comparative study of the iron smelting sites of the world civilisations to date also revealed no evidence of the river jetty, port management, ritual and Buddhist monument sites in the same area that shows the uniqueness and importance of the discovery in SBAC on the development of early world civilisations.
	The most complete ancient Kedah port complex	Archaeological studies conducted at the site on the edge of the ancient riverbank revealed 11 structures that served as river jetties (see Map 1). The results of excavations carried out at the site found that all the main monument structures were built in a directional manner and sloping towards the river, which suggested their function as a river jetty. The close spacing of the sites, which range from three to 15 metres apart, suggests that this area served as a port complex in SBAC. To date, archaeological studies of early river jetties, wharves, and harbours worldwide have not identified an area with as many river jetty structures suited for both river and sea environments. The Sungai Batu archaeological site is the only one in the world to date that has been able to reveal 11 sites of river jetty evidence that reveal the civilisation that took place in SBAC, which represents the ancient Kedah Kingdom and is representative of a highly civilised nation.
Port Management	The earliest civilisations reveal the clearest and most complete evidence of port management architecture	Most of the port sites identified are based on the discovery of trade artefacts such as beads, pottery, ceramics, glass and others. Evidence of port structures is incomplete as found in Mesopotamia, Indus, Egypt and China. Even if seen in studies in Southeast Asia, the port criteria are only identified based on the discovery of trade artefacts (Abd Halim, 2019). There is no data about the port itself and the role of the port management site. This makes the study at SBAC the only one in the world to date that reveals a clear and complete port management architecture
	First discovery of the architecture for managing iron export facilities in early world civilisations	Archaeological studies conducted in Mesopotamia, Egypt, Indus, China, Greek-Roman and Mesoamerican civilisations until now have not recorded the discovery of port management architecture used as the management of the iron ingot trade. To date, SBAC's port management is the only one in the world to reveal clear evidence of a port management architecture (Abd Halim & Saidin, 2025b). This makes SBAC the most complete centre of iron smelting and export management for the early civilisations of the world.

DISCUSSION

As the river jetty and port management site at SBAC have revealed a very special OUV, then the process of its development as a heritage tourism site was carried out vigorously after 2012. Even Abd Halim et al. (2022a; 2024a; 2025a) and Ali et al. (2021a, b; 2023) have discussed more detail about the marketing and development process of SBAC heritage tourism sites in the national tourism sector, emphasising the principles of sustainability and leaving no one behind. This can make the development of the tourism sector, especially in Malaysia, more efficient.

In addition, the heritage tourism sector in Malaysia, especially sites such as prehistoric sites in the Lenggong Valley (Rapidah et al., 2018; Talib et al., 2022: Abd Halim et al., 2025c), Gua Pelangi (Abd Halim et al., 2022b), and Neolithic sites in Guar Kepah (Abd Halim et al., 2024d), has also been developed as a sustainable heritage tourism product. Sustainability means that every tourism activity carried out emphasises the principle of preserving the heritage tourism site. At the same time, also involve the local community, either as a tour guide or as an association involved in providing tourism services. This shows that the marketing of heritage tourism is concerned with empowerment from the bottom up, which is specifically able to make heritage sites preserved based on the direct involvement of stakeholders, NGOs and the local community (Foncesa et al., 2025; Lawasi et al., 2025).

However, to ensure that a tourist location can attract domestic and international tourists, the implementation of several drastic measures is necessary to market the place or tourist destination to the general public. The five main components that need to be implemented in the travel offering movement are 1) destination attractions, 2) destination facilities and services, 3) destination accessibility (including transportation), 4) image, brand and perception and 5) price to visitors (Middleton & Clarke, 2001; Ali, 2022).

Therefore, the diversity of actors, roles and environmental factors is a main key that supports the development of a tourism area (Capone, 2006), so the heritage tourism development program in a planned manner should be designed and implemented. This is very closely related to the existing tourism service and product offerings and its relationship with business networks, interactions, resources and academic knowledge flow that should be given emphasis in advance so that delivery to end users can be done smoothly. For this reason, issues such as integration, collaboration and networking activities (Poon, 1993) need to be organised and coordinated at the grassroots level to achieve the end goal.

In fact, the involvement of local communities in tourism marketing initiatives (Ryan, 2002) is necessary to maximise the work of empowering the tourism sector in an area. At the Kedah state heritage tourism level, Malaysia has organised several activities to strengthen the heritage tourism sector, which include travel marts, town halls, carnivals, festivals and national and international conferences. The programme also involves the local community to strengthen community involvement in tourism development. To facilitate the work, cooperation with stakeholders (Machlouzarides, 2010) should be carried out, such as with the Kedah state, federal, the Kedah State Economic Planning Division (BPEN), Jerai Geopark, Sungai Petani Municipal Council (MPSPK), and the Tourismy; this is also the best step in marketing tourism destinations.

Additionally, utilising the latest technology (Abd Halim et al., 2024a; Yu et al., 2025) can positively impact the marketing process of tourist destinations, alongside the living culture gallery space that enables tourists to engage directly in demonstrations and hands-on activities. Digital marketing for tourist destinations, which includes analysing primary data studies, conducting marketing and promotion, developing strategic plans, and establishing branding, is the best approach for enhancing a tourist site. The use of virtual tourism methods is one of the effective methods that must be applied, as in many world tourism sites, such as the virtual centre of Alexandria and Kansas, United States (Aggour, 2017), in addition to several existing channels for promoting tourism destinations. In addition, a successful tourist destination also needs a tourist information centre that is able to manage all travel packages (Ludmila & Kristina, 2018) that are offered systematically. This is because the existence of the Tourism Information Centre is an initial step to provide information related to tourist destinations directly to tourists so that the selection of tour packages becomes more effective.

Providing tourism products and packages that prioritise the sustainability of tourist destinations should also be emphasised in developing the tourism sector. This is because if the sustainability of tourism products is not managed sustainably, then all tourism marketing programmes carried out will not be able to maintain the integrity of the tourism area, which ultimately has a negative impact on tourist visits. Therefore, the declaration of a tourist site as a UNESCO World Heritage site for the categories of World Heritage site for archaeology (WHS), global geopark (UGGp) and Man and Biosphere (MAB) is one of the best steps to preserve the tourist destination.

Tourism infrastructure at the global level also proves that all tourist destinations have maximised the construction of infrastructure such as hotel services, culinary, security and basic facilities at tourist locations (Cuka et al., 2015; Vinegar et al., 2015) to facilitate and provide maximum comfort to tourists. These elements must be given special attention to ensure that the tourist destination is able to attract tourists and become a successful tourist area.

Based on tourism marketing data for destinations, the world tourism site allows some good benefits to be taken for the development of heritage tourism marketing in SBAC. The management of the tourism information centre, product and package offerings, the availability of infrastructure, and the latest promotional activities are all necessary and can be of practical benefit to the development of the heritage tourism sector in this area.

CONCLUSION

Studies on primary evidence sites (trade and industry) in SBAC and the progress of destination marketing in its heritage tourism sector clearly demonstrate its importance to economic development in Malaysia in particular. To ensure that SBAC is able to attract tourists, the development of infrastructure in tourist areas, including accommodation and transportation, has become a priority and began to be developed in a planned manner. In fact, the SBAC has also been recognised as a

national heritage site in 2012, as Southeast Asia's oldest civilisation site in 2016, and is currently in the process of nomination as a UNESCO World Heritage Site through the Jerai Geopark concept. This is the backbone of the empowerment of the heritage tourism sector in SBAC, which is expected to develop this location on par with similar heritage tourism sites in other parts of the world.

Limitations of the study for futere study

The Sungai Batu Archaeological Complex area's heritage tourism study does not prioritize the involvement of stakeholders, NGOs, and the local community in the implementation of heritage tourism. This needs to be carried out as a comprehensive study along with accurate data related to the success of its implementation to measure the success of heritage tourism promotion offered.

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REFRAMING ROOTS TOURISM AS A SPATIALLY STRUCTURED HERITAGE LANDSCAPE: A MULTI-CRITERIA EVALUATION OF POSTCOLONIAL HERITAGE SPACES IN CON DAO, VIETNAM

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Abstract: In contemporary tourism research, roots tourism is increasingly recognized as more than a form of heritage visitation; however, its spatial organization within postcolonial heritage landscapes remains insufficiently examined. Existing studies have emphasized motivations, memory, identity, and heritage interpretation, while giving limited attention to the spatial configuration of heritage sites and their relationships within an integrated tourism system. This study conceptualizes roots tourism in Con Dao, Vietnam, as a spatially structured heritage landscape in which historical memory, commemorative practices, and visitor movement are organized across interconnected heritage spaces. Using an interpretive mixed-methods design, the research develops a multi-criteria evaluation framework to assess the functional and interpretive capacities of thirteen heritage sites. A three-round Delphi process involving 18 experts established the evaluation criteria, followed by the Analytic Hierarchy Process (AHP) to determine the relative importance of the criteria. These expert assessments were combined with evaluations from 28 participants, including professional tour guides and organized tour visitors, using a five-point Likert scale. The findings reveal that interpretive and commemorative capacity is unevenly distributed, forming distinct functional clusters, including core interpretive nodes, transitional and commemorative spaces, and peripheral visitor engagement areas. The analysis further demonstrates that the value of individual heritage sites is shaped not only by their historical significance but also by their spatial relationships and interpretive connectivity within the broader heritage network. By highlighting these spatial dynamics, the study advances understanding of roots tourism as an integrated heritage tourism system and provides a practical framework for destination planning, heritage interpretation, and sustainable management in postcolonial contexts.

Keywords: roots tourism; heritage landscape, spatial differentiation, functional clustering, postcolonial heritage, multi-criteria evaluation, Con Dao, tourism geography

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INTRODUCTION

Over recent decades, tourism research has moved beyond conceptualizations of tourism as mere consumption and leisure toward perspectives that emphasize its social, cultural, and educational functions. Within this shift, heritage tourism has increasingly been understood as a spatially embedded practice of meaning-making and historical learning, mediated through interactions among people, memory, and place (Poria et al., 2003; Ahmad & Hertzog, 2016; Timothy, 2018). Heritage spaces are no longer viewed solely as repositories of the past; rather, they operate as active components of tourism landscapes, shaping how history is interpreted and experienced through embodied, affective, and spatial engagement (Harrison, 2012). From a tourism geography perspective, such spaces form interconnected spatial systems in which interpretation, accessibility, and visitor movement are organized across differentiated sites rather than occurring in isolation.

Research on memory tourism and dark tourism further illuminates tourism practices at sites associated with collective suffering, violence, and sacrifice. Encounters at such sites often activate moral reflection and emotional engagement that extend beyond the passive reception of historical narratives (Light, 2017; Dresler, 2023). Learning in these contexts unfolds through spatial encounter and regulated movement, situating visitors within ethically sensitive relationships with the past. From the perspective of collective memory theory, memory is not fixed but socially constructed through discourses and practices embedded in specific spatial settings (Olick & Robbins, 1998; Hirst & Echterhoff, 2012).

Heritage spaces such as prisons, detention camps, and memorials therefore emerge as contested arenas within tourism systems, where multiple narratives compete for interpretive authority (Macdonald, 2009; Zhang et al., 2018; Shreya et al., 2026). Yet, while these studies illuminate interpretive and ethical dynamics, fewer contributions systematically examine how such sites are spatially differentiated and functionally organized within broader destination structures.

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The organization of heritage spaces that embody traumatic histories presents significant ethical and managerial challenges. Scholars have warned that commercialization or aestheticization of tragic memory may undermine interpretive integrity and reduce commemorative sites to consumable attractions (Stone & Grebenar, 2022; Dresler, 2024).

These concerns underscore the need for systematic approaches to evaluating how heritage spaces are structured, sequenced, and managed within tourism landscapes, particularly in relation to visitor movement and spatial connectivity (Lew & McKercher, 2006). In this regard, spatial differentiation–understood as the uneven distribution of interpretive, commemorative, and functional capacities across sites–becomes central to understanding how heritage tourism operates as a landscape-level system rather than as a collection of discrete attractions. Con Dao represents a paradigmatic postcolonial heritage landscape in Vietnam. Its network of colonial prison complexes, martyrs' cemeteries, commemorative monuments, and religious sites forms a multilayered memoryscape in which revolutionary, traumatic, and sacred narratives intersect spatially (Clark, 2013; Chung, 2025).

Although roots tourism in Con Dao has been widely developed, existing studies have primarily focused on visitor perception or symbolic memory discourse. The differentiated functional roles of individual heritage spaces and their spatial organization within the broader tourism landscape remain insufficiently examined. Moreover, limited attention has been given to how these sites collectively structure visitor routes, regulate experiential intensity, and form hierarchical patterns within the destination's spatial configuration. The aim of this study is to evaluate how heritage spaces in Con Dao function as spatially differentiated components of a structured heritage landscape within a postcolonial tourism context. Specifically, the study seeks (1) to develop a multi-criteria analytical framework for assessing the interpretive, ethical, and spatial-functional dimensions of heritage spaces; (2) to determine the relative importance of these dimensions; and (3) to analyze how heritage spaces are structured into distinct functional clusters across the heritage landscape.

By addressing these objectives, the research conceptualizes roots tourism not merely as commemorative visitation but as a spatially structured heritage tourism system that can be systematically evaluated and strategically organized in sensitive postcolonial contexts. In doing so, the study contributes to tourism geography by foregrounding landscape-level organization and functional differentiation as key analytical dimensions in the study of roots tourism.

LITERATURE REVIEW

Roots Tourism and the Shift toward Memory Education

In contemporary tourism research, roots tourism has moved beyond conventional heritage visitation to be understood as a spatially embedded practice associated with memory, identity, and historical interpretation. Rather than treating heritage as static objects of consumption, scholarship emphasizes spatial experience, movement, and interpretive mediation as mechanisms connecting visitors with the past (Poria et al., 2003; Ahmad & Hertzog, 2016; Timothy, 2018).

Heritage spaces thus function as nodes within broader tourism landscapes, shaping understanding through organization, accessibility, and design. From a tourism geography perspective, these nodes are relational rather than isolated, deriving significance through their position within destination-wide spatial configurations.

Recent syntheses of dark tourism and thanatourism research demonstrate a growing emphasis on authenticity, emotional engagement, and the governance of collective memory at sites of suffering (Hernández-Garrido et al., 2026). This shift highlights that meaning-making at traumatic or commemorative sites is shaped not only by historical content but also by interpretive framing and management practices. Accordingly, roots tourism in former prisons, memorials, and revolutionary landscapes must be approached as a structured encounter mediated by spatial sequencing and institutional regulation. Such mediation implies differentiated spatial roles among sites, rather than uniform interpretive functions across a destination.

Sites associated with violence or political struggle are typically experienced through curated routes and regulated access, influencing cognitive and emotional engagement (Biran et al., 2011; Light, 2017). Learning in such contexts unfolds through spatial choreography rather than isolated information transfer. Research on difficult heritage further shows that well-managed spatial organization can foster historical awareness and reflective engagement, whereas weak regulation risks commodification and spectacle (Dunkley et al., 2019; Farmaki, 2021; Stone & Grebenar, 2022). These findings suggest that the spatial structuring of visitor movement is not merely operational but constitutive of interpretive outcomes. These insights underscore the need to examine how heritage spaces are configured and connected within integrated tourism systems.

Within postcolonial destinations, roots tourism is shaped by the spatial politics of interpretation and identity formation. The organization and presentation of heritage spaces actively reproduce narratives of belonging and historical meaning (Clark, 2013; Winter, 2007; Shreya et al., 2026). Postcolonial heritage landscapes therefore represent spatially layered systems in which symbolic, political, and educational functions intersect across interconnected sites.

Heritage Spaces, Collective Memory, and Tourism Landscapes

Collective memory is socially constructed through practices embedded in specific spatial contexts (Olick & Robbins, 1998; Hirst & Echterhoff, 2012). In tourism settings, heritage spaces serve as arenas where memory is encountered through movement, spatial sequencing, and place-based narration. Spatial context thus becomes integral to the production and stabilization of collective memory within tourism environments.

Prisons, detention camps, and memorials often function as contested sites in tourism landscapes, where multiple narratives coexist and are mediated by layout, visitor circulation, and interpretive infrastructure (Macdonald, 2009; Waterton & Smith, 2010; Zhang et al., 2018). From a tourism geography perspective, individual sites derive meaning not only from intrinsic value but also from their connectivity within broader spatial systems (Lew & McKercher, 2006; McKercher & Lau, 2008; Till, 2012). Visitor understanding therefore emerges cumulatively across interconnected sites.

This cumulative process implies the existence of spatial differentiation, whereby certain sites act as interpretive anchors while others play supplementary or transitional roles within visitor itineraries.

Recent research highlights the relevance of route design and network analysis for structuring visitor mobility and accessibility. GIS-based modeling has been applied to optimize thematic routes and enhance spatial coherence within cultural tourism contexts (Akay, 2026). Although developed in urban settings, such approaches are pertinent to heritage landscapes characterized by dispersed yet interrelated sites. In postcolonial contexts, evaluating spatial connectivity becomes essential for understanding how memory is organized at the landscape scale. Even when formal GIS modeling is not employed, analytical attention to spatial clustering and route sequencing remains central to tourism geography.

Ethical Regulation and Interpretive Function of Heritage Spaces

Heritage sites associated with trauma operate within ethical boundaries shaped by historical significance and contemporary use. Spatial organization plays a critical role in regulating visitor behavior, emotional response, and interpretive engagement (Biran et al., 2011; Farmaki, 2021). Controlled circulation and interpretive zoning help preserve solemnity and prevent inappropriate consumption. Ethical regulation therefore manifests not only through discourse but through spatial arrangements that structure proximity, duration, and intensity of encounter. Studies of sacred landscapes further illustrate how ethical regulation is embedded in narratives, rituals, and local knowledge systems that guide visitor conduct (Setiyoningsih et al., 2026). Such moral frameworks operate alongside formal management mechanisms, reinforcing the ethical dimension of heritage interpretation. When spatial and interpretive regulation is weak, heritage sites risk becoming arenas of emotional spectacle rather than reflective engagement (Stone & Grebenar, 2022).

This risk is closely linked to spatial overexposure and insufficient differentiation among heritage functions. Interpretive capacity also depends on communication quality and experiential coherence. Research in museum contexts indicates that effective interpretive design–encompassing clarity, empathy, and narrative structure–enhances visitor engagement and reinforces educational outcomes (Chae, 2026). These findings suggest that interpretive capacity extends beyond informational provision to include experiential design. Within landscape-level analysis, interpretive capacity can therefore be understood as unevenly distributed across sites, contributing to differentiated functional roles.

From a planning perspective, heritage spaces function as managed territorial units within broader tourism systems. Their ethical and interpretive roles are intertwined with spatial capacity, visitor flow, and inter-site connectivity (Lew & McKercher, 2006). Evaluating heritage spaces therefore requires integrated frameworks combining ethical, interpretive, and spatial-functional dimensions. Such integration supports the analysis of heritage destinations as structured spatial systems rather than as isolated commemorative sites.

Research Gap and Analytical Framework

Although scholarship on memory tourism and dark heritage has expanded, much research remains focused on visitor emotions or single-site analysis. Less attention has been devoted to how multiple heritage spaces within one destination perform differentiated yet interconnected functions within a structured tourism landscape (Waterton & Watson, 2015; Light, 2017). In particular, limited empirical work has operationalized spatial differentiation and functional clustering as analytical categories within postcolonial heritage destinations.

Recent contributions emphasize authenticity governance (Hernández-Garrido et al., 2026), spatial route optimization (Akay, 2026), and ethical embedding in sacred landscapes (Setiyoningsih et al., 2026). However, systematic evaluation frameworks that integrate these dimensions within postcolonial heritage destinations remain limited.

In Con Dao, existing studies have examined the symbolic significance of individual sites but have rarely analyzed how these spaces collectively operate within an integrated heritage tourism system (Chung, 2025). Accordingly, this study conceptualizes heritage spaces as spatial units within a heritage tourism landscape and proposes an analytical framework evaluating their roles based on interpretive capacity, ethical regulation, spatial accessibility, and landscape connectivity. This framework provides the foundation for the multi-criteria evaluation approach presented in the following methodological sections. By doing so, the study advances a landscape-level perspective on roots tourism that aligns more explicitly with tourism geography while retaining sensitivity to memory and postcolonial contexts.

METHODS

Research Design

This study adopts an interpretive mixed-methods design that integrates qualitative expert knowledge with quantitative multi-criteria decision analysis to examine the functional and interpretive capacity of heritage spaces within the heritage tourism landscape of Con Dao. Mixed methods are employed to capture both the interpretive dimensions of heritage meaning and the need for systematic comparison across heterogeneous heritage sites (Ivankova & Wingo, 2018).

Rather than evaluating tourism performance in economic or satisfaction-based terms, the research focuses on the interpretive, ethical, and experiential functions of heritage spaces as components of a postcolonial tourism landscape. This approach aligns with critical tourism and heritage scholarship that conceptualizes heritage as a socially and politically embedded process shaped by power relations, interpretation, and spatial practice (Macdonald, 2009; Harrison, 2012).

The methodological design distinguishes between two knowledge sources: (1) a formal expert panel engaged in the Delphi–AHP process for criteria construction and weighting, and (2) a practitioner-based evaluation group composed of experienced tour operators and licensed local guides specializing in roots tourism in Con Dao. This distinction clarifies the analytical role of each dataset and addresses potential concerns regarding sample heterogeneity.

Study Area and Selection of Heritage Spaces

The empirical scope of the study includes 13 heritage spaces in Con Dao, selected to represent the principal layers of collective memory embedded within the island's tourism landscape. These include colonial prison complexes, formal commemorative sites, and locations associated with community-based and ritual practices (see Appendix).

Site selection was guided by two criteria: (1) historical and symbolic significance within the Con Dao heritage landscape, and (2) functional diversity in terms of visitor experience, spatial configuration, and interpretive form. Collectively, these sites constitute a multilayered heritage system that enables comparative analysis of differentiated functional roles within the broader tourism landscape (Waterton & Watson, 2015).

Expert Panel and Practitioner Knowledge Basis

The study draws on an expert panel comprising professionals in heritage management, tourism development, cultural interpretation, history, and experienced practitioners involved in guiding and organizing roots tourism activities. Experts were recruited through purposive sampling based on demonstrated professional experience and contextual familiarity with Con Dao. The experiential evaluation involved 28 practitioners who are not general tourists but specialized tour operators and licensed local guides with sustained professional engagement in Con Dao's roots tourism sector. Their inclusion reflects a practitioner-expert perspective grounded in repeated field-based interaction with heritage spaces rather than one-time visitor impressions. The relatively small size of this group (n = 28) reflects the limited population of professionals exclusively specialized in roots tourism within Con Dao. In methodological terms, the group constitutes a near-census of active operators in this niche segment rather than a convenience sample of general visitors. Accordingly, the findings represent professional interpretive consensus rather than statistically generalizable visitor perception.

Consistent with critical heritage and tourism approaches, expert knowledge is treated as situated and interpretive rather than as an objective measure of heritage value (Waterton & Smith, 2010; Harrison, 2012).

Development of Evaluation Criteria Using the Delphi Method

The Delphi method was employed to develop a structured set of criteria for assessing the interpretive and functional capacity of heritage spaces. Delphi is particularly suitable for complex tourism and heritage contexts where knowledge is distributed across expert groups and where no single indicator adequately captures spatial, ethical, and experiential dimensions (Hsu & Sandford, 2007). The process was conducted through three iterative rounds. In each round, experts reviewed proposed criteria, provided qualitative feedback, and reassessed their judgments in response to anonymized group input. Criteria were retained based on predefined agreement thresholds (≥70% convergence across rounds), ensuring conceptual clarity, stability, and relevance for heritage tourism analysis. Response stability between rounds was monitored to confirm convergence prior to finalization.

Weighting of Criteria through the Analytic Hierarchy Process

Following the establishment of the criteria set, the AHP was applied to determine the relative importance of each criterion group. AHP enables pairwise comparison within a hierarchical structure and is widely used in tourism and spatial planning to evaluate contexts characterized by multiple, incommensurable dimensions (Saaty, 2008).

Pairwise comparisons were conducted at the level of criteria groups rather than sub-criteria to preserve analytical coherence and avoid over-fragmentation in a context characterized by interpretive and ethical dimensions that are conceptually interrelated. Sub-criteria were treated as structurally embedded within their respective groups.

Consistency ratios (CR) were calculated to assess the reliability of expert judgments. All matrices achieved CR values below the accepted threshold of 0.10, indicating acceptable internal consistency (Saaty, 2008; Ishizaka & Labib, 2011).

Individual matrices were examined prior to aggregation to identify potential outliers, and no extreme inconsistencies were detected. Aggregation was performed using the geometric mean method in accordance with standard AHP procedures.

To examine robustness, a limited sensitivity check was conducted by introducing minor variations (±5%) in criteria-group weights. The relative ranking and clustering of heritage spaces remained stable, indicating that the differentiation patterns are not highly sensitive to marginal weight adjustments.

Evaluation Procedure, Reliability, and Data Analysis

The weighted criteria were applied to assess the 13 heritage spaces based on practitioner evaluations. Each practitioner evaluated the sites using a five-point Likert scale reflecting perceived interpretive clarity, ethical regulation, spatial accessibility, and experiential coherence.

Internal consistency of the practitioner-based evaluation instrument was assessed using Cronbach's alpha. The overall scale achieved an alpha coefficient above 0.80, indicating satisfactory reliability for exploratory spatial-functional assessment.

Inter-rater agreement was examined by analyzing variability across evaluators. Variance levels remained within acceptable bounds, suggesting convergence among practitioners despite differences in professional roles.

Although Likert-scale data are ordinal in nature, scores were treated as interval approximations for the purpose of comparative aggregation, a common practice in multi-criteria tourism research when scale categories are equidistantly defined. Interpretive claims are therefore limited to relative differentiation rather than absolute measurement.

Composite scores were calculated by integrating criteria weights and practitioner evaluations. Based on score patterns, heritage spaces were subsequently grouped according to their dominant functional characteristics within the overall

heritage tourism system. This analytical step supports the identification of differentiated spatial roles and informs the conceptualization of structured visitor routes within an integrated heritage landscape.

Methodological Limitations

Several limitations should be acknowledged. First, although the practitioner group represents a near-complete segment of roots tourism professionals in Con Dao, the sample size remains numerically limited and context-specific. The findings therefore reflect professional interpretive consensus rather than general visitor perception.

Second, the evaluation relies on structured expert judgment and practitioner assessment rather than direct measurement of visitor learning outcomes or behavioral change. Third, the AHP weighting procedure emphasizes relative importance at the criteria-group level and does not model dynamic spatial interactions between sites. Nevertheless, by integrating Delphi consensus-building, AHP consistency testing, practitioner-based evaluation, reliability assessment, and sensitivity checking within an interpretive mixed-methods framework, the study provides a transparent and replicable approach for evaluating the functional organization of heritage spaces within tourism landscapes. This methodological framework supports the analysis of roots tourism as a spatially structured form of heritage tourism in postcolonial contexts.

RESULTS

Criteria System for Evaluating Heritage Spaces within a Memory Landscape

The criteria system for evaluating heritage spaces in Con Dao was developed through a three-round Delphi process involving 18 experts from heritage management, tourism development, cultural interpretation, history and cultural studies, and professional practice related to roots tourism. The objective of the Delphi process was to establish a conceptually coherent and analytically robust criteria system capable of capturing the interpretive, ethical, and spatial-functional roles of heritage spaces within a sensitive postcolonial heritage tourism landscape such as Con Dao.

The initial pool comprised 26 candidate criteria synthesized from the literature on heritage tourism, difficult heritage, memory tourism, and heritage interpretation, complemented by contextual analysis of Con Dao and expert knowledge. In the first round, experts reviewed the relevance and conceptual fit of each criterion. Indicators primarily associated with general tourism performance–such as entertainment appeal, revenue generation, and current visitor volume–showed low consensus and high variance and were therefore excluded, as they were judged to shift the evaluation away from the interpretive and commemorative functions central to this study. In the second round, the refined list was further assessed for clarity, redundancy, and contextual sensitivity. Criteria related to large-scale group activities and experiential flexibility remained contested and were either removed or reformulated to emphasize contextual appropriateness and the specific requirements of sensitive heritage settings. The third round was conducted to confirm stability and consensus on the final system. All retained criteria met the predefined agreement thresholds for inclusion, indicating convergence across the expert panel. As a result, the final criteria system comprises 18 sub-criteria organized into six criteria groups, each representing a key dimension of heritage interpretation, ethical regulation, and spatial functionality.

This grouping structure supports evaluation of heritage spaces not merely as isolated physical sites but as interconnected spatial units within a broader heritage tourism landscape, where historical cognition, interpretive legibility, ethical limits, accessibility, conservation conditions, and route-based integration jointly shape visitor experience. The composition and functional dimensions of these six criteria groups are presented in Table 1.

Table 1. Criteria Groups for Evaluating Heritage Spaces in Con Dao
(Source: Authors' compilation based on Delphi expert consultations and literature review)

Criteria Group	Functional Dimension	Sub-criteria
G1. Memory Value and Authenticity	Foundations for historical interpretation	(C1) Historical–memory value; (C2) Authenticity and integrity; (C3) Representativeness of collective memory
G2. Interpretive Capacity and Infrastructure	Capacity of spaces to support interpretation	(C4) Quality of interpretation; (C5) Interpretive resources and materials; (C6) Organization of visitor routes and experiential rhythm
G3. Commemorative Ethics and Solemnity	Ethical regulation of heritage use	(C7) Sacredness and solemnity; (C8) Risk of entertainmentization/commercialization; (C9) Appropriateness of collective activities
G4. Accessibility and Safety	Practical conditions of visitor use	(C10) Accessibility; (C11) Safety of movement and experience; (C12) Suitability for specific visitor groups
G5. Carrying Capacity and Conservation	Sustainability of heritage use	(C13) Carrying capacity; (C14) Risk of deterioration and vulnerability; (C15) Conservation and monitoring capacity
G6. Route Connectivity and Collaborative Governance	Spatial and managerial coherence	(C16) Connectivity with other heritage spaces; (C17) Integration into interpretive programs; (C18) Stakeholder coordination

From a structural perspective, the six criteria groups form an integrated analytical framework rather than a collection of independent indicators. Groups G1 and G2 constitute the interpretive foundation of the system, defining the cognitive and narrative basis of heritage engagement. Group G3 functions as a regulatory dimension, establishing ethical boundaries for the use of sensitive heritage spaces. Groups G4 and G5 represent operational and sustainability conditions that shape the feasibility of heritage use within tourism systems.

Finally, Group G6 introduces a landscape-level perspective, emphasizing that heritage interpretation is reinforced when sites operate within coordinated spatial and managerial networks. This configuration ensures that evaluation

extends beyond attractiveness or economic performance and instead reflects the structured interaction between interpretive meaning, ethical regulation, and spatial organization within the Con Dao heritage landscape.

Criteria Weights and Structural Priorities

Following the establishment of the evaluation criteria through the Delphi process, the AHP was applied to determine the relative importance of the six criteria groups. Weighting was conducted at the criteria-group level in order to clarify how experts prioritize interpretive, ethical, operational, and spatial dimensions when conceptualizing heritage spaces in Con Dao as components of a sensitive postcolonial heritage tourism landscape. All pairwise comparison matrices satisfied the accepted consistency thresholds, confirming the internal reliability of expert judgments. The hierarchical structure of the AHP model comprised two levels: (i) the overall objective of evaluating the functional and interpretive capacity of heritage spaces within the Con Dao heritage landscape, and (ii) the six criteria groups identified. Experts conducted pairwise comparisons using Saaty's standard scale, and consistency ratios were calculated to ensure methodological rigor. The resulting weights for the six criteria groups are presented in Table 2.

The resulting weights reveal a differentiated priority structure rather than a uniform valuation of heritage attributes (Table 2). The highest weight was assigned to G3 (Commemorative Ethics and Solemnity) at 0.22, followed by G2 (Interpretive Capacity and Infrastructure) at 0.20 and G1 (Memory Value and Authenticity) at 0.18. Together, these three groups account for 60% of the total weighting, indicating that experts conceptualize heritage spaces primarily through ethical and interpretive dimensions rather than through operational or logistical considerations.

Table 2. Weights of Criteria Groups for Evaluating Heritage Spaces
(Source: Authors' calculations based on AHP results from expert pairwise comparisons)

Criteria Group	Core Focus	Weight
G3	Commemorative ethics and solemnity	0.22
G2	Interpretive capacity and infrastructure	0.20
G1	Memory value and authenticity	0.18
G5	Carrying capacity and conservation	0.16
G4	Accessibility and safety	0.14
G6	Route connectivity and collaborative governance	0.10
Total		1.00

The prominence of G3 suggests that, in the context of Con Dao, ethical regulation is regarded as a foundational condition for heritage tourism development. Sites associated with traumatic and revolutionary histories are expected to operate within clearly defined moral boundaries, which function not as peripheral constraints but as central structuring principles of the heritage landscape. G2 and G1 form the interpretive core of the weighting structure. While memory value and authenticity (G1) provide the historical basis for interpretation, experts prioritized interpretive capacity and infrastructure (G2) slightly higher, indicating that historical significance alone is insufficient without coherent narrative organization, spatial legibility, and appropriate interpretive resources. This ordering underscores the functional interdependence between intrinsic heritage value and its communicative articulation within tourism settings.

Operational dimensions–G5 (0.16) and G4 (0.14)–occupy an intermediate tier. Although assigned lower weights than ethical and interpretive dimensions, these groups define the practical feasibility and long-term sustainability of heritage use. Their positioning reflects an understanding that operational conditions enable, but do not define, the interpretive legitimacy of heritage spaces. G6, with a weight of 0.10, received the lowest relative importance.

However, this lower weight should not be interpreted as marginal significance. Rather, it indicates that spatial connectivity functions as a systemic enabler whose impact emerges through the cumulative integration of sites rather than through the intrinsic attributes of individual spaces. In destinations such as Con Dao, where heritage interpretation is structured through thematic routes and clusters of interconnected sites, connectivity contributes to landscape coherence even if it is not perceived as the primary determinant of site-level performance. Overall, the AHP results demonstrate a three-tier priority structure within the Con Dao heritage landscape: (1) ethical and interpretive foundations (G3, G2, G1); (2) operational and conservation conditions (G5, G4); and (3) systemic connectivity (G6). This hierarchy of weights provides the structural basis for subsequent composite evaluation and spatial differentiation of heritage spaces across the landscape.

Composite Evaluation and Spatial Differentiation of Heritage Spaces

Based on the criteria system and criteria-group weights established in the preceding sections, a composite evaluation of the 13 heritage spaces in Con Dao was conducted to examine their differentiated functional roles within the overall heritage tourism landscape. The analysis integrates AHP-derived expert priorities with practitioner-based experiential assessments, thereby combining normative orientation and field-based interpretive performance. The composite scores and classification results for the 13 heritage spaces are presented in Table 3.

As shown in Table 3, the composite assessment results reveal substantial variation in functional and interpretive capacity across the 13 heritage spaces, indicating an uneven spatial distribution of heritage performance within the landscape. The detailed scoring structure and classification levels are presented in Table 3.With an overall mean composite score of 3.14 (CD), the Con Dao heritage landscape as a whole falls within the "moderate potential" classification. However, this aggregate value conceals pronounced internal differentiation. Because ethical and interpretive dimensions

(G3, G2, and G1) together account for 60% of the total weighting structure, sites that perform strongly in these highly weighted criteria groups gain structural advantage in the composite ranking. Conversely, sites with adequate operational conditions but weaker interpretive density tend to occupy intermediate or peripheral positions within the spatial hierarchy.

Table 3. Composite Assessment Results of Heritage Spaces in Con Dao (n = 28)

Site Code	G1 (0.18) B / W	G2 (0.20) B / W	G3 (0.22) B / W	G4 (0.14) B / W	G5 (0.16) B / W	G6 (0.10) B / W	Total Score	Classification
D1	4.70 / 0.85	4.60 / 0.92	4.80 / 1.06	4.40 / 0.62	4.50 / 0.72	4.30 / 0.43	4.59	Very high potential
D2	4.50 / 0.81	4.40 / 0.88	4.60 / 1.01	4.20 / 0.59	4.30 / 0.69	4.10 / 0.41	4.39	Very high potential
D3	4.20 / 0.76	4.00 / 0.80	4.10 / 0.90	3.70 / 0.52	3.80 / 0.61	3.60 / 0.36	3.94	High potential
D4	3.90 / 0.70	3.80 / 0.76	3.90 / 0.86	3.50 / 0.49	3.60 / 0.58	3.40 / 0.34	3.73	High potential
D5	3.80 / 0.68	3.70 / 0.74	3.80 / 0.84	3.40 / 0.48	3.50 / 0.56	3.30 / 0.33	3.63	High potential
D6	3.30 / 0.59	3.10 / 0.62	3.00 / 0.66	2.90 / 0.41	3.00 / 0.48	2.80 / 0.28	3.04	Moderate
D7	3.20 / 0.58	3.00 / 0.60	3.10 / 0.68	2.90 / 0.41	3.00 / 0.48	2.80 / 0.28	3.02	Moderate
D8	3.10 / 0.56	2.90 / 0.58	3.00 / 0.66	2.80 / 0.39	2.90 / 0.46	2.70 / 0.27	2.92	Moderate
D9	3.00 / 0.54	2.90 / 0.58	2.90 / 0.64	2.70 / 0.38	2.80 / 0.45	2.60 / 0.26	2.84	Moderate
D10	2.90 / 0.52	2.80 / 0.56	2.80 / 0.62	2.60 / 0.36	2.70 / 0.43	2.50 / 0.25	2.74	Moderate
D11	2.50 / 0.45	2.40 / 0.48	2.30 / 0.51	2.20 / 0.31	2.30 / 0.37	2.10 / 0.21	2.32	Low potential
D12	2.30 / 0.41	2.20 / 0.44	2.10 / 0.46	2.00 / 0.28	2.10 / 0.34	1.90 / 0.19	2.12	Low potential
D13	1.70 / 0.31	1.60 / 0.32	1.50 / 0.33	1.40 / 0.20	1.50 / 0.24	1.30 / 0.13	1.52	Very limited potential
CD	3.32 / 0.60	3.18 / 0.64	3.22 / 0.71	2.98 / 0.42	3.08 / 0.49	2.88 / 0.29	3.14	Moderate

Note: B / W denotes the pre-weighting score and the corresponding weighted score, respectively. Heritage spaces are coded as follows: D1 – Con Dao Prison System (Phu Hai, Phu Son, Phu Tuong, Phu Binh); D2 – Con Dao Museum; D3 – Hang Duong Cemetery; D4 – Pier 914; D5 – Memorial to Con Dao Political Prisoners; D6 – Hang Keo Cemetery; D7 – Island Governor's Residence; D8 – Cow Shed (Trai Bo) Site; D9 – Former Communal Hall (Nha Cong Quan); D10 – An Son Temple and Cau Temple; D11 – So Co Site; D12 – So Lo Voi Site; D13 – Ma Thien Lanh Bridge Site; CD refers to the mean composite score across all heritage spaces

Core Interpretive Nodes

Two heritage spaces–the Con Dao Prison System (D1, 4.59) and the Con Dao Museum (D2, 4.39)–were classified as having very high potential. These sites achieved consistently strong performance across all six criteria groups, particularly in Commemorative Ethics and Solemnity (G3) and Interpretive Capacity and Infrastructure (G2), which carry the highest weights in the evaluation model.

Their composite dominance reflects structural centrality within the heritage landscape. The convergence of memory value (G1), interpretive clarity (G2), and ethical regulation (G3) produces a high degree of interpretive density, positioning these spaces as primary anchors for narrative orientation. In spatial terms, they function as core interpretive nodes from which thematic routes are structured and within which visitors acquire foundational historical frameworks.



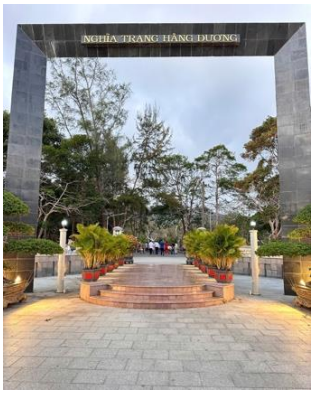
Phu Hai Phu Son Phu Tuong Phu Binh

D1 – Con Dao Prison System D2 – Con Dao Museum

Figure 1. Core Interpretive Nodes within the Con Dao Heritage Landscape, Vietnam (Source: Authors, 2026)

Secondary and Transitional Spaces

A second cluster of sites–classified as high potential–includes Hang Duong Cemetery (D3), Pier 914 (D4), and the Memorial to Con Dao Political Prisoners (D5), with composite scores ranging from 3.63 to 3.94. These spaces demonstrate strong symbolic and commemorative value but comparatively lower performance in operational (G4), conservation (G5), and connectivity (G6) dimensions. Functionally, these sites operate as secondary or transitional nodes within the heritage landscape. While they reinforce and deepen interpretive engagement initiated at the core nodes, their comparatively weaker infrastructural coherence reduces their systemic centrality. The group of sites classified as moderate potential (D6–D10) further illustrates transitional roles. These spaces contribute to thematic diversification and narrative layering but do not independently structure visitor understanding. Their role is primarily supportive within organized routes.



D3 – Hang Duong Cemetery



D4 – Pier 914



D5 – Memorial to Con Dao Political Prisoners



D6 – Hang Keo Cemetery



D7 – Island Governor's Residence



D8 – Cow Shed (Trai Bo) Site



D9 – Former Communal Hall





D10 – An Son Temple and Cau Temple

Figure 2. Secondary and Transitional Heritage Spaces within the Con Dao Heritage Landscape, Vietnam (Source: Authors, 2026)

Peripheral and Fragmented Memory Spaces

At the lower end of the spectrum, So Co Site (D11), So Lo Voi Site (D12), and Ma Thien Lanh Bridge Site (D13) were identified as having low to very limited potential. These sites exhibit constraints related to conservation status, accessibility, interpretive infrastructure, and limited integration into structured routes. Rather than functioning as active nodes within the interpretive system, these spaces currently operate as peripheral or fragmented memory sites. Their limited performance in highly weighted criteria groups reduces their structural centrality within the landscape.



D11 – So Co Site



D12 – So Lo Voi Site



D13 – Ma Thien Lanh Bridge Site

Figure 3. Peripheral and Fragmented Memory Spaces within the Con Dao Heritage Landscape, Vietnam (Source: Authors, 2026)

Spatial Hierarchy and Landscape Structuring Mechanism

While Table 3 distinguishes five statistical classification levels based on equal-interval scoring, the spatial hierarchy identified here reflects a functional interpretation of landscape roles. The analytical tiers therefore synthesize adjacent score categories into structurally meaningful clusters rather than strictly reproducing the numerical classification scheme.

Three interrelated tiers can thus be identified: (1) Core interpretive nodes (D1–D2), characterized by high interpretive density and strong ethical regulation; (2) Secondary and transitional spaces (D3–D10), which reinforce and extend narrative engagement across routes; (3) Peripheral or fragmented sites (D11–D13), with limited functional capacity under current conditions. This hierarchy emerges from the interaction between weighted criteria priorities and site-level performance patterns. Ethical and interpretive strength shapes centrality, while operational feasibility and route connectivity influence integration. The spatial distribution of these sites across Con Dao Island further illustrates the clustering and hierarchical relationships described above, as shown in Figure 1, 2, 3.

Figure 4 visually reinforces the differentiation between core nodes, secondary clusters, and peripheral sites, demonstrating that roots tourism in Con Dao operates as a spatially structured heritage system rather than a collection of isolated attractions.

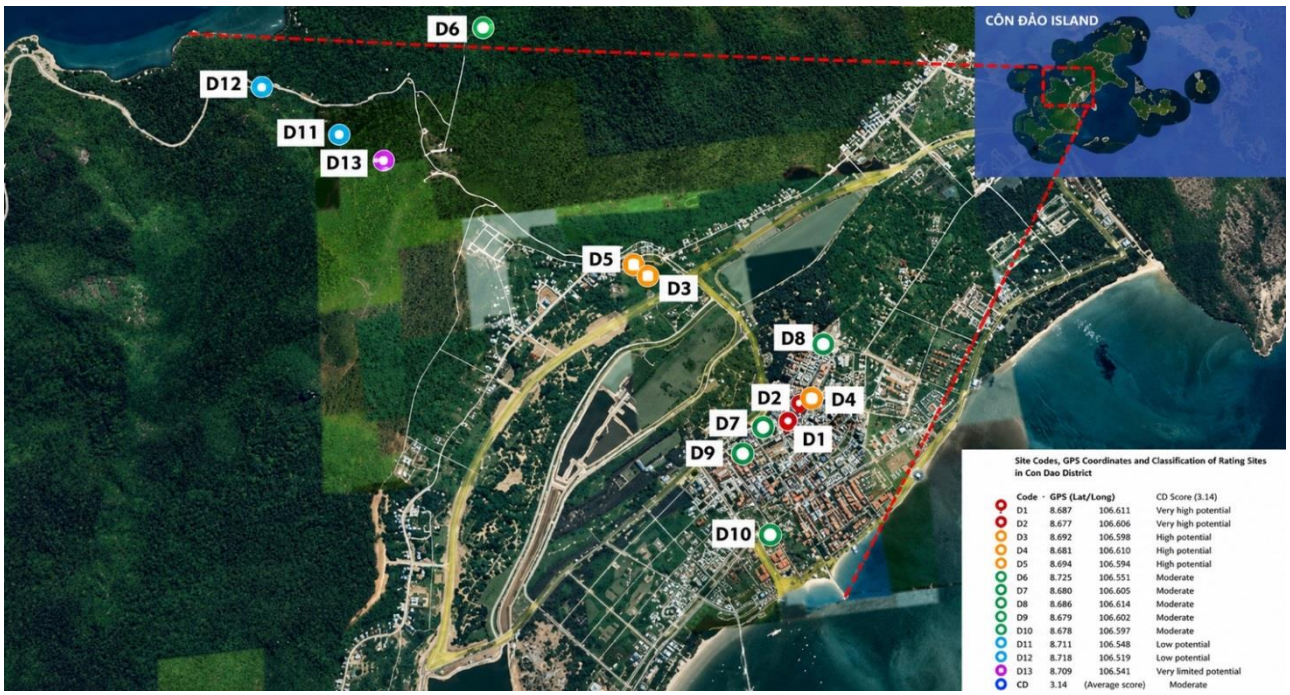


Figure 4. Spatial Distribution of the 13 Surveyed Heritage Sites in Con Dao Island, Vietnam (Source: Authors, 2026)

DISCUSSION

The findings demonstrate that roots tourism in Con Dao operates as a spatially differentiated and ethically structured heritage system rather than as a collection of historically significant sites. By integrating Delphi-based criteria construction, AHP weighting, and composite site evaluation, the study reveals how normative priorities translate into landscape-level hierarchy. The interaction between ethical centrality, interpretive capacity, and spatial organization produces a structured configuration in which heritage spaces assume differentiated but interdependent roles. This discussion situates the findings within debates on memory tourism, difficult heritage, postcolonial memory politics, and tourism geography, while clarifying their theoretical and applied implications. Importantly, the study moves beyond a dominant tendency in the literature to examine memory tourism through site-specific encounters and visitor emotions, by demonstrating how interpretive meaning and ethical regulation become structured across interconnected heritage spaces at the landscape scale.

Ethical Centrality as a Structuring Principle

The AHP results show that commemorative ethics (G3), interpretive capacity (G2), and memory value (G1) together account for 60% of the total weighting structure. This configuration indicates that heritage performance in Con Dao is defined primarily through moral legitimacy and interpretive coherence rather than through operational efficiency.

This finding is consistent with dark tourism scholarship emphasizing tensions between memorial significance and experiential consumption (Light, 2017). Research on moral emotions further demonstrates that engagement at sites of suffering unfolds through complex ethical registers rather than simple attraction mechanisms (Dresler, 2023). However, the present study extends this literature in two ways. First, rather than treating ethics as an external constraint on tourism development, the weighting structure indicates that ethical regulation functions as a primary determinant of heritage "capacity" and legitimacy. Second, while much dark tourism research remains centered on visitor affect and meaning-making within single sites, the Con Dao results show that ethical calibration shapes landscape-level centrality: sites become core nodes not only because they are historically significant but because they sustain ethical framing and interpretive coherence at a level that supports repeated, organized visitation.

Spatial Differentiation and Landscape-Level Interpretation

The composite results reveal a three-tier spatial hierarchy–core interpretive nodes, secondary/transitional spaces, and peripheral sites–emerging from the weighted interaction of ethical, interpretive, and operational criteria. This differentiation demonstrates that interpretive capacity is distributed across interconnected sites rather than embedded solely within individual attractions. This supports and empirically extends conceptualizations of heritage as a spatial process constituted through contemporary use and negotiation (Waterton & Watson, 2015). It also operationalizes Macdonald's (2009) notion of difficult heritage by demonstrating how spatial configuration shapes interpretive authority and narrative coherence. In particular, the findings suggest that "difficult heritage" is not only negotiated through interpretive content but through spatial allocation of roles–where certain sites are positioned as interpretive anchors, others as commemorative intensifiers, and others as peripheral traces requiring conservation-oriented approaches.

In contrast to route-optimization approaches in tourism geography that prioritize accessibility and efficiency (Akay, 2026), the present framework shows that route design in sensitive postcolonial contexts must be guided primarily by ethical and interpretive priorities. Spatial connectivity therefore functions not merely as a logistical variable but as a

mechanism of narrative sequencing and moral framing. This distinction is important because it shifts the planning logic from efficiency-based mobility to ethically guided route choreography, which is more consistent with the commemorative demands of postcolonial prison and martyrdom landscapes.

Co-Production of Meaning Through Structured Mobility

The integration of practitioner-based experiential assessments reinforces the argument that heritage meaning is co-produced through spatial engagement. Visitor learning outcomes depend not only on interpretive content but on how experiences are structured and sequenced (Packer & Ballantyne, 2016). Recent research on memory-making in tourism similarly highlights visitors' active role in attaching personal meaning to collective narratives (Pfoser & Stach, 2024).

The findings suggest that structured mobility–regulated pacing, controlled transitions, and thematic progression–constitutes a central mechanism through which interpretive realization occurs. Core nodes provide narrative anchoring; transitional sites deepen contextualization; peripheral spaces contribute thematic layering. This spatial choreography transforms dispersed heritage sites into an integrated interpretive system. Compared with approaches that equate learning with informational provision, this emphasizes that interpretive effectiveness depends on route rhythm and spatial sequencing, especially where ethical boundaries constrain visitor behavior and modes of engagement.

Emotional Regulation and Responsible Experience Design

The high weight assigned to solemnity and ethical regulation aligns with critical heritage scholarship warning against the commodification of traumatic memory (Farmaki, 2021). Emotional engagement, when responsibly mediated, can function as a catalyst for reflective understanding (Dresler, 2023). However, unmanaged affect risks transforming memory sites into spectacles detached from historical context. The spatial differentiation observed in Con Dao illustrates how emotional calibration is achieved through movement regulation, interpretive framing, and site-specific pacing rather than through amplification of affect. Ethical governance is thus embedded within spatial organization, shaping visitor flow, congregation patterns, and narrative emphasis. This reinforces a key implication for dark-heritage management: affective intensity should be regulated through spatial practice, not simply curated through narrative content.

Postcolonial Memory Politics and Functional Allocation

Within postcolonial contexts, spatial organization of heritage sites is inherently political. Decisions regarding route prominence, infrastructural investment, and interpretive focus actively shape contemporary narratives of identity and belonging (Cant et al., 2025). The evaluation framework developed here enables functional differentiation across the heritage landscape. Core interpretive nodes may support intensive educational programming, while fragile or peripheral sites may require conservation-oriented strategies or mediated interpretation. Such differentiation reduces the risk of uniform development models that could oversimplify layered and contested memories and provides a defensible basis for allocating interpretive resources and managing visitation intensity according to ethical sensitivity.

Methodological and Disciplinary Contribution

Methodologically, the study demonstrates how abstract theoretical constructs–ethics, authenticity, interpretive capacity–can be operationalized within a spatial multi-criteria framework. Unlike conventional AHP applications in tourism that emphasize attractiveness or economic performance, the weighting structure developed here foregrounds moral and interpretive dimensions. This reorientation illustrates how decision-analysis tools can be aligned with critical heritage perspectives rather than managerial optimization alone. From a disciplinary standpoint, the findings contribute to tourism geography by empirically illustrating how landscape hierarchy emerges from weighted normative priorities. Centrality is not determined solely by intrinsic historical value but by cumulative performance across ethically and interpretively weighted dimensions, which in turn structure route logic and the spatial distribution of visitor experience.

Synthesis

Overall, the study corroborates key arguments in memory tourism and difficult heritage research while extending them through spatial operationalization. By demonstrating how ethical and interpretive priorities generate hierarchical differentiation across interconnected sites, the research reframes roots tourism as a landscape-level system structured through moral calibration and spatial sequencing.

This spatially informed perspective bridges conceptual heritage theory and applied tourism geography, providing a foundation for strategic planning and responsible management in postcolonial heritage destinations.

CONCLUSIONS

This study reconceptualizes roots tourism in Con Dao as a spatially structured heritage system situated within a postcolonial memory landscape, rather than as a collection of commemorative or historical attractions. By integrating a criteria-based evaluation framework, hierarchical weighting through the AHP, and practitioner-informed experiential assessment, the research demonstrates how ethical priorities and interpretive capacity translate into measurable spatial differentiation across interconnected heritage spaces. The findings confirm that interpretive and commemorative functions are unevenly distributed and organized into a structured hierarchy. Core interpretive nodes anchor historical understanding; secondary and transitional sites deepen and extend narrative engagement; peripheral spaces contribute contextual layering or require conservation-oriented approaches. This spatial differentiation indicates that effective roots tourism depends not on the isolated enhancement of individual sites, but on ethically sequenced route design and landscape-level coordination.

Academic Contributions

The study advances heritage and tourism research in three principal ways. First, it shifts analytical focus from site-based memory encounters toward landscape-level structuring, thereby extending debates on memory tourism and difficult heritage into the domain of spatial hierarchy and system organization. Unlike predominantly descriptive or visitor-emotion–focused studies of memory tourism, this research provides a structurally operational model for examining how ethical priorities generate differentiated spatial centrality across interconnected heritage sites. Second, the study operationalizes abstract constructs–ethics, authenticity, and interpretive coherence–within a transparent multi-criteria evaluation framework. By aligning critical heritage theory with decision-analytic tools, it demonstrates how normative principles can be translated into structured, comparable, and context-sensitive assessment models. Third, the concept of functional clustering is advanced as an empirical mechanism for understanding how multiple heritage spaces collectively operate within an integrated tourism landscape. Rather than treating sites as independent attractions, the framework reveals how inter-site relationships shape interpretive effectiveness and governance priorities. In doing so, the research contributes to tourism geography by illustrating how weighted normative priorities shape spatial hierarchy, route logic, and heritage centrality, offering a replicable analytical approach for other postcolonial or conflict-related heritage destinations.

Practical and Policy Implications

From a planning perspective, the framework provides a defensible basis for differentiated management strategies. Rather than applying uniform development or visitation models, heritage managers can align interpretive depth, visitation intensity, conservation priority, and infrastructural investment with the functional role of each heritage cluster. Such differentiation is particularly important in postcolonial contexts where ethical sensitivity constrains commercial expansion and experiential design. By foregrounding ethical calibration and spatial sequencing, the model supports the design of structured heritage routes that balance commemoration, education, and sustainability. It also offers a strategic basis for allocating interpretive resources and regulating visitor flows in ways consistent with the symbolic integrity of sensitive heritage spaces.

Limitations and Future Research

Several limitations should be acknowledged. The experiential assessment relied on a relatively small and specialized participant group, and the findings therefore reflect context-specific professional insight rather than broad visitor generalization. In addition, while the study evaluates functional capacity and spatial organization, it does not directly measure long-term visitor learning outcomes, behavioral change, or governance dynamics.

Future research may expand participant diversity, conduct cross-destination comparative analysis, or apply sensitivity testing to alternative weighting structures. Further investigation into digital mediation, participatory governance models, and longitudinal patterns of visitor engagement would deepen understanding of how spatially structured heritage systems evolve over time and across different socio-political contexts.

Final Reflection

Overall, this study demonstrates that roots tourism, when conceptualized through an ethically grounded and spatially informed framework, operates as a structured heritage landscape in which centrality, integration, and marginality are analytically identifiable. The case of Con Dao shows that heritage spaces do not merely preserve historical traces; they actively organize visitor understanding through calibrated spatial relationships and normative prioritization.

By linking critical heritage theory with operational evaluation and route-based planning, the research provides both conceptual refinement and applied guidance for managing sensitive memory landscapes. In postcolonial contexts where tourism development intersects with collective trauma and identity formation, spatially differentiated and ethically calibrated approaches offer not only managerial direction but a principled foundation for responsible heritage governance.

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FROM EXPERIENCE TO RESPONSIBILITY: THE CONTRADICTION INFLUENCE OF TOURIST RECREATIONAL EXPERIENCE ON WETLAND CONSERVATION BEHAVIORS

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Abstract: Wetland ecosystem flourishes the biodiversity, local livelihood, and economy. However, the tourism activity in wetland can alter the ecosystem degradation. Thence, this study examines the psychological relationship of tourist recreational experience (TRE) on tourist satisfaction and environmentally responsible behavior (ERB). The tourist satisfaction (TS), meanwhile, was utilized as a mediator between TRE and ERB. The assessment was conducted through Stimulus-Organism-Response (SOR) theory lens in Pong wetland Himachal Pradesh, India. The quantitative method was administered by using partial least squares structural equation modelling (PLS-SEM) for data analysis. The questionnaires were employed collecting 219 valid data among domestic tourists at Pong wetland region. Whereas, the internal consistency of all constructs was assessed using Cronbach's alpha and McDonald's ω, with each construct scoring above 0.7. While, the overall Cronbach's alpha and McDonald's ω values were 0.967 and 0.969, respectively. The results indicated that recreational experiences significantly enhance satisfaction and positively predict environmentally responsible behavior. However, there was an unexpected negative direct effect of tourist recreational experience toward environmentally responsible behavior. This indicates that the hedonic recreational experiences may not straightaway translate into commitment to the environment without the mediating role of tourist satisfaction. The findings shed light on experience-satisfaction-behavior correlations in wetland tourism. Noting that, solely of the wetland recreational value has no psychologically impact on environmentally responsible behavior. Therefore, the destination management organization should project on nurturing the conservation activities that enhance visitor satisfaction. As such, the creation and design of nature-based recreation that satisfying, inspiring and mastering awareness on environmental conservation while establishing sustainable wetland governance. In addition to this, the local community participation in wetland management should be prioritized.

Keywords: environmentally responsible behavior, tourist recreational experience, wetland, attitude, satisfaction, SOR theory

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INTRODUCTION

Wetlands are environmentally sensitive ecosystems that support a diverse species and offer significant impact on socio-economic as well as (Yiamjanya et al., 2024) nature-based tourism. Though, wetland does exist only 6% of the whole world, but its natural settings provide crucial social well-being (Van & Doo-Chul, 2025), recreational and educational benefits to visitors, increasing their admiration for nature. Furthermore, wetland habitats are widely perceived for SDG achieving goals (Stojanovic et al., 2025). It was metaphor as the earth's kidney that is one of the three primary ecosystems service for mankind. It is noticeable in current day that wetlands have more degradation and loss biodiversity (Wang et al., 2025). As Chatterjee et al. (2025) cited the wetlands were damage consistently from 1970 to 2015 with higher decline rate per year than natural forest. At the same time, tourism activity is regarded as wetland resource usage because of its attractiveness (Stojanovic et al., 2025). Addedly in the postmodern society, people prompted re-evaluation of tourism practices to a more integrated approach prioritizing biodiversity conservation alongside tourism development. Destination managers can support the sustainable development of recreational surroundings and enhance the scientific supply of park services by evaluating urban parks' environmentally responsible behaviour practices (Zhao et al., 2018).

Such a shift has the aim of restoring degraded ecosystems and biodiversity and creating sustainable economic opportunities for local communities. It aligns with evolving tourist behaviours and expectations in the context of the "new normal" (Afifi, 2021). Tourists typically sought to visit attractions in small groups in open-air locations like mountains, isolated islands and deserts. Such an aim is echoed by Skryl & Gregoric (2022), who stressed that through ecotourism and rural tourism, travellers favour remote locations, green and natural settings, fresh and pure air, and activities such as cycling, hiking, and trekking. Yet, wetland has gained more popularity among visitors especially nature-based tourists.

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However, not every visitor has a positive in wetland spaces as Ausique et al (2025) stated the feeling of discomfort, rejection, and insecurity toward urban wetland because of socio-environmental factors and limitation in educational. Thence, the wetland conservation program initiative studies have recommended as in Vietnam found community involvement in managing wetland resources is vital (Van & Doo-Chul, 2025), the wetland scientific knowledge, infrastructure, and service quality are required in Kazakhstan (Dildabek et al., 2025), and activity-based instruction in school for natural sound mapping in Chile to stimulate students draw attention in the environment (Rabello-Mestre et al., 2026). At the same token, the tourism grows in these biodiversity locations, it is essential to comprehend the psychological and behavioral mechanisms that determine tourists' environmentally responsible behavior (ERB).

Though in India, the government has emphasized of its 93 Ramsar sites conservation tourism practices. The Pong Wetland in Himachal Pradesh is one of the projected sites. That exhibits biodiversity and historical sites such as Masroor Temple and Bathu Ki Ladi Temple, as well as the opportunities for bird watching and outdoor recreation. Despite a greater emphasis on wetland ecosystem preservation, the research on understanding the tourists' ERB is also crucial. Literally, this field of study still remains limited. Albeit, there were researches identified environmental attitudes, place attachment, and biospheric values as important predictors of ERB (Lee, 2011; Ramkissoon et al., 2013; Lin & Lee, 2019), whereas some studies pinpointed the recreational experience with nature can increase environmental awareness (Galley & Clifton, 2004; Ballantyne et al., 2011a). Nevertheless, the causal relationship between tourists' recreational experience and ERB in natural settings remains unclear (Lin & Lee, 2020). Secondly, the satisfaction has been hypothesized as a potential predictor of ERB (Lee & Jan, 2015a), but its mediated role in wetland tourism has yet to be empirically verified. Research on sustainability attitudes and biodiversity knowledge (Naparin & Karsudjono, 2025) underscores the necessity to investigate these internal factors. To address these gaps, this study adopts the Stimulus-Organism-Response (SOR) framework (Mehrabian & Russell, 1974), which holds that external stimuli generate internal evaluations that influence behavioral responses. Although it is widely employed in tourism and hospitality (Dogra et al., 2023), SOR is underexplored in wetland tourism specifically in India. This theoretical gap restricted our knowledge of how wetland-base experiences explain the conversation behavior.

Henceforth, we develop a structural model to investigate the relationships between recreational experience, satisfaction, and ERB among domestic visitors to the Pong Wetland, in India. This study also delves into satisfaction as a mediator of recreational experience and ERB. Ultimately, the theoretical expounding of ERB drivers by giving empirical information from a Ramsar-designated in an emerging economy, as well as informing managers who desire to establish recreational experiences that encourage sustainable preservation of wetlands will be addressed.

LITERATURE REVIEW

Stimulus-Organism-Response Theory

The Stimulus–Organism–Response (SOR) framework (Mehrabian & Russell, 1974) provides a foundational lens for understanding how external environmental cues shape individuals' internal states and subsequent behavioural responses. In tourism, SOR has been widely adopted to explain how attributes of the tourism environment function as stimuli that activate cognitive or affective evaluations, which then translate into outcomes such as satisfaction, behavioural intentions, and loyalty. This triplex structure has offered scholars a robust way to conceptualize the experiential pathways that connect destination attributes to visitor behaviour. Empirically, Cheng et al. (2016) illustrate that mediating variables generally represent the effects of visitor experiences to behavioral intentions. Zhou et al. (2022) discovered that experiencing inputs significantly influence tourists' internal appraisals, which then drive loyalty-related behaviors. Besides, the adoption of satisfaction as mediator is significantly between servicescape (S) and loyalty (R) in a healthcare setting (Suess & Mody, 2018), the memorable experiences (S) enhance destination attachment and overall satisfaction (O), resulting to the development of destination brand equity (R) base on customer (Guleria et al., 2024).

Collectively, these investigations demonstrate SOR's utility in recording multimodal experience processes and understanding how external factors influence behavioral responses. Although SOR has been widely utilized to explain behavioral intentions such as loyalty, revisit intention, and brand equity, its applicability to environmentally responsible behavior (ERB) is restricted, particularly in ecologically sensitive contexts alike wetland (Tang et al., 2025). Meanwhile, scholars studying ERB typically use alternative theoretical frameworks, such as the Theory of Reasoned Action and Theory of Planned Behavior (Lee et al., 2015; Lee & Jan, 2015b; Naparin & Karsudjono, 2025), the Value-Belief-Norm Theory (Lee & Jan, 2015a; Xu et al., 2018), Stakeholder Theory (Su et al., 2018), and the Theory of Goal-Directed Behavior (Han et al., 2018) rather than SOR. While these prior-mentioned theories provide useful insights into the attitudinal and normative drivers of ERB, they commonly ignore the senses and affective processes that arise from interaction with natural environments—mechanisms that are important to wetland tourism. Despite the strong conceptual alignment between SOR and the experiential aspect of wetland tourism, the theory has received little attention in this field.

In spite of that, no empirical study has used the SOR paradigm to explain ERB in wetland tourism contexts in India. This gap narrows our understanding of how recreational experiences behave as triggers, how satisfaction functions as an organismic state, and how these processes influence environmentally responsible behavior in fragile ecosystems.

Tourist Recreational Experience

Tourist recreational experience (TRE) is considered an integral driver of attitudes, satisfaction, and subsequent behavioral intentions in tourism research. It was defined as a multidimensional construct with emotional, cognitive, sensory, educational, entertaining, and hedonistic engagement (Pine & Gilmore, 1998; Schmitt, 1999; Kim, 2018; Câmara et al., 2023; Ge & Chen, 2024). The larger perspective views recreational experience as a holistic psychological

process impacted by interactions with place, nature, and interpretation, rather than just an activity-based encounter (Tang et al., 2024). In nature-based tourism, scholars (Xu et al., 2018) cited thoughts, emotions, and reflections that ecotourists develop when engaging in wetland-related activities. These experience components, particularly draw on the dynamic and multisensory qualities of wetland ecosystems, foster direct contacts with biodiversity, observation of ecological processes, and involvement with conservation narratives. In line with environmental psychology and ecotourism frameworks, such immersive nature-based interactions promote affective and cognitive restoration while strengthening environmentally responsible behavior through increased place connection and moral engagement (Ballantyne et al., 2011a; Ballantyne et al., 2011b). That is the emotional components such as admiration, empathy, and attachment to nature can foster deep psychological engagement and lead to behavioural motivation (Rasul et al., 2025). And the experiential quality constructs the foundation for environmental stewardship and influence visitors' willingness to act responsibly both during and after their visit. As evidence of a significant of emotion effect in tourism (Javed et al., 2020), community-based tourism verifies these dynamics: recreational experiences have been found to impact environmental attitudes, which in turn motivate environmentally responsible behavior (Lee & Jan, 2015b) activities experience exert satisfaction and behavioral intention (Ge & Chen, 2024). This can be inferred that the tourists' recreational experience and satisfaction could nurture behavior and attitudes toward endangered wetland habitats. Despite these findings, empirical understanding remains fractured. In particular, the structural links between recreational experience, ecologically oriented attitudes, satisfaction, and ERB have not been thoroughly investigated in wetland tourism. Given that wetlands offer unique dynamic and instructive environments, exploring these experiential pathways is critical for establishing effective nature-based tourism strategies that promote both visitor satisfaction and ecological responsibility. We anticipate that educational and emotional factors will influence ERB more significantly than hedonic factors, as the former promote conservation mindsets, whilst the latter may emphasize satisfying oneself. As well as, the multi-sensory immersion during visitation would generate holistic positive evaluations. Thence, our hypothesis is:

H1: TRE has a significant impact on Tourist satisfaction (TS)

H3: TRE has a significant impact on ERB

Tourist Satisfaction

Tourist satisfaction (TS) is regarded as an important indicator of destination loyalty and intent to return (Sahabuddin et al., 2021; Carvache-Franco et al., 2022). Satisfaction is typically portrayed in tourism literature as a mediating psychological mechanism that directs the influence of experiencing stimuli into behavioral results (Radovic et al., 2021; Carvache-Franco et al., 2022; Prayag, 2009). In tourism studies, satisfaction is defined as an emotional or cognitive appraisal (Liu et al., 2023) obtained by comparing actual experiences to pre-visit expectations, which is consistent with the foundations of expectancy-disconfirmation theory and norm theory (Javed et al., 2020; Beard & Ragheb, 1980; Yoon & Uysal, 2005). Where, the high-quality recreational experiences, particularly those that incorporate enjoyment, learning, and immersion, are consistently associated with higher levels of visitor satisfaction (Tribe & Snaith, 1998; Radovic et al., 2021; Haji et al., 2021). Visitors who are satisfied are more likely to recognize the importance of environmental conservation, especially in natural settings (Jiang et al., 2022). Similarly, in wetland tourism, satisfaction serves as a mediator between motivation, destination image, attitudes, and behavioral intentions (Lee, 2009). These findings suggest that satisfaction not only reflects the evaluative conclusion of recreational activities, but also acts as a crucial psychological state that converts experiencing encounters into future actions. Satisfaction levels impact visitors' decision-making to revisit and share positive things about the place (Lai et al., 2018).

Despite the importance of satisfaction in tourism behavioral models, its relevance in the nexus of recreational experience and environmentally responsible behavior (ERB) in wetland settings is understudied. Given that wetlands ecological sphere may induce psychological correlation between tourists' experiential attachment and their pro-environmental actions—however, scientific information on this approach is limited. We expect that satisfaction in a sensitive natural ecosystem creates a sense of reciprocal obligation. Therefore, our second hypothesis is:

H2: Tourists' satisfaction has a significant impact on environmentally responsible behaviour

H4: Satisfaction mediates the relationship between TRE and ERB

Environmentally Responsible Behaviour

Environmentally responsible behavior (ERB) refers to humans' intentional acts aimed at reducing environmental degradation and preserving ecological integrity (Zacher et al., 2023; Tan et al., 2023; Han et al., 2016; Lee, 2011; Confente & Scarpi, 2021) or interchangeably as pro-environmental behavior. It composes of four set of behavior including; environmental activism; nonactivist publicly but donation or complying to policy; private environmentalism as such green behavior; and other behavior like influencing (Zacher et al., 2023). Simultaneously, ERB in tourism is comprised of ecological knowledge, environmental attitude, place-based sensitivity, and recognized personal responsibility (Tang et al., 2025). These cognitive-affective components are expressed through behaviors such as following travel instructions, reducing waste, conserving resources, respecting wildlife, and supporting conservation projects (Chiu et al., 2014; Steg & Vlek, 2009; Zacher et al., 2023; Yu et al., 2024; Zhang et al., 2024).

ERB is thus regarded as a necessary foundation to preserving ecotourism growth and protecting endangered areas (Lee et al., 2013). A significant amount of research has identified different causes of ERB in multiple nature-based tourism environments. Place attachment and recreational involvement have been demonstrated highly predict ERB in wetland habitats (Lee, 2011; Xu et al., 2018) show that engagement and experience appreciation are antecedents of ERB in wetland parks. Although this research emphasizes the significance of experience-based and psychological drivers of

ERB, they only provide a partial comprehension of the complex mechanisms that link recreational activities with pro-environmental behavior. Notably, Figure 1 the structural associations between tourist recreational experience (TRE), tourist satisfaction (TS), and ERB in wetland based on SOR will be examined.

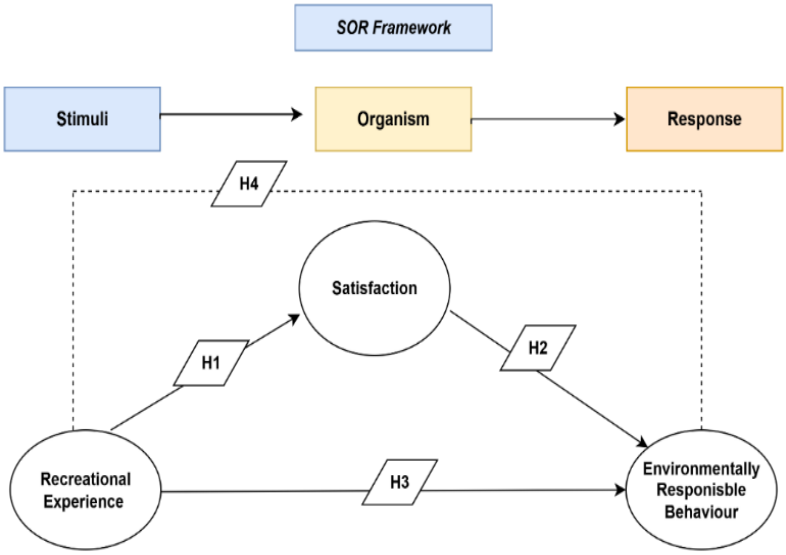


Figure 1. Conceptual Model (Source: Author's own creation)

METHODOLOGY

Research Design

The Quantitative research method and cross-sectional design have been employed to accomplish the research objectives, which are to examine the impact of TRE on ERB in wetland tourism destinations and the mediating roles of satisfaction. According to Apuke, (2017) quantitative research methods were selected for multiple reasons, including the potential of generalising the findings, addressing research questions through numerical data, and statistical analysis, etc. The study can be completed more quickly and cost-effectively, and a cross-sectional research design was used (Setia, 2016).

The questionnaires were constructed for data collection at Pong wetland site. Each measurement item used in the study was adapted and modified from the body of existing literature. The survey used a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), as it is a common method for data collection that needs less time and effort than scales with more points (Likert, 1932). Tourist recreational experience is an exogenous variable, assessed using 12 indicators adapted from Ballantyne et al. (2011a); Lee & Jan (2015a); satisfaction is an intervening variable, assessed using 9 indicators adapted from (Lee, 2009); environmentally responsible behaviour is an endogenous variable, assessed using 5 indicators from (Xu et al., 2018)**.** The questionnaire was examined by domain experts and pretested with a small group of visitors to verify linguistic clarity, cultural appropriateness, and contextual accuracy before the final survey.

Study Area

This study focuses on Pong Wetland, also known as Maharana Pratap Sagar in Figure 2, one of India's largest artificial wetlands and a designated Ramsar site with diverse and unique biodiversity, located in the Kangra district of Himachal Pradesh (Kohli, 2015). It was established in 1975 on the Beas River. Pong Wetland likely serves as the first significant resting place for migrating birds from the Trans-Himalayan region during winter. This Ramsar site has been established as a sustainable tourism destination under the Swadesh Darshan Scheme 2.0.

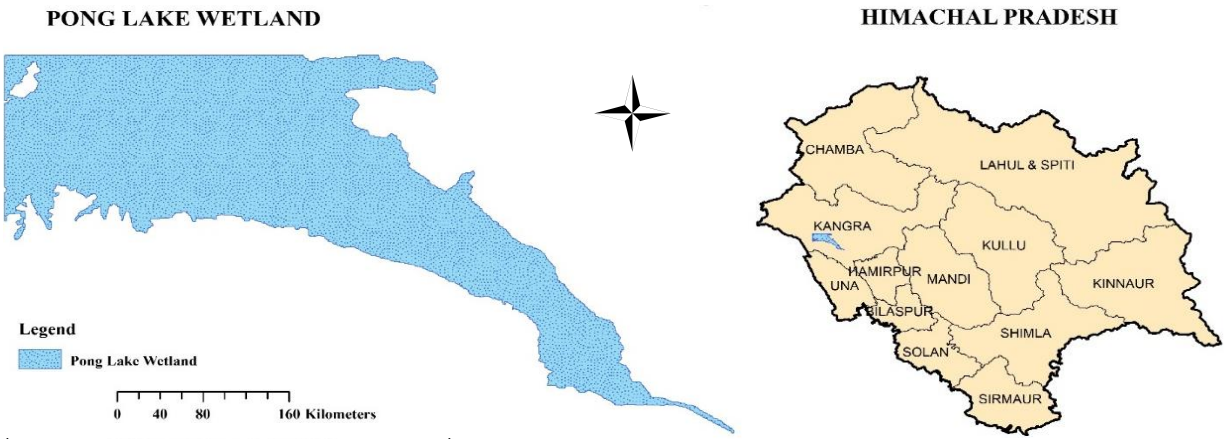


Figure 2. Pong Wetland (Source: Created by the authors using USGS Earth Explorer and ArcGIS10.5)

Sampling and Data Collection Procedure

The research methods were evaluated among visitors to the Pong Wetland (Ramsar site) in Himachal Pradesh, India. Before the final data collection, this study utilised an "a priori sample size calculator for structural equation models". The total number of responses required for the model's structure is sufficient for SEM, with 3 latent variables, 22 observed variables, an expected effect size of 0.30, a significance level of 0.05, and a statistical power of 0.80. The calculation shows that at least 119 responses are necessary to detect the effect **(**Westland, 2010**).** However, this study collected 219 valid responses, substantially exceeding this threshold and ensuring reliability, validity and adequate statistical power for hypothesis testing (Hair et al., 2014). The questionnaire was distributed offline at Pong Wetland. Data collection took place over three months, in October – December 2024, with respondents asked to complete the questionnaire. Before conducting the final survey, a pilot study was carried out with the first 30 respondents to verify clarity and reliability. The internal consistency of all constructs was assessed using Cronbach's alpha and McDonald's ω, with each construct scoring above 0.7. The overall Cronbach's alpha and McDonald's ω values were 0.967 and 0.969, respectively. Thus, the reliability of the questionnaire was established (Hair et al., 2019). The data was gathered among 230 domestic tourists using a convenience sampling technique, in which the respondents were chosen for their willingness and availability to participate while they were there. After initial screening, 11 unsatisfactory responses were eliminated, leaving a final sample size of 219 responses to be analysed with a response rate of 95.21%.

Data Analysis

Partial least squares structural equation modelling through SMART PLS 4.0 was applied to test both the measurement model (reliability and validity) and the structural model (path analysis) and the same was utilised to pilot-test as well as analyse the demographic profile of the respondents using Jamovi (version 2.3). For social sciences, conceptual model analysis, particularly in hospitality and tourism studies, partial least square path modelling is a reliable technique (Ali et al., 2018). Moreover, PLS-SEM is a useful tool for examining datasets with restricted observations (Hair et al., 2019). The research utilised the bootstrapping technique to estimate the statistical significance of both direct and indirect effects (Hayes, 2018). The methodology was conceptualized as shown in Figure 3.

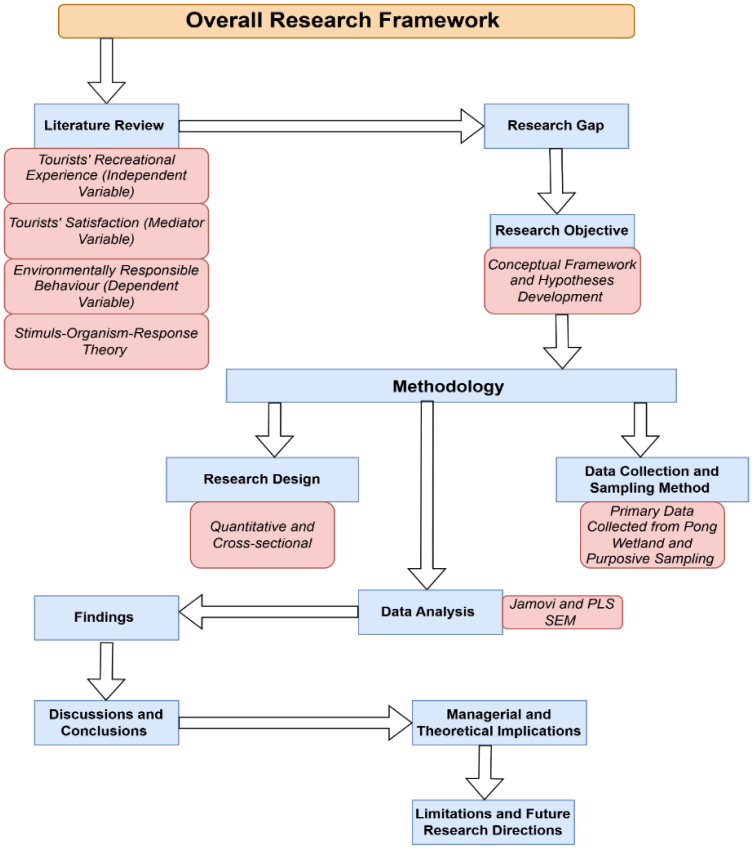


Figure 3. Research Framework

RESULTS

Descriptive statistics

Figure 4 shows the total of 219 responses data, it reveals that 63.0% of the tourists were male, while 37.0% were female. The largest group of tourists is aged 21-30 (68.5%), followed by those aged 31-40 (16.9%). Most are single (71.7%), with 27.4% married. In terms of educational background, 53.0% are postgraduates, 26.9% are graduates, and the majority are first-time visitors (48.9%). Additionally, 65.3% were accompanied by friends on this trip.

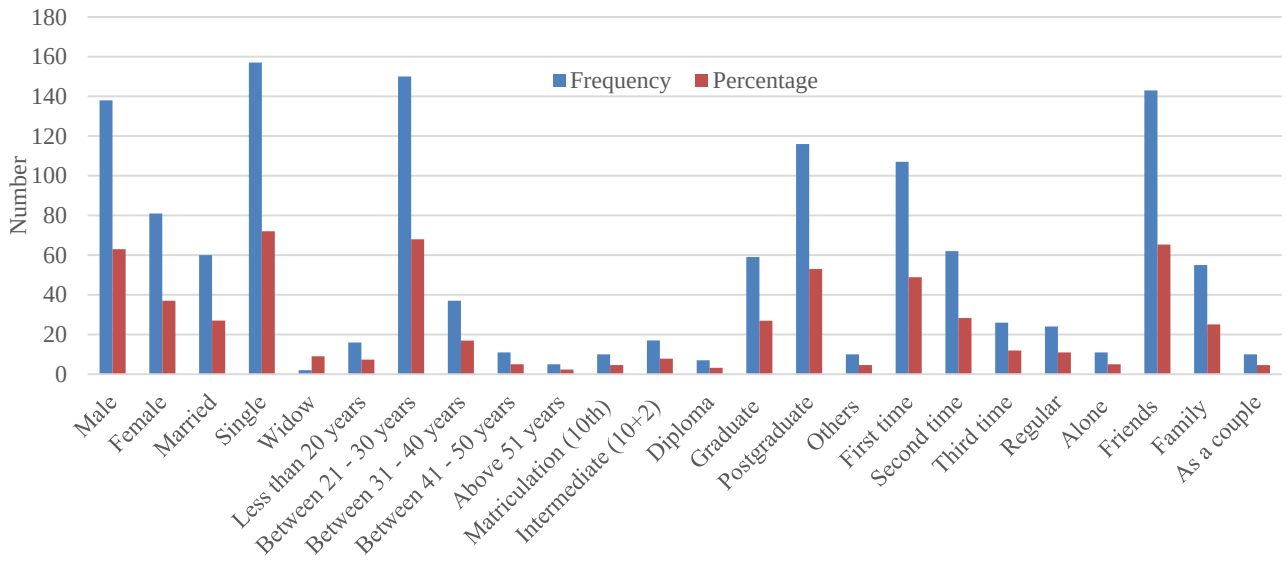


Figure 4. Respondents' Profile (Source: Author's own creation)

Assessment of the measurement model

To check the common method bias, Harman's Single Factor test was applied. The finding was that the first factor accounted for just 28.36% of the total variance, which is below the criterion of 50%. The implication is that there was no issue of common method bias (Fuller et al., 2016). The measurement model evaluation involves verifying construct reliability through measures such as Cronbach's alpha and composite reliability, along with assessing convergent validity (average variance extracted) and discriminant validity. The outer loadings of the 22 indicators ranged from 0.686 to 0.880, all exceeding 0.6. As shown in Table 1, Cronbach's alpha values were above 0.7, confirming that all constructs are reliable (Hair et al., 2014). The collinearity test results for the outer model revealed that all variance inflation factor values were under five, confirming the absence of multicollinearity and bias in the regression analysis.

Table 1. Construct reliability and validity (Source: Author's own creation)

Items		Factor loadings	VIF	Cronbach alpha	rho_c	rho_a	AVE
Tourists Recreational Experience				0.879	0.903	0.890	0.539
TRE1	"A fascinating and new experience"	0.728	1.591				
TRE4	"An amazing experience with water-based activities (Boating, Kayaking, Canoeing, etc.)"	0.710	1.705				
TRE5	"An emotional connection with the nature (flora-fauna)"	0.686	1.651				
TRE6	"A sheer pleasure as I got to see a wide variety of migratory birds"	0.748	1.708				
TRE8	"A refreshing experience as the air in the wetland was fresh and calming"	0.758	2.236				
TRE9	"Highly enjoyable as far as land-based recreational experiences were concerned (cycling tour, nature walk, etc.)"	0.734	2.102				
TRE10	"A very calming experience, as I felt a deep sense of peace within myself during the tour"	0.793	2.327				
TRE11	"A unique experience, where I witnessed a perfect balance between environmental preservation and recreational promotion"	0.714	1.892				
Tourists Satisfaction				0.908	0.925	0.914	0.580
TS1	"The recreational experiences offered at Pong Wetland (boating, bird watching, nature walks, etc)"	0.749	2.069				
TS2	"The tourist attractions (natural, cultural and religious), available at the Pong Wetland"	0.793	2.388				
TS3	"A thoughtful and worthwhile decision"	0.763	2.003				
TS4	"Time and money I have spent"	0.813	2.569				
TS5	"The environment of the destination"	0.806	2.489				
TS6	"The natural landscape at the Pong Wetland"	0.708	1.702				
TS7	"The Pong Wetland biodiversity"	0.622	1.687				
TS8	"The tourist facilities offered at the Pong Wetland (Information Centre, drinking water, washrooms etc,)"	0.792	2.428				
TS9	"Overall service distribution at the Pong Wetland"	0.789	2.310				
Environmentally Responsible Behaviour				0.890	0.919	0.904	0.695
ERB1	"I would talk to friends or relatives about environmental issues"	0.880	3.006				
ERB2	"I would try to persuade others to adopt environmentally responsible behaviour"	0.827	2.479				
ERB3	"I would report it to the wetland managers if I spotted improper behaviours"	0.864	2.657				
ERB4	"I would pick up the garbage that I see during my trip to Pong Wetland"	0.829	2.371				
ERB5	"I joined in community clean-up efforts"	0.763	1.806				

Additionally, the composite reliability (rho_c and rho_a) of all constructs was above 0.7 (Bagozzi & Yi, 1988; Dijkstra & Henseler, 2015), and the average variance extracted (AVE) was above 0.5, indicating that each construct explains at least 50% of the variance in its indicators (Hair et al., 2019). The AVE increased from 0.539 to 0.695. The AVE values of each construct are "Recreational Experience" 0.539, "Satisfaction" 0.580, and "Environmentally Responsible Behaviour" 0.695. Thus, the convergent validity was valid. To assess discriminant validity, using the Heterotrait-Monotrait ratio and Fornell-Larcker criterion in *italic numbers with* $\sqrt{\boldsymbol{AVE}}$ in ***italic bold***, Table 2. All HTMT values below the threshold of 0.9 or 1 (Henseler et al., 2015; Voorhees et al., 2016). Therefore, discriminant validity is valid.

Table 2. Heterotrait-Monotrait Ration (HTMT) and *Fornell-Larcker Criterion* $\sqrt{AVE}$ (*Italic numbers are Fornell-Larcker Criterion)

Constructs	TRE	TS	ERB
TRE	**0.734**	0.551	0.001
TS	0.590	**0.761**	0.336
ERB	0.132	0.367	**0.834**

Table 3. Explanatory Power (Source: Author's own creation)

Constructs	R-square	R-square adjusted	Q^2 predict
ERB	0.162	0.154	-0.011
TS	0.304	0.300	0.292

Table 3 presents the explanatory power of the models, highlighting the impact of predictor variables on each construct. The recreational experience accounts for 16.2% of the variance in tourists' satisfaction. Moreover, satisfaction explains 30.4% of the variance in environmentally responsible behaviour. The predictive validity of the structural model was confirmed through R-squared values for the endogenous latent variables of appreciation and actual visits, both of which exceeded the acceptable value of 0.10 (Chin et al., 2020). The Q2 prediction results show that the model has good predictive relevance for tourist satisfaction, indicated by the positive value (0.292). Conversely, the negative value for environmentally responsible behaviour (-0.011) suggests that the model has limited or no predictive power for ERB. This indicates that while the model predicts TS effectively, additional constructs are necessary to improve ERB prediction.

Structural Model

The structural model was evaluated using Model Fit (SRMR), f2, and path coefficients, as well as t-statistics and p-values, in SmartPLS 4.0. The model fit was excellent, with an SRMR (Standardized Root Mean Square Residual) value of 0.075. Effect size analysis showed that ERB → TRE ($f^2 = 0.058$) has a small effect, so ERB modestly explains the variability in the tourist recreational experience. Conversely, the effect size of ERB → TS is medium ($f^2 = 0.193$), indicating that environmentally responsible behaviour moderately contributes to tourist satisfaction. TRE → TS has a large effect size of $f^2 = 0.436$, suggesting that the recreational experience of tourists is a very strong predictor of tourist satisfaction.

Table 4. Hypothesis Testing Results (direct relationship) (Source: Author's own creation)
(Note: TRE: Tourist Recreational Experience: TS: Tourist Satisfaction: ERB: Environmentally Responsible Behaviour)

Construct (path)	β (path coefficients)	Std	T- statistics	p values	95% Confidence Interval (LICI-UICI)		Support
TRE→ ERB	-0.265	0.091	2.906	0.004	-0.445	-0.089	H1→ No (different sign)
TRE → TS	0.551	0.061	9.098	0.000	0.432	0.670	H2→ Yes
TS→ ERB	0.482	0.066	7.323	0.000	0.367	0.624	H3→ Yes

A bias-corrected and accelerated (Bca) bootstrap method with 5000 subsamples was employed to examine the relationship between tourists' recreational experience, satisfaction, and environmentally responsible behaviour in the Pong Wetland. The tourist recreational experience has a negative and significant effect on environmentally responsible behaviour (βTRE→ERB = -0.265, t = 2.906, p = 0.004; Table 4). This suggests that increased recreational engagement might decrease environmentally responsible behaviour. Therefore, H1 is not supported because of the different sign. This negative correlation raises the possibility that tourists may unawares experience psychological stress as a result of increased exposure to environmental responsibility. Conversely, it has a positive and significant influence on tourist satisfaction (βTRE→TS = 0.551, t = 9.098, p = 0.000; Table 5), supporting H2. The result emphasizes the necessity of creating environmental programs that lessen the immediate reliance on behavior and satisfying visitors. Additionally, satisfaction has a positive and significant impact on environmentally responsible behaviour (βTRE→ERB = 0.482, t = 7.323, p = 0.000), confirming H3.

Mediation Analysis

A mediator, according to Baron & Kenny (1986), is a variable that influences how the independent and dependent variables relate to one another. The results indicate that tourist satisfaction serves as a positive and significant mediator between the recreational experience and environmentally responsible behaviour of tourists (βTRE→TS→ERB = 0.266, t = 5.924, p = 0.000; Table 5). Notably, while the direct impact of TRE on ERB is negative, the indirect impact through satisfaction is positive, suggesting a competitive (inconsistent) mediation (Zhao et al., 2010). Therefore, H4 is confirmed. Consequently, three hypotheses are supported.

Table 5. Mediation Analysis (indirect effect) (Source: Author's own creation)

Construct	β (path coefficients)	Std	t- statistics	p values	95% Confidence Interval (LICI-UICI)		Result
TRE→TS→ERB	0.266	0.045	5.924	0.000	0.196	0.371	H4→ Yes

In Figure 5 depicts the structural equation model's hypothesized correlations between Tourist Recreational Experience (TRE), Tourist Satisfaction (TS), and Environmentally Responsible Behavior (ERB). The path coefficients and p-values reflect the strength and importance of these associations.

Figure 6 demonstrates that the importance-performance map analysis (IPMA) reveals clear differences among the constructs. Tourist satisfaction scores highly on both importance and performance, signifying it is a key factor influencing the target outcome and performs well. In contrast, tourists' recreational experience exhibits high performance but low importance, implying it has a smaller direct influence on the desired behavior outcome.

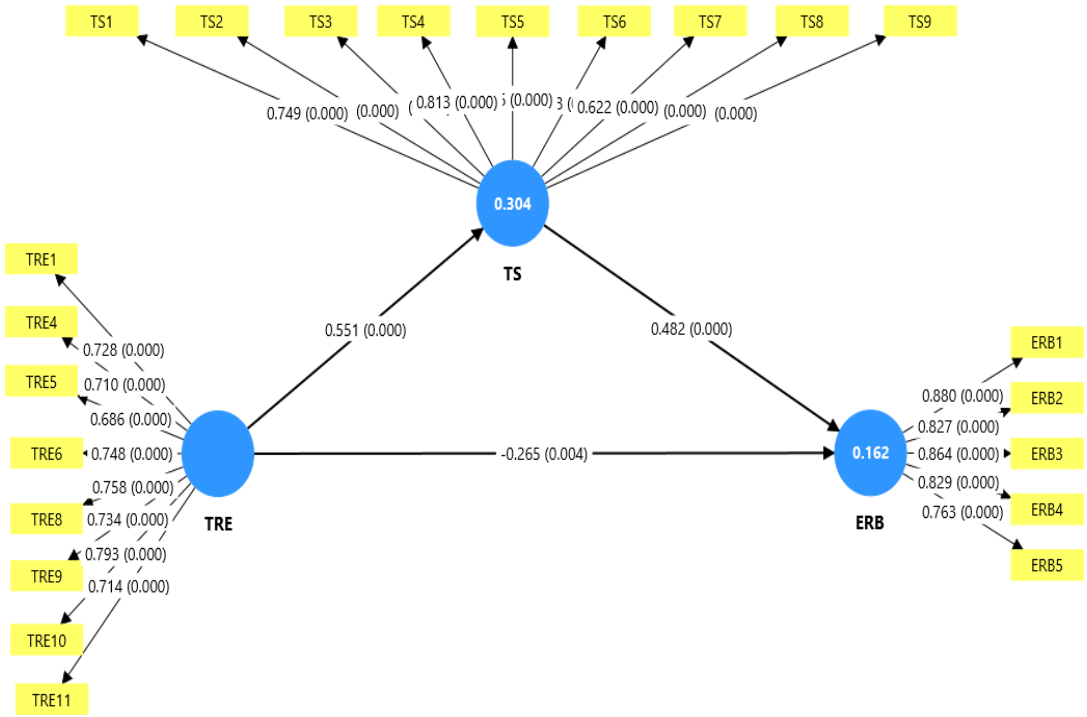


Figure 5. Path model results

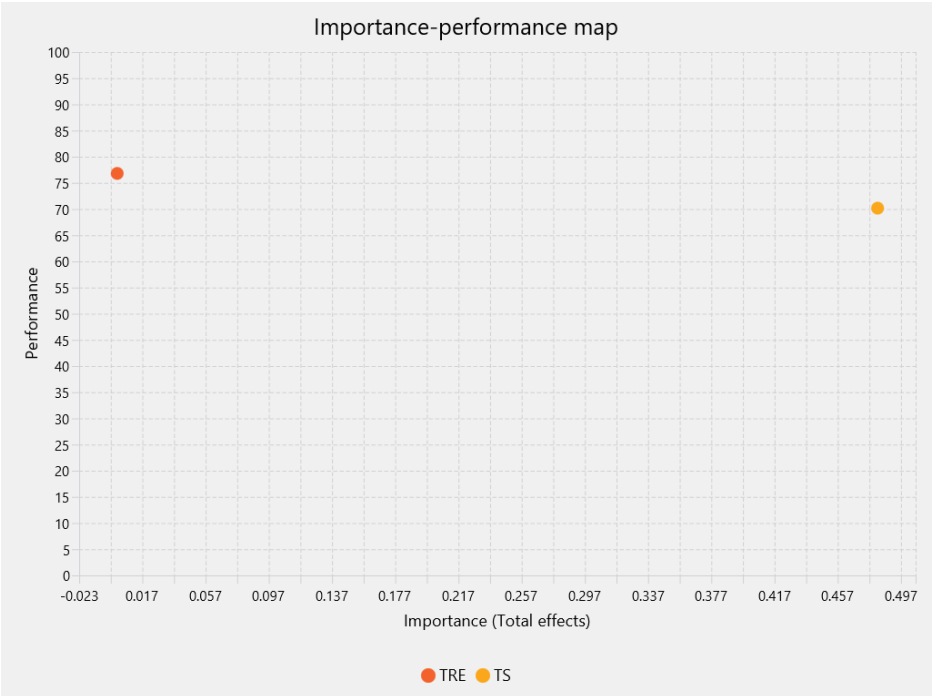


Figure 6. Importance-performance map analysis (IPMA)

DISCUSSION AND CONCLUSIONS

The findings confirm that tourist recreational experience (TRE) significantly contributes to tourist satisfaction (TS), which is consistent with previous research concluding that emotional, cognitive, and sensory experiences shape positive visitor evaluations in nature-based settings (Pine & Gilmore, 1998; Schmitt, 1999; Kim, 2018; Tang et al., 2025).

This finding is consistent with previous research demonstrating that meaningful nature experiences enhance tourists' attitudes and well-being (Ballantyne et al., 2011b; Xu et al., 2018). TS emerges as a major predictor of environmentally responsible behavior (ERB), reinforcing previous research showing satisfied visitors are more likely to appreciate, protect, and behave responsibly in natural settings (Chi & Qu, 2008; Jiang et al., 2022). This supports prior investigations suggesting that satisfaction influences behavioral intentions such as revisits, recommendations, and pro-environmental behaviors (Hultman et al., 2015; Hung et al., 2021).

Another significant theoretical variation is the negative direct effect of TRE on ERB, which puts into doubt the notion that pleasant experiences always encourage stewardship (Lee & Jan, 2015a; Ramkissoon et al., 2013). This indicates that higher involvement in recreational activities could reduce environmentally responsible behavior. This implies that recreational enjoyment alone does not convert into responsible behavior unless mediated by satisfaction or equivalent evaluative systems. This complexity contrasts with research that place experience as a direct antecedent of ERB (Lin & Lee, 2019; Xu et al., 2018), emphasizing the potential risks of establishing wetland tourism primarily around hedonic experiences. Overall, the data support the mediation function of satisfaction (Baloglu et al., 2004; Lee, 2009), which implies that TRE only contributes to ERB when visitors have positive appraisals of their experience. This highlights the importance for wetland managers to incorporate interpretative and conservation-oriented elements into recreational programs to guarantee that satisfying experiences foster responsible behavior rather than passive enjoyment.

Managerial, Theoretical Implications and Limitations

Our findings present an important challenge for managing wetland. The recreational experience itself does not directly initiative the environmentally responsible behavior. Hence, the development of recreational experiences must be planned carefully that not only entertainment is offered but also satisfaction levels are increased, and environmentally responsible behaviour values are promoted. Through enhancing satisfaction using interpretive programs, nature storytelling, or green infrastructure, tourism managers can enhance the likelihood that tourists translate their positive experience into environmentally friendly behaviour. It is recommended to cooperate with local community on the conservation program. As well as, collaboration with tourism operators, teachers, and social media influencers can also be a critical factor in raising awareness and creating a positive destination image.

The SOR theory illustrates its relevance to eco-tourism behaviour, particularly by indicating how satisfaction acts as a mediator of recreational experiences and environmentally friendly behaviour.

This research provides evidence of its applicability in explaining pro-environmental behavioural norms in natural tourism contexts. It adds to eco-tourism literature by conceptualising satisfaction as an important psychological process by which stimuli (experience) affect responsible responses, hence deepening the knowledge of sustainable tourist behaviour. This shows that satisfaction is not only a behavioural antecedent but also a psychological process that transforms recreational pleasure into significant, conservation-oriented actions.

This theoretical advancement enhances the understanding of sustainable tourists' behaviour in wetlands.

Though this research has yielded some useful findings, it does have a number of limitations, which are noted. In the first place, the study was undertaken in one wetland (Ramsar Site), Pong Wetland, within Himachal Pradesh, India. This could restrict the applicability of the findings to other natural environments. Secondly, the study utilised a cross-sectional survey design, where tourists' answers are captured at one point in time, and a quantitative method.

Thirdly, the study's main concern was tourists' recreational experience (Stimulus), impact satisfaction (Organism), and environmentally responsible behaviour (Response). Although this follows the SOR theory, future research can utilise destination image or environmental education (Stimulus), affect place attachment, or ecological concern (Organism), and reconsider intentions or word of mouth (Response). Lastly, this research did not apply any moderating variables.

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UNBOXING THE ANTECEDENTS OF HOTELS EMPLOYEE PROACTIVE PRO-ENVIRONMENTAL BEHAVIOR

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Abstract: This study focuses on employee proactive pro-environmental behavior (EPPB) rather than task-related pro-environmental behaviors. EPPB encompasses actions that promote sustainability and environmentally friendly practices beyond job tasks. Such behaviors reflect a proactive approach to environmental stewardship. This study applies social identity theory to examine the new combined effects of green organizational identity (GOI) and corporate social responsibility (CSR) on employee environmental concerns (EECs) and EPPB within the hospitality industry. It also examines the extent to which environmentally specific servant leadership (ESSL) moderates the indirect effects of CSR and GOI on EPPB through EECs. A sample of 406 supervisor-subordinate dyads from 7 five-star and 8 four-star hotels was collected using a two-wave data collection procedure. AMOS analyses indicate that ESSL moderates the indirect effects of CSR and GOI on EPPB through EECs. The study extends the existing literature that examined the effects of CSR and GOI on employee pro-environmental behaviors individually. This study explores the intricate relationships between CSR and GOI and their combined effects on proactive environmental behaviors. In addition, the study provides a novel, more integrated perspective on the roles of CSR and GOI in influencing ECs. As such, the findings of this study contribute to our understanding of the complex relationships and mechanisms involved in the CSR and GOI effects on ECs and EPPB. Finally, this study offers novel practical insights for the service industry, which poses significant environmental risks due to its operations.

Keywords: corporate social responsibility, green organizational identity, environmental concerns, proactive pro-environmental behavior, environmentally specific servant leadership

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INTRODUCTION

In the hotel industry, proactive behaviors of employees are a critical source of competitive advantage for success and sustainability (Abuelhassan et al., 2024; Ndlovu et al., 2026). Most organizations in the hospitality industry adhere to the standards of environmental sustainability that are established on the basis of strict regulations (Durrah et al., 2026; Ferdos et al., 2026; Khreis et al., 2025b). Based on the pro-environmental behavior literature, there are two main types of pro-environmental behaviors: task-related and proactive (Karatepe et al., 2021).

This study focuses on examining employee proactive pro-environmental behavior (EPPB) instead of task-related behaviors. Task-related behaviors at work are actions directly associated with fulfilling job requirements (Darvishmotevali & Altinay, 2022; Karatepe et al., 2021). On the other hand, EPPB at work involves employees' proactive measures taken to foster environmental practices beyond their job responsibilities (Bissing-Olson et al., 2013; Durrah et al., 2026). EPPB at work takes pro-environmental actions to a higher level. They involve self-initiated efforts to identify and implement innovative solutions for environmental challenges, actively seeking opportunities to improve sustainability practices beyond what is expected in one's job role. Such behaviors demonstrate a proactive and forward-thinking approach toward environmental stewardship (Bissing-Olson et al., 2013). EPPB refers to the voluntary efforts made by employees to engage in environmentally sustainable behaviors beyond their usual environmental work tasks (Bissing-Olson et al., 2013).

EPPB involves employees taking an active and self-starting approach to their environmentally friendly work practices (Bissing-Olson et al., 2013; Durrah et al., 2026). Engaging in proactive pro-environmental behaviors might involve offering valuable suggestions for the environment, pinpointing environmental issues, creating inventive solutions for environmental challenges, and tackling barriers to enhance current environmental processes (Bissing-Olson et al., 2013; Durrah et al., 2026). Employee pro-environmental behaviors are influenced by various internal factors, such as their values, attitudes, and beliefs, including employee environmental concerns (EECs) (Haldorai et al., 2023). EECs refer to employees' awareness, attitudes, and beliefs regarding environmental issues and the importance of taking proactive measures to address them (Haldorai et al., 2023). Additionally, external situational factors also play a role, such as interpersonal interactions with

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leaders, for example, environmentally specific servant leadership (ESSL) (Xu et al., 2022), and organizational factors such as corporate social responsibility (CSR) and green organizational identity (GOI) (Shiri & Jafari-Sadeghi, 2023).

The social identity theory (Tajfel et al., 1979) offers valuable insights into how hotels adopting CSR and cultivating GOI can influence EECs, ultimately leading to pro-environmental behavior (Raza et al., 2021). When hotels prioritize CSR and GOI, they create a distinctive social group that employees can identify with, fostering a shared commitment to environmental behaviors. This sense of group affiliation enhances employees' sense of belonging and strengthens their pro-environmental awareness by highlighting the importance of pro-environmental preservation. ESSL, characterized by leaders prioritizing the environment's well-being, plays a crucial moderating role (Xu et al., 2022).

Such leaders inspire and empower employees to adopt pro-environmental values and behaviors, reinforcing the alignment between the organization's sustainability goals, such as CSR and GOI, and employees' environmental motivations, like EECs. By recognizing the interplay between the social identity perspective, CSR, GOI, and ESSL, hotels can effectively cultivate a culture of environmental responsibility (EECs) and harness the collective power of employees to drive meaningful change toward a more sustainable future by EPPB (Fatnassi et al., 2026; Khreis et al., 2025a; Ndlovu et al., 2026). ESSL has been widely acknowledged as a significant factor in shaping employees' pro-environmental behaviors (Badar et al., 2016). However, scarce research has ventured into testing the moderating role of ESSL (Darvishmotevali & Altinay, 2022), the CSR-EPPB relationship, and the GOI-EPPB relationship via EECs.

The study model (Figure 1) aims to address this gap in the scholarly landscape, further advancing the understanding of CSR, GOI, ECs, EPPB, and ESSL. Finally, the implications of the findings extend beyond academia, as they hold substantial relevance for the hospitality industry, providing valuable insights for practitioners and managers in fostering sustainable practices (Durrah et al., 2026; Fathy et al., 2025; Khreis et al., 2025).

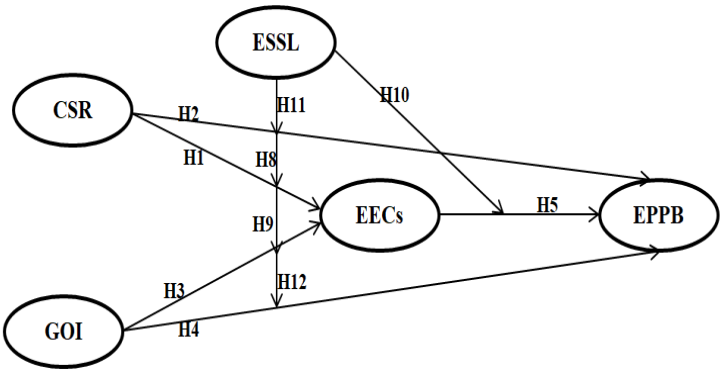


Figure 1. The Research Model

LITERATURE REVIEW

The Relationship between CSR, EEC, and EPPB

Drawing on the social identity theory (Tajfel et al., 1979), an organization actively engages in CSR practices showing its interest to prioritize environmental sustainability. it sends a clear message to employees that the organization values and prioritizes environmental responsibility (Shiri & Jafari-Sadeghi, 2023). CSR initiatives often involve raising awareness about environmental issues like climate change, pollution, and resource conservation (AlSuwaidi et al., 2021). By providing information and education, companies can help employees better understand these concerns and their environmental impact (AlSuwaidi et al., 2021; Su & Swanson, 2019). Organizations committed to CSR are likelier to engage employees in environmental sustainability activities such as organizing volunteer environmental programs, sustainability initiatives, or environmental campaigns (Cheema et al., 2020; Shiri & Jafari-Sadeghi, 2023). Active employee environmental involvement fosters a sense of ownership and empowerment, making them more invested in environmental concerns (AlSuwaidi et al., 2021; Su & Swanson, 2019).

H1: CSR positively impacts employees' EECs.

The second hypothesis suggests that CSR may positively affect EPPB. According to the social identity theory (Tajfel et al., 1979), when an organization shows dedication to CSR, especially in terms of environmental sustainability, it communicates to its employees the critical nature of environmental responsibility (Rhou & Singal, 2020). CSR initiatives in environmental practices can raise employees' awareness about environmental issues and their impacts (AlSuwaidi et al., 2021; Rhou & Singal, 2020). By actively engaging in CSR programs, employees become more informed about the importance of environmental behavior (Cheema et al., 2020; Su & Swanson, 2019). When an organization places a high emphasis on CSR, it establishes a normative benchmark for its workforce. Employees may experience societal pressure to conform their conduct to the organization’s values and participate in green practices (AlSuwaidi et al., 2021; Cheema et al., 2020).

Based on the social identity theory, when employees perceive their company as socially responsible, they are more likely to feel a sense of pride and loyalty (Shiri & Jafari-Sadeghi, 2023), which can translate into greater motivation to engage in pro-environmental behaviors (AlSuwaidi et al., 2021). When organizations implement CSR practices regarding environmental responsibility and encourage employees to participate, they provide role models for employees to follow (Cheema et al., 2020; Rhou & Singal, 2020). Employees may be inspired by their organization's actions and emulate them in their behaviors, including pro-environmental activities (Song et al., 2019). Finally, CSR environmental initiatives often

involve providing employees with environmental resources, training, and support to engage in pro-environmental behaviors (Rhou & Singal, 2020). Employees with the necessary environmental tools and knowledge are likelier to take proactive steps toward environmental sustainability (AlSuwaidi et al., 2021). Literature evidence supports that perceived CSR motivates employees to engage in green innovation. These behaviors encompass activities such as generating and implementing novel green ideas. Moreover, employees will likely proactively develop and implement ideas to reduce their organization's environmental impact (Shah et al., 2021; Shahzad et al., 2020).

H2: CSR has a positive effect on employee EPPB.

The Relationship between GOI, EEC and EPPB

Developing a comprehensive GOI can significantly enhance employees' awareness of environmental issues, concerns, and behaviors toward the environment (Haldorai et al., 2023). Based on the social identity theory (Tajfel et al., 1979), when an organization is acknowledged for its environmentally responsible practices and values (Song & Yu, 2018), it can impact EECs and EPPB in various ways. A robust GOI aids in aligning employees' values with the company's environmental concerns (Haldorai et al., 2023). Employees who believe their company prioritizes sustainability and environmental responsibility are likelier to have a positive attitude toward environmental concerns and embrace environmental initiatives promoting sustainability (Haldorai et al., 2023). This shared purpose creates a strong sense of community and encourages a culture of environmental responsibility within the organization (Soewarno et al., 2019). Organizations with a green identity tend to provide their employees with resources, training, and information on environmental issues (Peng et al., 2020). This approach increases employees' awareness about environmental concerns, they become better equipped to understand the importance of sustainability (Zhang & Huang, 2019).

H3: GOI has a positive impact on EECs

The social identity theory (Tajfel et al., 1979) posits that when individuals within a workforce align themselves with an organization that embodies an environmentally sustainable identity, it may foster an enhanced sense of pride and intrinsic motivation. They feel proud to be associated with a company that prioritizes environmental responsibility and takes concrete actions to address sustainability challenges (Haldorai et al., 2023). This pride and inspiration can translate into increased engagement and commitment to environmental concerns, leading to proactive participation in green initiatives and a willingness to go the extra mile to contribute to sustainability goals (Soewarno et al., 2019). An organization that emphasizes environmental stewardship can exert a beneficial influence on the attitudes and behaviors of its employees regarding environmental issues (Haldorai et al., 2023). By establishing norms and expectations that promote eco-friendly behavior and by rewarding such behavior, employees are more likely to adopt environmental concerns leading to advocate for environmentally responsible practices (Peng et al., 2020; Soewarno et al., 2019). This can translate into proactive actions to conserve energy, reduce waste, make responsible consumption choices, and promote sustainability both inside and outside the workplace (Song et al., 2019).

H4: GOI has a positive impact on EPPB

The Mediating role of Employee Environmental Concerns

The social identity theory and the existing literature suggest that EECs can positively mediate the CSR-EPPB and GOI-EPPB relationships. The literature sugessts that employees with strong environmental concerns show high attitudes and beliefs about the importance of environmental issues (Cheema et al., 2020; Kim et al., 2016). Thus, they tend to be motivated and engage in green behaviors proactively (Zhang & Huang, 2019). Their environmental concerns are mediated by bridging the relationship between environmental and organizational goals (CSR and GOI) and their proactive actions. Employees who are environmentally concerned are more likely to interpret CSR initiatives and GOI as genuine and meaningful, which increases their motivation to engage in pro-environmental behavior (Haldorai et al., 2023; Shiri & Jafari-Sadeghi, 2023). Employees who are environmentally concerned and perceive their organization as socially responsible are likelier to take proactive steps toward environmental sustainability (Shiri & Jafari-Sadeghi, 2023; Soewarno et al., 2019). Therefore, they can achieve the organizational environental goals by initiating actions such as proactively conserving energy, advocating for sustainable practices, reducing waste, or participating in environmental initiatives inside and outside the workplace (Xu et al., 2022).

H5: EECs have a positive impact on EPPB

H6: EECs positively mediate the relationship between CSR and EPPB.

H7: EECs positively mediate the relationship between GOI and EPPB.

The Moderation Role of Environmentally Specific Servant Leadership

The study suggests that ESSL moderates the effect of CSR and GOI on EECs. Leaders have a crucial impact on the relationship between an organization's environmental initiatives and goals and its employees' environmental awareness, concerns, behaviors, and performance (Luu, 2019; Tuan, 2021). Leaders who exhibit high ESSL create supportive environments that enhance these connections. They provide information, practices, resources and training to support employees in addressing environmental concerns (Aboramadan et al., 2021; Tuan, 2020, 2021). Thus, Leaders with high ESSL are able to strengthen the effect of CSR and GOI on EECs by enhancing their subordinates' awareness of CSR and GOI initiatives and practices (Javed et al., 2024; Zafar et al., 2023). Conversely, leaders with low ESSL diminish the effectiveness of CSR and GOI on EECs on EECs by not supporting environmental practices and initiatives, failing to involve employees in green decision-making, and providing insufficient support, encouragement, and resources

(Aboramadan et al., 2021; Tuan, 2020, 2021). Accordingly, leaders with high ESSL act as potent stimulators, enhancing the effects of CSR and GOI on EECs. Leaders with low ESSL serve as isolators, diminishing the connection between subordinates' environmental concerns and both CSR and GOI initiatives and practices.

H8: ESSL moderates the CSR-EECs relationship

H9: ESSL moderates the GOI-EECs relationship

The literature suggests that ESSL can influence the relationship between EECs and EPPB in multiple ways. Leaders with high ESSL, rather than those with low ESSL, appreciate subordinates' environmental concerns and value their perspectives on environmental issues by providing environmental support and empowerment (Badar et al., 2023). This approach motivates employees with environmental concerns to engage in proactive behaviors (e.g., EPPB) (Abuelhassan et al., 2024). Leaders with high ESSL are role models for proactive environmental behaviors by exhibiting environmentally responsible behaviors. They demonstrate the importance of green interests through their actions and decisions, inspiring their subordinates to follow suit (Aboramadan et al., 2021). Therefore, leaders with high ESSL create a supportive environment that enhances the relationship between EECs and EPPB. They encourage their subordinates to elevate their environmental concerns to be proactive in green behaviors. On the other hand, leaders with low ESSL neglect the importance of providing employees with the necessary resources, tools, and opportunities to engage in pro-environmental behaviors (Aboramadan et al., 2021; Tuan, 2020). They decrease allocating budget and time for green initiatives, promoting training programs, or providing access to environmentally friendly technologies and practices (Badar et al., 2023). Leaders with low ESSL can weaken the relationship between EECs and EPPB. They do this by reducing support and resources and fostering an environment that does not prioritize environmental contributions. As a result, they fail to create a supportive atmosphere that encourages employees to engage in proactive green behaviors when environmental concerns arise. In contrast, leaders with high ESSL can enhance the impact of EECs and EPPB by empowering, inspiring, and supporting employees with environmental concerns, encouraging them to adopt proactive green behaviors. Accordingly,

H10: ESSL moderates the EECs-EPPB relationship

The moderated mediation analytical paradigm suggests that the relationship between an independent variable (such as CSR or GOI) and a mediator (like EECs) can be influenced by a specific moderator (for instance, ESSL in hypotheses H8 and H9). In this context, the indirect relationship linking the independent variable to a dependent variable (such as EPPB) through the mediator is typically affected by the same moderator (Preacher et al., 2007). Additionally, hypothesis H10 posits that ESSL moderates the relationship between EECs and EPPB. Therefore, the following hypotheses are proposed:

H11: ESSL moderates the CSR- EPPB indirect relationship via EECs.

H12: ESSL moderates the GOI- EPPB indirect relationship via EECs.

MATERIAL AND METHODS

Data Collection Process

Five-star and four-star hotels in the KSA were approached for participation in a research study, out of which 7 five-star and 8 four-star hotels agreed to take part in the survey. Once the human resource departments of these hotels were approved, questionnaires were distributed among the employees and their leaders. The respondents were required to answer the questionnaire items and submit them to the designated person in charge. In the study, the author distributed 512 questionnaires to employees and their supervisors. This was done in person, with 224 questionnaires going to five-star hotels and the rest to four-star hotels. At Time 1, the author collected 476 valid employee questionnaires over two weeks. Time 2 (one month after Time 1), distributed 476 questionnaires to the employees who had returned their questionnaires. The author collected 444 valid questionnaires during this phase. Two months after Time 1, the author collected 456 questionnaires from 96 supervisors. The author assigned unique codes to each questionnaire to match the employees' and supervisors' questionnaires. The author obtained 406 sets of questionnaires from both employees and supervisors, which accounts for 79.3% of the original 512 questionnaires distributed.

Measurements and Analysis

The study utilized the Likert scale ratings from the sources of the constructs. The study used Su & Swanson's (2019) five items to measure CSR and rated them on a seven-point Likert scale. Using a five-point Likert-type scale, the study assessed GOI with six items from Mittal & Dhar (2016). The four items of EECs were taken from Kim et al. (2016) using a 7-point scale. For EPPB, the study utilized the three items developed by Karatepe et al. (2021) and rated them on a 5-point scale. For ESSL, the study used the twelve items created by Luu (2020) and rated them on a 5-point scale. To ensure discriminant validity, the study used the square root of the average variance extracted (AVE) values. For evaluating convergent validity, the study utilized factor loadings, composite reliabilities (CR) and AVE. Finally, the author conducted confirmatory factor analysis (CFA) and tested our hypotheses using AMOS 21.

RESULTS

Construct Validity

Table 1 presents the means, standard deviations, and correlations among study constructs. All constructs correlate positively with each other ($p< 0.01$). The study used the AVE values to ensure discriminant validity. Fornell and Larcker suggested that every variable should have an AVE value greater than its correlation values with other variables. Our results, shown in Table 1, indicate that in this study, the square root of the AVE values of each variable was higher than all their correlation coefficient values, proving the study's discriminant validity.

Table 1. Descriptive Analysis, Variance Inflation Factor, Correlation, and Discriminant Validity

Variables		Mean (SD)	Correlation				
			1	2	3	4	5
1	ESSL	3.19 (1.305)	**(0.825)**				
2	CSR	4.65 (1.723)	0.590**	**(0.805)**			
3	GOI	3.93 (1.024)	0.511**	0.387**	**(0.729)**		
4	EECs	4.71 (1.590)	0.793**	0.524**	0.658**	**(0.815)**	
5	EPPB	4.01 (0.872)	0.349**	0.306**	0.341**	0.468**	**(0.865)**

Notes: N = 406, p<0.01= **

To assess the study's convergent validity, the study analyzed the loadings of the items belonging to the five constructs (Table 2). The loadings were all significant ($p < 0.01$) and higher than 0.50. The lowest loading was for GOI2, with a value of 0.708, while the highest was for EPPB1, with a value of 0.906. The finding found that all five constructs had CR values of over 0.60, with the highest value of 0.962 for ESSL and the lowest value of 0.872 for GOI.

The high significant factor loadings and CR values indicated that the five constructs had no convergent validity issues. Additionally, all of the study's constructs had AVE values exceeding 0.50, further demonstrating convergent validity (Hair et al., 2010). Finally, the CFA findings using AMOS showed a good fit ($\chi 2$ [pdf] = 476.451 [395], $\chi 2$/pdf =1.206, CFI = 0.991, RMSEA= 0.023, AGFI= 0.916, GFI = 0.929, NFI = 0.949), which confirmed the construct validity.

Table 2. The Convergent Validity and Loadings

Variables and Items	AVE	CR	Loadings
Environmentally Specific Servant Leadership	**0.681**	**0.962**	
ESSL1			0.805**
ESSL2			0.830**
ESSL3			0.814**
ESSL4			0.846**
ESSL5			0.827**
ESSL6			0.854**
ESSL7			0.808**
ESSL8			0.835**
ESSL9			0.831**
ESSL10			0.827**
ESSL11			0.798**
ESSL12			0.827**
Corporate Social Responsibility	**0.648**	**0.902**	
CSR1			0.812**
CSR2			0.801**
CSR3			0.800**
CSR4			0.811**
CSR5			0.802**
Green Organizational Identity	**0.532**	**0.872**	
GOI1			0.717**
GOI2			0.708**
GOI3			0.771**
GOI4			0.732**
GOI5			0.717**
GOI6			0.728**
Employee Environmental Concerns	**0.665**	**0.888**	
EECs1			0.810**
EECs2			0.803**
EECs3			0.797**
EECs4			0.850**
Employee Proactive Pro-Environmental Behavior	**0.747**	**0.899**	
EPPB1			0.906**
EPPB2			0.812**
EPPB3			0.873**
Notes: ** =P<0.01			

Two tests were conducted to check for any potential common method bias (CMB) in the proposed model. Firstly, we performed a one-way analysis of variance (ANOVA) to investigate the CMB of the supervisor survey. The result of the ANOVA was insignificant (F = 1.274, p = 0. 061), suggesting that supervisors rated their subordinates' EPPB independently. The author conducted Harman's single-factor test to test the CMB of the employee survey. The analysis revealed no CMB problem in the study, as the most significant variance explained for all constructs' items was 47 %, less than 50% (Podsakoff et al., 2003). Therefore, we concluded that no CMB issue was present in the study.

Hypotheses Testing

The findings presented in Table 3, Step 1, indicate that CSR significantly influences EECs (β = 0.306, p < 0.01) and EPPB (β=0.200, p < 0.01), thereby supporting H1 and H2, respectively. Based on the findings of H3 and H4, GOI positively impacts both EECs and EPPB. The results presented in Table 3 (Step 1) show that GOI significantly affects EECs (β = 0.471, p < 0.01) and EPPB (β = 0.236, p < 0.01), providing support for H3 and H4, respectively. The findings presented in Table 3 (Step 2) demonstrate that EECs significantly influence EPPB (β =0.326, p < 0.01). Therefore, H5 is supported. The results of the analysis, shown in Step 2 of Table 3, indicated a positive indirect effect of CSR (β = 0.100, p < 0.01) and GOI (β = 0.153, p < 0.01) on EPPB through EECs. Therefore, the findings fully supported both H6 and H7.

Table 3. The Results of Hypotheses

Variables	Environmental Concerns				Proactive Pro-Environmental Behavior							
	Direct Effect				Direct Effect				Indirect Effect			
	β	SE	Bootstrapping		β	SE	Bootstrapping		β	SE	Bootstrapping	
			Lower	Upper			Lower	Upper			Lower	Upper
Step 1												
Age	0.040	0.042	-0.041	0.122	0.030	0.050	-0.065	0.129				
Gender	-0.037	0.037	-0.109	0.036	-0.002	0.046	-0.109	0.089				
Education	-0.017	0.038	-0.091	0.057	0.130	0.050	0.031	0.226				
Tenure	-0.024	0.042	-0.104	0.060	-0.014	0.049	-0.111	0.082				
CSR	0.306**	0.037	0.231	0.375	0.200**	0.048	0.107	0.295				
GOI	0.471**	0.029	0.414	0.526	0.236**	0.060	0.119	0.354				
R^2	**0.420**				**0.140**							
Step 2												
Age	0.04	0.042	-0.041	0.123	0.016	0.049	-0.079	0.112	0.013	0.014	-0.011	0.046
Gender	-0.037	0.037	-0.109	0.037	0.01	0.045	-0.077	0.102	-0.012	0.013	-0.041	0.010
Education	-0.017	0.038	-0.091	0.058	0.136	0.048	0.041	0.229	-0.006	0.012	-0.030	0.019
Tenure	-0.024	0.042	-0.104	0.06	-0.006	0.049	-0.101	0.088	-0.008	0.014	-0.038	0.018
CSR	0.306**	0.037	0.232	0.375	0.101	0.058	-0.011	0.215	0.100**	0.024	0.058	0.152
GOI	0.471**	0.029	0.414	0.526	0.083	0.078	-0.063	0.240	0.153**	0.033	0.092	0.219
EECs					0.326**	0.067	0.191	0.452				
R^2	**0.420**				**0.200**							
Step 3												
Age	0.047	0.034	-0.021	0.114	0.016	0.049	-.0790	0.122	0.015	0.012	-0.006	0.041
Gender	-0.023	0.031	-0.081	0.038	0.010	0.045	-0.077	0.102	-0.007	0.010	-0.029	0.012
Education	0.001	0.032	-0.061	0.062	0.136	0.048	0.041	0.229	0.001	0.010	-0.020	0.022
Tenure	-0.022	0.034	-0.089	0.046	-0.006	0.049	-0.101	0.088	-0.007	0.012	-0.032	0.015
CSR	0.100**	0.039	0.020	0.176	0.101	0.058	-0.011	0.215	0.033*	0.015	0.006	0.063
GOI	0.284**	0.041	0.200	0.361	0.083	0.078	-0.063	0.240	0.092*	0.023	0.050	0.140
EECs					0.326**	0.067	0.191	0.452				
ESSL	0.569	0.044	0.487	0.659								
ESSL X CSR	0.137	0.031	0.077	0.198								
R^2	**0.630**				**0.200**							
Step 4												
Age	0.051	0.031	-0.009	0.112	0.016	0.049	-0.079	0.112	0.017	0.011	-0.003	0.041
Gender	-0.040	0.028	-0.094	0.015	0.010	0.045	-0.077	0.102	-0.013	0.010	-0.034	0.005
Education	0.022	0.029	-0.036	0.041	0.136	0.048	0.079	0.229	0.007	0.010	-0.011	0.028
Tenure	-0.025	0.032	-0.086	0.039	-0.006	0.049	-0.101	0.088	-0.008	0.011	-0.031	0.012
CSR	-0.007	0.035	-0.079	0.059	0.101	0.058	-0.011	0.215	-0.002	0.012	-0.026	0.020
GOI	0.453**	0.042	0.365	0.533	0.083	0.078	-0.063	0.240	0.148**	0.032	0.085	0.210
EECs					0.326	0.067	0.191	0.452				
ESSL	0.614**	0.037	0.543	0.690								
ESSL X GOI	0.316**	0.033	0.250	0.379								
R^2	**0.680**				**0.200**							
Step 5												
Age	0.040	0.042	-0.041	0.123	-0.017	0.047	-0.109	0.075	0.012	0.014	-0.012	0.043
Gender	-0.037	0.037	-0.109	0.037	-0.016	0.041	-0.096	0.067	-0.011	0.012	-0.038	0.011
Education	-0.017	0.038	-0.091	0.058	0.094	0.046	0.003	0.182	-0.005	0.012	-0.029	0.019
Tenure	-0.024	0.042	-0.104	0.060	-0.016	0.047	-0.107	0.075	-0.007	0.014	-0.036	0.018
CSR	0.306	0.037	0.232	0.375	0.072	0.057	-0.038	0.188	0.095	0.026	0.045	0.147
GOI	0.471	0.029	0.414	0.526	0.120	0.075	-0.023	0.271	0.146	0.038	0.071	0.218
EECs					0.309	0.047	0.151	0.458				
ESSL					0.057	0.078	-0.037	0.148				
ESSL x EECs					0.327	0.038	0.252	0.402				
R^2	**0.420**				**0.300**							

Notes: Corporate social responsibility = CSR, green organizational identity = GOI, environmentally specific servant leadership = ESSL, employee environmental concerns = EECs, employee proactive pro-environmental behaviour = EPPB, *= p<0.05, ** = p<0.01, N = 406

The finding revealed that the ESSL-CSR interaction (β = 0.137, p < 0.01; Figure 2), ESSL-GOI interaction (β = 0.316, p < 0.01; Figure 3), and ESSL-EECs interaction (β = 0.327, p < 0.01; Figure 4) are significantly positive, supporting H8, H9, and H10 respectively. The findings show that ESSL significantly moderated the indirect association between CSR and EPPB through EECs (H11, β = 0.095, p < 0.01), as well as the indirect relationship between GOI and EPPB via EECs (H12, β = 0.146, p < 0.01).

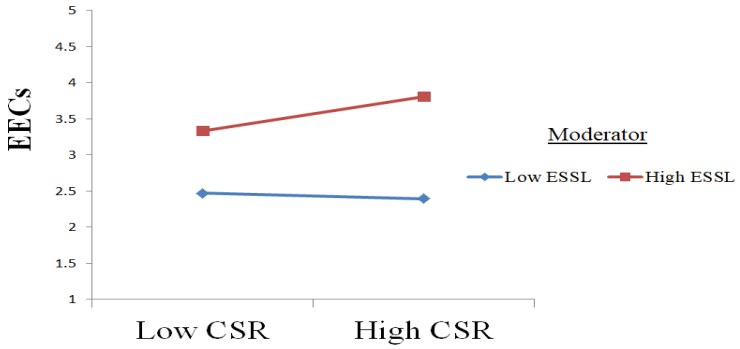


Figure 2. ESSL Moderates CSR-EECs Relationship

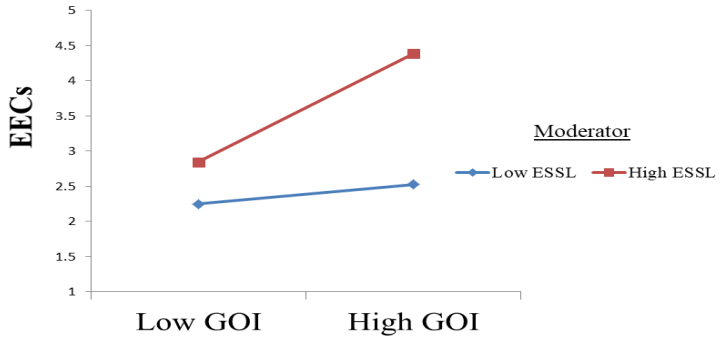


Figure 3. ESSL Moderates GOI-EECs Relationship

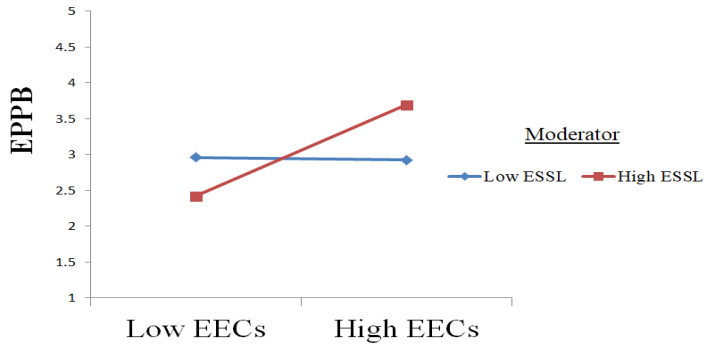


Figure 4. ESSL Moderates EECs-EPPB Relationship

DISCUSSION

Theoretical Contributions

The findings highlighted several novel theoretical contributions within the context of CSR, GOI, ECs, ESSL, and EPPB. First, the study asserts its pioneering contribution in unraveling the intricate dynamics of CSR and GOI, particularly in their influence on ECs and EPPB (Fatnassi et al., 2026; Ferdos et al., 2026; Khreis et al., 2025c). The study goes beyond previous research (Shiri & Jafari-Sadeghi, 2023; Zafar et al., 2023) that investigated the individual impacts of CSR and GOI on employee pro-environmental behaviors. This study delves deeper into the complex relationships between CSR and GOI and their joint effects on proactive environmental behaviors. Also, it offers a novel and more comprehensive understanding of how CSR and GOI shape ECs. Therefore, these findings enhance our knowledge of the intricate interactions and mechanisms underlying the effects of CSR and GOI on ECs and EPPB, providing valuable insights into the dynamics of sustainable behavior within organizations (Bissing-Olson et al., 2013; Durrah et al., 2026).

Second, the study fills a critical void in the literature by examining the mechanisms through which CSR and GOI impact EPPB via EECs. It advances our understanding of the underlying processes that explain how organizational factors (e.g., CSR and GOI; Nourafkan et al., 2024; Pham et al., 2023) influence EPPB (Bissing-Olson et al., 2013; Durrah et al., 2026). This theoretical contribution provides valuable insights into the pathways through which CSR and GOI translate into tangible environmental outcomes (Nourafkan et al., 2024; Shiri & Jafari-Sadeghi, 2023; Song et al., 2019), highlighting the

importance of fostering EECs as a mediating mechanism (Darvishmotevali & Altinay, 2022). Also, it provides further support for the tenets of the social identity theory (Tajfel et al., 1979) through the mediating role of ECCs in CSR and GOI's effects on pro-environmental behaviors. Previous research has focused on examining the relationship between CSR and task-related pro-environmental behaviors, mainly through the mediating mechanism of personal environmental norms (AlSuwaidi et al., 2021). Third, this study recognizes the importance of ESSL in influencing employees' pro-environmental behaviors. While previous research (Aboramadan et al., 2021; Javed et al., 2024) has highlighted its significance, no studies have examined its moderating role in the relationships between CSR and GOI with EPPB through EECs. The study applies social learning theory to explain how ESSL can moderate the relationship between pro-environmental organizational factors (CSR and GOI) and employees' pro-environmental tendencies and attitudes (EECs). It also found that ESSL, in collaboration with CSR and GOI, interacts with employees' EECs to encourage proactive engagement in pro-environmental behaviors. This research supports recent findings in the hospitality industry on the potential impact of ESSL in promoting environmentally responsible behaviors (Darvishmotevali & Altinay, 2022; Javed et al., 2024).

Finally, our study contributes to the literature on proactive employee behaviors (Abuelhassan & AlGassim, 2022) by providing empirical evidence for the flourishing of EPPB in the hospitality industry. We examine and evaluate the role of green-oriented organizations in promoting proactive individuals' green behaviors.

We also depict the roles of organizations and leaders in shaping employees' EECs to promote EPPB. Our research findings advance our understanding of the importance of all members of an organization, including policy-makers, leaders, and employees, in boosting EPPB by revealing causal relationships between them.

Managerial Contributions

The practical contributions of this research are relevant to organizations, experts, and policy-makers in the hospitality industry. First, the study recommends that policy-makers implement laws and regulations to promote and support environmental initiatives, including impact assessments and waste management systems, in the hospitality industries. Specifically, these could consist of technological standards for emissions and discharges and technological-specific standards for water, electrical, and thermal energy consumption. The study asserts that large industries' responsibility regarding environmental sustainability is more crucial than individuals' responsibility. In other words, at the management level, green strategies and practices could significantly impact the creation of a genuinely sustainable effort.

Promoting CSR and GOI through green consumerism and eco-friendly products will foster individual responsibility and encourage more efforts in environmental protection. For CSR, hospitality management should prioritize eco-friendly operations, community engagement, and ethical sourcing to enhance EECs and encourage EPPB. On the other hand, for GOI, hospitality management should focus on integrating sustainable practices, promoting environmental values within the organizational culture, and emphasizing sustainability in day-to-day operations to develop a strong GOI. This can create a sense of environmental concern among employees and motivate them to engage in environmentally proactive behaviors.

Second, the study highlights that EECs positively impact EPPB and act as a mediator between CSR and EPPB as well as between GOI and EPPB. Therefore, hospitality management needs to recognize the significance of EECs as a pathway through which CSR and GOI can influence EPPB. Organizations can enhance the impact of CSR and GOI initiatives on EPPB by strengthening EECs. For instance, hospitality management can implement strategies such as raising awareness, educating on environmental issues, offering training programs, organizing workshops, and sharing information on sustainable practices. These efforts can help employees develop a deeper understanding of environmental concerns and encourage them to adopt proactive pro-environmental behaviors. Also, we suggest that hotels integrate environmental concerns and values into employee selection, recruitment, performance evaluation, and motivation processes.

To promote pro-environmental behavior, employee recruitment and selection standards and job descriptions should emphasize the significance of environmental concerns and values. Intrinsic and extrinsic rewards can be essential tools to promote and incentivize employees' environmental concerns and values.

Finally, the research findings indicate that ESSL moderates the indirect relationships between CSR and PPB via EECs, and GOI and PPB via EECs. Therefore, hospitality management must recognize the importance of ESSL in shaping the relationships between organizational factors, EECs, and EPPB. Supporting and empowering ESSL can enhance the impact of CSR and GOI on employees' EECs and EPPB. Hospitality management should prioritize the development of ESSL skills among leaders in the hospitality industry. ESSL involves demonstrating environmental consciousness, providing support and resources for sustainable practices, and setting an example for employees.

By promoting ESSL, hospitality management can foster a culture of sustainability and encourage employees to engage in EPPB. For instance, hotels may prefer to promote employees with the same vision and values regarding environmental protection during the promotion process. By using promotion criteria, organizations can communicate the importance of environmental protection to prospective leaders, encouraging ESSL development.

CONCLUSION

Collectively, the findings support the notion that CSR, GOI, and EECs all play important, albeit complementary, roles in facilitating proactive pro-environmental behaviors in hospitality employees. By simultaneously rather than separately investigating CSR and GOI, this research offers a more complete understanding of how organizational values and identity impact individual-level green behaviors. The results also help to clarify the complex relationships between the dynamics of CSR and GOI that promote EECs, which in turn promote EPPB. Hence, the present study contributes to a more nuanced understanding of proactive environmental behavior in service contexts.

The results also underscore the importance of ESSL as a moderator variable that mediates the relationships between CSR, GOI, EECs, and EPPB. Environmentally focused leaders, in concert with green-oriented organizational practices, help foster powerful environmental cognitions, which, in turn, motivate hospitality employees to go beyond their prescribed job responsibilities and participate in voluntary pro-environmental behaviors.

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Conflicts of Interest: The author declares no conflict of interest.

Use of Generative AI: Not applicable.

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USABILITY EVALUATION OF A PERSONALIZED AUGMENTED REALITY APPLICATION FOR MUSEUM TOURISM: EVIDENCE FROM GENERATION Z VISITORS

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Abstract: This study aims to evaluate the usability of a personalized Augmented Reality (AR) application in a museum tourism context and to examine how such digital tools support Generation Z (Gen Z) visitors' interaction with cultural exhibits. Specifically, it seeks to assess whether personalized AR can deliver consistent and positive user experiences across different visitor groups. A personalized museum AR application, "Explore Muse", was developed and implemented in a museum setting. Usability evaluation was conducted using the System Usability Scale (SUS) with 52 Gen Z participants. Descriptive statistics, reliability analysis, and factorial ANOVA were employed to examine overall usability performance and the influence of demographic variables. The findings indicate that the personalized AR application demonstrates a good level of perceived usability among Gen Z visitors. Reliability analysis confirms the internal consistency of the usability measurement, supporting the robustness of the evaluation results. Further analysis reveals no significant differences in usability perceptions across demographic characteristics or prior AR experience, suggesting that the system delivers a stable and consistent user experience for diverse visitor groups. These results underscore the effectiveness of personalization in supporting inclusive and engaging digital interactions within museum tourism contexts. From a tourism and heritage management perspective, the findings provide empirical evidence supporting the integration of personalized AR technologies to enhance visitor engagement and experience quality in cultural tourism settings.

Keywords: Augmented Reality, museum tourism, visitor experience, usability evaluation, personalization, Generation Z

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INTRODUCTION

Museums play a central role in cultural tourism by functioning not only as repositories of heritage but also as key destinations for learning, interpretation, and experiential consumption. As important nodes of cultural communication and knowledge dissemination, museums are rich in historical content; however, traditional display media often struggle to meet the evolving experiential expectations of contemporary museum visitors (King et al., 2025). In response to broader shifts in smart tourism and visitor behavior, museums have increasingly turned to digital technologies to enhance cultural communication and enrich the quality of the visitor experience. Among these technologies, Augmented Reality (AR) has emerged as a prominent innovation in museum tourism and digital heritage interpretation (Cipparrone et al., 2025). AR technologies enable the overlay of digital content onto physical spaces, allowing museums to design interactive and immersive environments that transform visitors from passive observers into active participants (Hatami & Rashidi, 2025). Beyond improving access to cultural assets, AR facilitates digital reconstruction, simulated historical settings, and immersive storytelling, thereby strengthening interactive communication between museums and visitors (Kefi et al., 2024; Shu, 2025). As museums increasingly compete within the cultural tourism market, AR technologies are becoming strategic tools for improving visitor satisfaction, engagement, and overall experience quality.

Within diverse museum visitor groups, the Generation Z (Gen Z) who are born between the mid-1990s and early 2010s, exhibits obvious technological behavior and a high level of digital engagement expectations (Benítez-Márquez et al., 2022). As digital natives, Gen Z museum visitors value interactivity, personalization, and ease of use in technology-mediated experiences, and they tend to evaluate cultural offerings through both experiential and functional lenses (Chang & Chang, 2023; Peter et al., 2025). This specific profile gives both chances and difficulties to the museums that want to implement new technologies because they should go beyond being able to engage with visitors at a personal level, and need to ensure usability and visitor's long-term cultural engagement. In the context of smart tourism, these

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considerations are particularly critical in museum tourism settings, where visitor satisfaction and experience quality directly influence revisit intention and cultural value creation (Li et al., 2024; Pimentel et al., 2025).

Despite the growing body of research on AR applications in museums, empirical evidence examining how personalized AR applications support visitor engagement and experience remains limited. Existing studies have largely focused on technical development or conceptual discussions of AR's advantages, offering comparatively fewer insights into systematic approaches for evaluating design effectiveness and usability from a visitor-centered perspective (Dargan et al., 2023; Li et al., 2025). Moreover, while the System Usability Scale (SUS) is a well-established and widely validated instrument within Human-Computer Interaction (HCI) research, its systematic application in evaluating AR-based interpretive tools in museum tourism contexts remains underexplored (Genc et al., 2023; Graser et al., 2024). This gap highlights the need for empirical studies that bridge technological evaluation with museum tourism research.

In this context, the present study develops a personalized museum AR application, "Explore Muse", and evaluates its usability among Gen Z museum visitors, a key group within contemporary cultural tourism. By employing the SUS as a standardized assessment tool and examining the influence of demographic factors, the study aims to generate empirical insights into visitor interaction with personalized AR technologies and to assess the applicability of usability evaluation methods in museum tourism environments. Accordingly, the study addresses the following research questions (RQ):

- RQ1: How do Gen Z museum visitors perceive the overall usability of a personalized AR application in a museum tourism context?
- RQ2: To what extent does the SUS serve as an effective instrument for evaluating usability in interactive AR-based tourism settings?
- RQ3: Do usability evaluations differ significantly across visitor demographic characteristics?

Beyond addressing methodological gaps, this study contributes to museum tourism literature by providing empirical evidence on the usability of personalized AR applications and by enhancing understanding of how Gen Z visitors engage with digitally mediated cultural experiences. By combining standardized usability evaluation with demographic analysis, the study offers a replicable framework for assessing personalization digital tools in cultural tourism contexts (Mahajan & Taggar, 2025). From a practical perspective, the findings aim to inform museum managers and designers in developing AR experiences that are not only technologically functional but also meaningful, inclusive, and aligned with contemporary museum tourism strategies (Zhang et al., 2024).

LITERATURE REVIEW

AR Development in Museum Tourism

AR enables more interactive and immersive experiences because it provides viewers with superimposition of the virtual world on the real one (Arena et al., 2022). Nowadays, AR has found extensive application in the museum tourism to assist in preserving cultural heritage sustainably and communicating through the effective representation of cultural heritage (Logan, 2025) The more recent projects on AR use in museum tourism have touched upon its application in exhibits and interactive screens and cultural communications by use of various technologies that optimize the experience of the visitors (Hsieh et al., 2025; Khor & Mubin, 2024). These attempts are useful practical examples of the digital communication of museums and reflect the great potential of AR in the cultural interaction and engagement.

An example of this is (Ahmed et al., 2025) designed and planned a mobile application called MUSEON referring to the ontological theory of gamification learning, and tested the perception of 86 discriminatory visitors about the effectiveness of the MUSEON based on a 3-tiered evaluation model (M3). Gozali et al., 2024 developed a mobile application using Immersal software development kit (SDK), which helps users to use the surroundings of the Bandung Geological Museum. (Xu et al., 2024) presented two physical AR prototypes, which are meant to be used in the display of cultural objects, named Postcard AR and CubeMuseum AR, and conducted three user tests that helped to optimize the overall design quality. Another paper by (Jung et al., 2020) showed a VR/AR-powered visualization platform called JejuView that is intended to provide the visitors with an immersive and intuitive experience of the cultural heritage of the Jeju Island.

AR Usability Evaluation

In the ISO 9241-11 framework, the concept of usability is defined as the level of effectiveness, efficiency, and overall contentment with which the assigned users can complete certain tasks through the system (ISO, 1998). Usability testing is a methodology inherent in HCI research, and is mainly preoccupied with the degree to which the users can use and interact with a system (Nielsen, 2010). It points out the need to study real users since they perform real work to identify any problem of usability, determine their level of satisfaction and guide future design evolution (Meyer et al., 2021). The significance of usability testing in the context of AR research is supported by the extensive use of methods of this type over time, which streamlines the user-centered design and enhances the quality of the interaction in general (De Paolis et al., 2023).

In museum tourism settings, usability evaluation is essential in determining the role of AR technologies in helping visitors to engage in the situation, understand information, and experience interaction (Bekele et al., 2018). Standardized usability measurement tools have also been used in the past to assess usability and this includes the following: heuristic evaluation checklists (Nielsen, 1993), the System Usability Scale (Jordan et al., 1996), and the User Experience Questionnaire (UEQ) (Laugwitz et al., 2008). Although these methods have produced meaningful findings into the AR interface performance, most of the studies focus on overall users, ignoring the unique digital behaviors and user expectation of the Gen Z. As a result, the literature regarding the empirical studies of AR usability evaluation in museums is limited to be specific to Gen Z, which is a prime opportunity to be filled via further research.

Generation Z Visitor Engagement Studies

Gen Z visitors have grown up within digital environments, which shapes their expectations for interactivity, immersion, and personalized engagement when encountering cultural content (Onjewu et al., 2025). In response the new expectations, museums have increasingly introduced AR-based storytelling, interactive installations, and visually distinctive spaces designed to encourage social sharing and active participation, particularly among younger visitors (Diez, 2021).

These practices are not merely aesthetic enhancements; rather, they reflect a broader shift in museum tourism toward experience-oriented interpretation, where visitors co-construct meaning through digital interaction rather than passively consuming information (Zhu et al., 2025). Despite this growing adoption of AR-driven experiences, empirical research remains limited in explaining how such technologies shape Gen Z visitors' usability perceptions and subsequent engagement with museum tourism content. Existing studies have tended to emphasize technological affordances or experiential appeal, while paying comparatively less attention to how usability influences interaction quality, learning processes, and sustained cultural involvement among digitally native visitors (Škola et al., 2024).

Addressing this gap is critical for aligning AR innovation with visitor-centered museum tourism strategies. Accordingly, further empirical research is needed to systematically examine the relationship between AR usability, Gen Z visitor responses, and cultural engagement within museum tourism settings (Hwang et al., 2024; Singh & Ahmad, 2024).

MATERIALS AND METHODS

Research Design

This study develops a virtual AR application named "Explore Muse" to create 3D artifacts animation through Unity with C# programming language. The main design idea is to transform traditional museum visits into self-directed journeys, which enables users to explore digital artifacts overlaid on the physical environment through their smartphone cameras.

It is compatible with Android devices which have OS version 7.0 (API Level 24) or above, and includes AR Foundation and Vuforia SDK to enable marker-based tracking, real-time rendering, and touch to AR response (Linowes & Babilinski, 2017). The AR portal is based on a looped workflow consisting of: (1) camera initialization, (2) marker detection, (3) target-image matching, (4) 3D model rendering, and (5) continuous tracking and it repeats itself until the user leaves the session. As illustrated in Figure 1, when any target is identified, the system triggers real time rendering and constant tracking, which means that the virtual objects can be maintained in visual consistency and live responsive as the user renders his device. This AR application aims to provide a fast and dependable user experience by reducing latency and jitter causes by being lightweight on asset management, and dynamically modulating performance. Subsequently, this study adopts a quantitative cross-sectional design to evaluate the usability of the "Explore Muse" among Gen Z visitors at the Yanshi museum in China. The study design is a mixture of structured usability testing with post-experience surveys of SUS, which would be followed by reliability testing and a factorial ANOVA (Barnum, 2021). After the AR app is developed, there is a one-group post-test study where the subjects go through the "Explore Muse", followed by a standardized SUS questionnaire. Based on a previous study that uses the SUS scale, a target population size of 50 will be selected to provide adequate statistical power to perform a descriptive and inductive analysis (Lacoche et al., 2022). The objective of this design aims to collect direct user perceptions of the AR application's usability without the influence of a control group or pre-test bias.

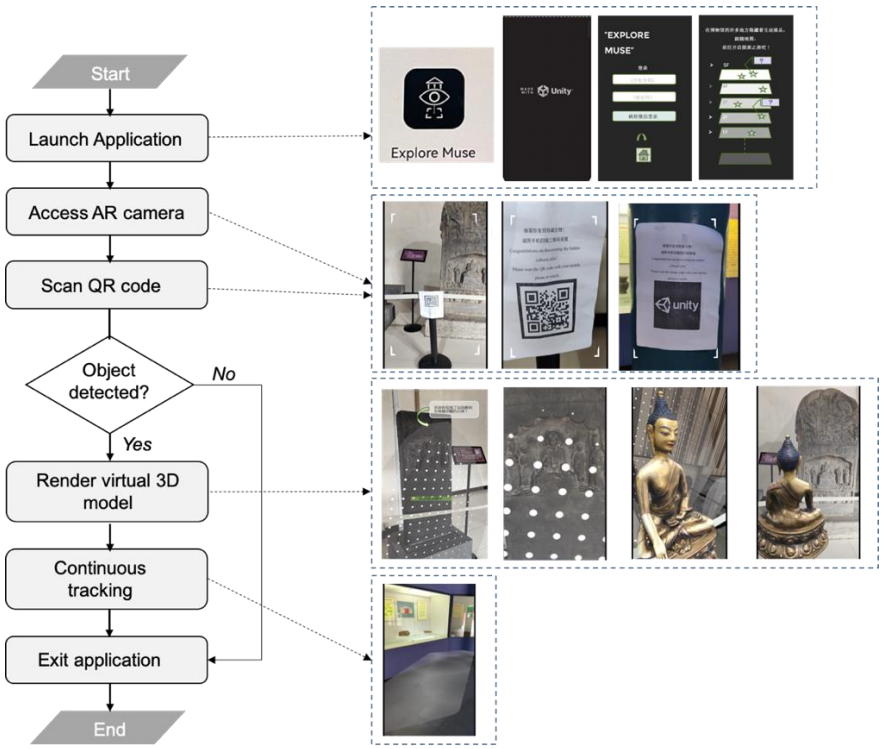


Figure 1. Flow chart of AR portal and usage demonstration (Source: Authors' own work)

Participants

The target participants in this study are members of Gen Z who belong to the cohort born roughly from 1995 to 2010. Participants are randomly recruited from a sampling pool that integrated both online and offline channels, including university forums, social media platforms (e.g., WeChat and QQ), and onsite promotion during visits to the Yanshi Museum in China. The inclusion criteria required participants to be between 15 and 30 years old and have basic proficiency in smartphone usage. Additionally, the sample selection is balanced in terms of gender and educational background to reflect the diversity of Gen Z. Prior experience to AR technology is recorded for reference but is not a requirement for participation. This sampling strategy ensured that participants are representative of typical Gen Z museum visitors, making the results more reliable and meaningful for understanding emerging generation visitors usability perceptions of AR technologies.

Instrument

This study uses the standardized SUS questionnaire as the primary tool for usability testing. The questionnaire is divided into two sections. The first section consists of ten SUS items rated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) (Likert, 1932). Odd-numbered items express positive statements about the AR application, whereas even-numbered items are negatively worded. The second section collects demographic information, including participants' age, gender, education level, and prior experience with AR. These data are used to contextualize the SUS results and to examine whether individual characteristics influence perceived usability. Each response is scored using the conventional SUS calculation method (Brooke, 1996), as shown in following Equation 1.

$$\text{SUS Score} = 2.5 * \{ \sum(5 - P) + \sum(N - 1) \} \quad (1)$$

Where P = positive statement score, N = negative statement score.

In the case of positively expressed statements, the determination of each item score is in the form of subtracting 1 of the rating chosen. The value of negatively phrased statements is determined by subtraction of the selected rating and 5. A sum of item scores divided by 2.5 is used to get the total score and the final value is obtained as the multiplication of the result by 2.5 a final SUS value. The score less than 50 means there is a bad system usability and is usually unacceptable. The values between 50 and 70 will be moderate usability whereas the values over the 70 will be good usability with a higher value indicating greater perceived ease of use (Orfanou et al., 2015).

Data Collection and Analysis

Before the experiment, all eligible participants were provided with an ethical statement and signed consent form to ensure voluntary participation and confidentiality. Participants were then invited to install the "Explore Muse" AR application on their mobile phone. Subsequently, they were encouraged to freely explore the AR content for approximately 10-15 minutes, allowing for a natural and self-directed journey. Upon completing the exploration, participants are invited to completed an online questionnaire via Wen Juanxing, a widely used online survey platform in China. During the session, researchers remained available to assist with technical issues and provide non-intrusive support without influencing participants' responses. After completing the survey, participants were thanked for their contribution, marking the end of the testing session. All collected data are exported to Microsoft Excel for preliminary cleaning, including the removal of incomplete or invalid responses. Four approaches of data analysis are performed: (1) Descriptive statistics. The central tendency (mean) and Standard Deviation (SD) analyses are computed mainly using Statistical Package for the Social Sciences (SPSS) software 31.0. (2) SUS scores are calculated according to standard method, resulting in usability scores ranging from 0 to 100. (3) To assess the internal consistency of SUS items, Cronbach's alpha (Cronbach's α) is computed using Python. (4) A factorial ANOVA is conducted in SPSS software 31.0 to examine whether participants' demographic variables had significant effects on usability score.

All four variables are treated as between-subjects factors, and interaction effects are included in the model. A significance threshold of $p < .05$ is applied for all statistical tests (Lacoche et al., 2022).

Table 1. Demographic information of Gen Z participants (Source: Authors' own work)

Demographic Variable		Number (n)	Percentage (%)
Gender	Male	25	48.08
	Female	27	51.92
Age	15-18 years old	4	7.69
	19-25 years old	24	46.15
	26-30 years old	24	46.15
Education Level	High school education or below	4	7.69
	College or bachelor's degree	25	48.08
	Master's degree	19	36.54
	Doctoral degree	4	7.69
Prior AR experience	Have used	30	57.69
	Not used	22	42.31

RESULTS AND DISCUSSION

Demographic Descriptive Statistics

A total of 60 participants completed the survey, of which 52 valid responses were retained after excluding invalid questionnaires. As shown in Table 1, among the 52 Gen Z participants, 48.08% identified as male (n = 25) and 51.92%

as female (n = 27). The majority were between the ages of 19 and 30. Specifically, 7.69% were aged 15-18 (n = 4), 46.15% were aged 19-25 (n = 24), and another 46.15% were aged 26-30 (n = 24). The average age of all participants was approximately 24.35 years with a standard deviation of 3.66 (SD = 3.66), suggesting a relatively moderate variation in age distribution and indicating a representative sample of Gen Z visitors. Regarding educational level variable, 7.69% had a high school education or below (n = 4), 48.08% hold a college or bachelor's degree (n = 25), 36.54% hold a master's degree (n = 19), and 7.69% hold a doctoral degree (n = 4). In addition, 57.69% participants (n = 30) have used AR applications before, 42.31% participants (n = 22) have not used any AR applications before this survey. The demographic distribution of participants are illustrated in Figure 2. Those demographic characteristics indicate that the sample was diverse in terms of gender, age, education level, and prior AR experience, providing a balanced foundation for subsequent analyses.

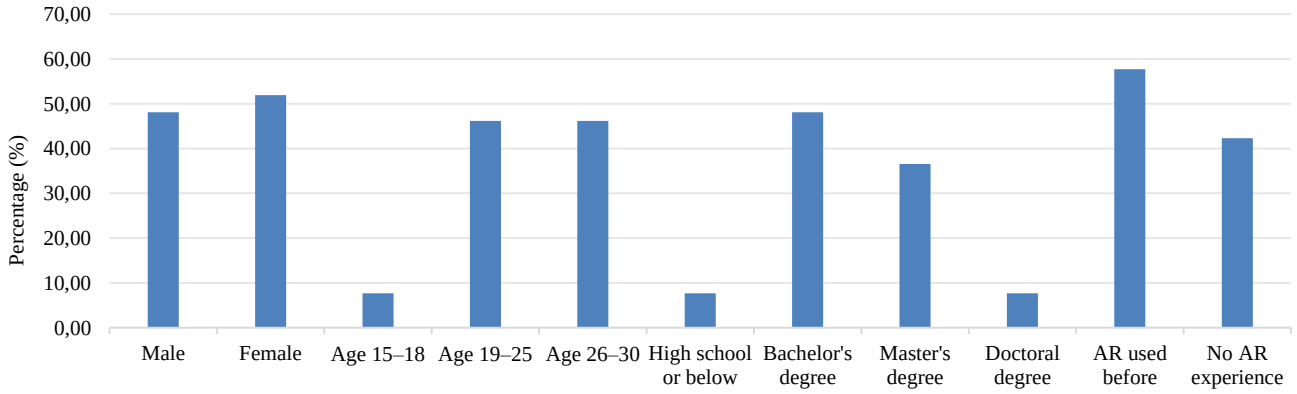


Figure 2. Demographic distribution of 52 participants (Source: Authors' own work)

SUS Score Analysis

As shown in Table 2, The total SUS score reached 3707.5, with an average score of 71.30. According to established SUS interpretation benchmarks, a score above 70 generally indicates acceptable usability and is considered "good" in terms of user experience (Bangor et al., 2008). This suggests that Gen Z participants perceived the application system as usable and functionally coherent. The standard deviation of SUS scores was 10.10, indicating a moderate level of variability in participants responses. While the average usability score suggested a generally positive perception, the distribution of scores reflects a degree of subtle inconsistency among 52 participants. As illustrated in Figure 3, the majority of scores fell between 60 and 80, with a peak around the mean value of 71.30. The distribution closely resembles a normal curve, indicating consistent usability perceptions across overall users. The red dashed line represents the overall mean, suggesting that most users rated the system within the "acceptable" to "good" usability range according to standard SUS interpretation benchmarks.

Table 2. Overall SUS scores analysis (Source: Authors' own work)

Participant Number	SUS Score	Mean	SD	Category
1-5	62.5/67.5/67.5/75/60	66.5	5.76	Acceptable
6-10	55/80/62.5/65/75	67.5	10	Acceptable
11-15	80/55/72.5/62.5/85	71	12.33	Good
16-20	82.5/55/67.5/65/55	65	11.32	Acceptable
21-25	67.5/67.5/75/67.5/55	66.5	7.20	Acceptable
26-30	52.5/55/57.5/60/60	57	3.26	Acceptable
31-35	85/80/82.5/75/82.5	81	3.79	Good
36-40	80/72.5/70/75/72.5	74	3.79	Good
41-45	80/82.5/82.5/80/72.5	79.5	4.11	Good
46-50	82.5/80/80/75/80	79.5	2.74	Good
51-52	87.5/82.5	85	3.54	Excellent
Average Score in Usability Testing		71.30		Good
Standard Deviation		10.10		variability

Table 3. Internal consistency and reliability test result (Source: Authors' own work)

SUS Item	CITC	Cronbach's α if Item Deleted	Cronbach's α	SUS Item	CITC	Cronbach's α if Item Deleted	Cronbach's α
1	0.481	0.718	0.749	6	0.424	0.727	0.749
2	0.694	0.692		7	0.445	0.724	
3	0.144	0.773		8	0.434	0.727	
4	0.396	0.731		9	0.396	0.731	
5	0.422	0.727		10	0.37	0.735	

Internal Consistency and Reliability Test

To assess the internal consistency and reliability of the SUS questionnaire, Cronbach's α was calculated. As shown in Table 3, the resulting reliability coefficient was 0.749, which is above the commonly accepted threshold of 0.7, indicating that the SUS evaluation instrument in this study has acceptable reliability and good internal consistency (DeVellis & Thorpe, 2022). The result supporting its suitability for further data analysis.

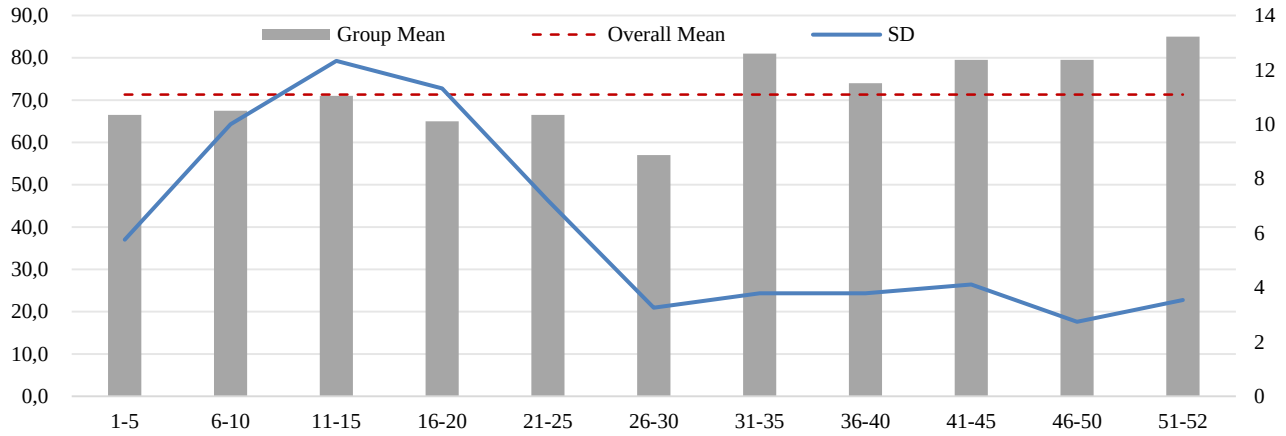


Figure 3. Distribution of SUS score among 52 participants (Source: Authors' own work)

The Corrected Item-Total Correlation (CITC) analysis further supported the reliability of the instrument, with most items showing moderate to strong correlations with the overall SUS score (ranging from 0.37 to 0.69). Among them, Items 2, 5, 6, and 7 exhibited particularly robust correlations (CITC > 0.40), indicating that participants' responses were generally coherent and consistent across different usability dimensions (Nunnally & Bernstein, 2010).

Demographic Variables Factorial ANOVA

A factorial ANOVA was conducted to examine whether gender, age, education, and prior AR experience had significant effects on perceived usability scores, as measured by the SUS scale. The analysis included both main effects and two-way interaction effects among the four demographic variables. As shown in Table 4, the results of the main effects are summarized as follows: (1) Gender, $F(1, 34) = 0.049$, $p = 0.826$; (2) Age, $F(1, 34) = 0.504$, $p = 0.483$; (3) Education, $F(1, 34) = 0.222$, $p = 0.802$; (4) Prior AR experience, $F(1, 34) = 0.125$, $p = 0.726$. Additionally, the model explained approximately 22.0% of the variance in SUS scores, suggesting that demographic attributes such as gender, age, educational level, and prior AR experience contributed marginally to variations in usability perceptions.

Similarly, the interaction terms showed no notable variations across conditions (all $p > 0.05$), indicating that the combined effects among these factors were limited in shaping usability ratings. These results demonstrated that Gen Z participants across different demographic profiles evaluated the AR application in a relatively consistent manner.

Table 4. Tests of demographic variables and between-subjects effects (Source: Authors' own work)

Source	Type III Sum of Squares	*df*	Mean Square	F	Sig.
Gender	5.842	1	5.842	0.049	0.826
Age	60.233	1	60.233	0.504	0.483
Education	53.138	2	26.569	0.222	0.802
AR_Experience	14.921	1	14.921	0.125	0.726
Interaction Effects Test					
Gender * Age	75.630	1	75.630	0.633	0.432
Gender * Education	91.629	1	91.629	0.767	0.387
Gender * AR_Experience	48.481	1	48.481	0.406	0.528
Age * Education	96.004	1	96.004	0.804	0.376
Age * AR_Experience	39.880	1	39.880	0.334	0.567
Education * AR_Experience	284.527	1	284.527	2.382	0.132
Gender * Age * Education	11.208	1	11.208	0.094	0.761
Gender * Age * AR_Experience	3.604	1	3.604	0.030	0.863
Gender * Education * AR_Experience	3.500	1	3.500	0.029	0.865
Age * Education * AR_Experience	7.607	1	7.607	0.064	0.802
Gender * Age * Education * AR_Experience	0.000	0			
Error	4061.771	34	119.464		
Total	269543.750	52			

DISCUSSION

In response to RQ1, the findings indicate that Gen Z visitors generally perceive the personalized AR application as usable and supportive of their museum visit experience. The average SUS score of the 52 participants was 71.30 that falls within the standard interpretation rule of being considered as "Good" level. Most of the scores were in the range of 60-80 with the highest point in the range of 71.30. The curve is highly similar to a normal curve meaning that the results were consistently done with equal perspectives of usability by the participants. The overall usability evaluation suggests that "Explore Muse" functions as an accessible and intuitive interpretive tool, enabling visitors to engage with cultural content without cognitive or operational barriers. The relatively concentrated distribution of usability perceptions further indicates that visitors shared comparable experiences when interacting with the application, reflecting a stable level of interaction quality across the sample. Consistent with prior museum tourism research, these findings indicate that

usability is closely linked to visitors' sense of involvement and perceived cultural engagement when digital technologies are embedded into exhibition environments (Pentescu, 2023). Regarding RQ2, the results demonstrate that a standardized usability evaluation approach can effectively capture visitor interaction quality in AR-based museum environments. The internal consistency resulted in Cronbach 0.749 level, which showed that the SUS scale is acceptable. Most of the items were found to have moderate to strong correlations with the overall SUS score (all between 0.37 and 0.69), as the values reported by CITC. Echoing previous findings (DeVellis & Thorpe, 2022; Deshmukh & Chalmeta, 2024; Ntoa, 2024), the internal consistency of the usability assessment indicates that visitors responded coherently across different dimensions of system interaction, such as learnability, efficiency, and confidence during use. This consistency suggests that usability perceptions among museum visitors are not fragmented impressions, but rather reflect an integrated evaluation of their overall experience with the digital interpretive tool. From a museum tourism perspective, these findings are particularly relevant because they show that usability evaluation instruments originally developed in HCI research can be meaningfully applied to cultural and tourism settings.

When adapted to interpretive technologies, such tools offer a structured way to assess how visitors experience digital mediation during their visits. This contributes to bridging the methodological gap between technical evaluation and experiential assessment in museum tourism research, where systematic evaluation of digital tools remains relatively limited.

With respect to RQ3, the absence of significant differences in usability perceptions across demographic variables suggests that the personalized AR application delivered a relatively homogeneous experience among Gen Z visitors. Factors such as gender ($F(1, 44) = 0.45$, $p = 0.507$), age ($F(2, 44) = 0.38$, $p = 0.685$), educational level ($F(2, 44) = 0.54$, $p = 0.588$), and prior AR experience ($F(1, 44) = 0.07$, $p = 0.791$) did not substantially influence how visitors evaluated the AR system. This finding implies that personalization within the AR application may have mitigated potential disparities in digital familiarity or prior exposure, resulting in a more inclusive and balanced visitor experience. These results align with earlier studies in immersive digital media and tourism contexts, which similarly reported limited demographic effects on perceived usability and experience quality (Othman et al., 2022; Mohamad Rosman et al., 2023). From a museum tourism management perspective, this suggests that well-designed personalized AR applications can support equitable access to digital interpretation, reducing the risk of excluding certain visitor segments. Such inclusivity is particularly important for museums seeking to engage younger visitors while maintaining broad accessibility and experience consistency.

CONCLUSION

This study examined the usability of a personalized AR application within a museum tourism context, with a specific focus on Gen Z visitors. By developing and empirically evaluating the "Explore Muse" application, the research contributes to a growing body of literature exploring how digital interpretation tools shape visitor experiences in contemporary museums (Almashyakhi, 2022; Trivedi, 2024; Schapsis et al., 2025). The findings indicate that personalized AR applications can deliver consistently positive usability experiences among Gen Z visitors, regardless of demographic characteristics or prior exposure to AR technology. This suggests that usability perceptions within this digitally native generation tend to be relatively homogeneous, highlighting the potential of personalization to support inclusive and accessible digital experiences in museum tourism settings (Tang & Zhou, 2025). Rather than acting as a technical constraint, usability functions as an enabling condition that allows visitors to engage more meaningfully with cultural content. From a methodological perspective, the study demonstrates the applicability of standardized usability evaluation approaches in museum tourism research.

By combining the System Usability Scale with demographic analysis, the research offers a replicable framework for assessing visitor interaction quality with AR-based interpretive tools. This approach extends traditional usability testing into three-dimensional cultural environments and provides empirical grounding for evaluating digital heritage applications beyond purely technical performance (Zhang et al., 2024). The study also carries practical implications for museum managers and designers. The results emphasize that effective AR implementation should prioritize usability and personalization as core design principles, particularly when targeting younger visitor segments. Well-designed AR systems can support engagement without creating digital barriers, thereby enhancing overall visitor experience quality and contributing to sustainable museum tourism development (Mahajan & Taggar, 2025). Despite these contributions, the study is subject to certain limitations. The sample size and focus on a single generational group may limit the generalizability of the findings.

Future research should extend the analysis to broader visitor segments and employ multi-method evaluation approaches, combining standardized usability measures with behavioral or qualitative data to capture more nuanced interaction processes.

Further studies could also examine how advanced AR features (e.g., personalization, gamification, or multimodal interaction) influence visitor engagement and usability, as well as explore longitudinal effects of AR use on learning and sustained cultural interest (Cheng et al., 2025). Such efforts would deepen understanding of how AR technologies can be sustainably integrated into museum tourism and cultural heritage interpretation.

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Glossary

AR – Augmented Reality; Gen Z – Generation Z; SUS – System Usability Scale; HCI – Human-Computer Interaction; RQ – Research Questions; M3 – 3-tiered evaluation model; SDK – Software Development Kit; VR – Virtual Reality; ISO – International Organization for Standardization; UEQ – User Experience Questionnaire; 3D – Three-Dimensional; OS – Operating System; API – Application Programming Interface; ANOVA – Analysis of Variance; SD – Standard Deviation; SPSS – Statistical Package for the Social Sciences; CITC – Corrected Item-Total Correlation.

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LEVERAGING AI AND USER-GENERATED CONTENT IN SPORT TOURISM: HOW ENGAGEMENT AND FAMILIARITY DRIVE PURCHASE INTENT FOR FOOD BRANDS IN EMERGING MARKETS

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Abstract: This study investigates the complex role of Artificial Intelligence (AI) and User-Generated Content (UGC) in enhancing Online Brand Equity (OBE) within the food industry, focusing on the emerging sport tourism markets of Saudi Arabia and Egypt. It specifically explores how AI-driven digital environments and word-of-mouth reshape brand loyalty among fans and tourists during major global sporting events. Employing a quantitative research design, the study utilizes a primary dataset collected via questionnaires from 606 consumers across both countries. The participants were specifically screened to include consumers who actively follow or participate in sport tourism activities, ensuring the data reflects the intersection of sports travel and food brand consumption. The theoretical model posits Brand Familiarity as a moderating variable and Consumer Engagement as a mediating variable, with data analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). Results and Discussions: The findings validate that UGC is pivotal in strengthening OBE, with a marginally stronger effect in Egypt compared to Saudi Arabia. Notably, Consumer Engagement mediated the relationship between brand promotion and OBE differently in each country: Saudi consumers favored low-engagement, brand-initiated promotions, while engagement fully mediated the effect in Egypt. In both contexts, Brand Familiarity acted as a psychological anchor, reinforcing trust when fans seek familiar food brands like 'Blabn' or 'Baheeg' during sporting events. This research contributes actionable insights for food industry marketers by providing a robust, comparative model for leveraging UGC in emerging tourism markets. It highlights the necessity of tailoring engagement strategies based on specific cultural preferences and the regional sport tourism calendar. The study proves that while digital tools are global, the psychological path to loyalty varies significantly across borders. Marketers are encouraged to launch UGC-driven campaigns during major events to convert spectator enthusiasm into sustainable brand advocacy.

Keywords: Emerging Tourism Markets, User-Generated Content (UGC), Online Brand Advocacy (OBA), Customer Engagement, Brand Familiarity, Online Brand Equity (OBE)

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INTRODUCTION

User-generated content (UGC) is recognized today as one of the most potent sources that influence and even transform consumers' brand perception, sentiment, and behaviors in online social contexts. For instance, a few studies underlined the significant influence of such content on consumers' buying decisions in the realm of experience-driven industries, especially the food sector, where the power of online reviews, star ratings, and people's sharing their eating experiences is immense in attracting new customers (Wilk, 2020). With the changing face of digital communication, consumers are no longer a passive group getting fed with information by a brand; they even create and share content themselves which not only changes the image of the brand but also affects consumer preferences and the extent of their brand loyalty.

Therefore, by functioning as a medium for expression and freedom of opinion, user-generated content opens the door to individuals going one step further than being consumers and becoming content co-creators (Gandhi & Ubba, 2025). Thus,

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TripAdvisor is one of the platforms which promotes this idea by providing a virtual environment where users may display their skills, accumulate social capital, and be part of communities of people who share their interests (Mathew, 2021). In other words, UGC is not only a means to obtain information but also a channel through which people are able to create socially acceptable online identity, therefore, self-presentation turns out to be the main reason for posting content (Scholz et al., 2019).

Besides these changes in behavior, the way we experience digital content has been radically altered, especially in the aftermath of the COVID-19 pandemic. Through the increased closeness of different groups and communities, reliance on online channels was greatly stimulated, particularly, the majority of networks to which content is accessed are through mobile phones (Wilk, 2019). On top of that, this phenomenon is clearly visible in the case of Egypt and Saudi Arabia, the pace of digital adoption is so fast here that it surpasses many other countries. In Egypt, it is estimated that mobile users account for almost 110 million, alongside 96.3 million internet users and close to 50 million social media users. On the hand, Saudi Arabia recorded around 48.1 million mobile subscriptions, 33.9 million internet users, and 34.1 million active social media users (González-Rodríguez et al., 2021). Such statistics not only confirm how digital platforms have become an integral part of people's daily lives but also UGC is the key driver of brand-marketing and communication in both of these markets (Rezaee, 2023). In the specific context of Sport Tourism, this digital adoption plays a crucial role. As Egypt and Saudi Arabia host major global sporting events, tourists rely heavily on UGC to discover food brands that align with their event experiences. This makes the food sector an integral part of the sport tourism ecosystem in these emerging markets.

LITERATURE REVIEW

1. User-Generated Content (UGC)

Social media and digital platforms have revolutionized the interaction of brands with people in Egypt and Saudi Arabia. Egyptian brands mainly use Facebook and Instagram for their interaction with the audience. While in Saudi Arabia, Twitter and Snapchat are the top-most communicative channels. Citizens of both countries are very much inclined towards sharing their experiences on the internet in the form of ratings, recommendations, or reviews, and this has had a significant impact on their perception of brands (Burmann & Zeplin, 2005; Alalwan et al., 2017). One of the main factors which has led to a significant increase in the creation and sharing of user-generated content is the highly interactive environment on social media, throughout which people spread their content, i.e. reviews and comments describing their experiences with specific products or even giving general information about them (Roma & Aloini, 2019).

There coexist many different platforms, each with their separate nature, and the companies are going through various strategies to figure out the best way to utilise this content. This phenomenon can especially be largely seen when the case of discussion is open social media platforms like X, which used to be called Twitter (Rezaee, 2023; Guillen et al., 2025). In the same manner, on closed or semi-closed social media networks, for instance, private Facebook groups or WeChat in China, marketers should concentrate on personal relationships which are formed in these virtual worlds, as stated in the research by (Wijaya et al., 2023). This condition is very significant in Egypt, where consumers are heavily dependent on digital content for their buying decisions. As a result, with social media and review platforms becoming pervasive, brands that are operating in Egypt need to be conscious of this issue and give it their proper attention (Roma & Aloini, 2019). The significance of user-generated content in influencing the views is obvious, and by its nature, it has a major influence on more extreme behaviors, such as being a brand advocate online.

2. Online Brand Advocacy (OBA)

In Egypt, the brand trust that customers have is the main factor that influences how much the customers will support the brand. Also, online word-of-mouth (eWOM) and reviews are the most influential channels for the brand's reputation (Wilk et al., 2019; Hutzinger, 2021). The case in Saudi Arabia is a bit different; there, support is more strongly associated with the brand's prestige and rarity, which, in turn, leads to the creation of a different kind of relationship. In both areas, people are inclined to react positively to authentic and genuine content, particularly when it is their social and cultural values that are being mirrored (Aljarah et al., 2024). According to social exchange theory, the relationship with consumers is created by companies through social interaction, where consumers give to brands good feedback and support in return for a feeling of being valued, emotional satisfaction, or gratitude (Acharya, 2020). The rise in digital communities in Egypt has made online brand endorsement a key factor as Egyptian consumers have become more engaged in discussions, writing reviews, and giving recommendations that help the decision of buying (Wijaya et al., 2023).

3. Customer Engagement (CE)

Basically, customer engagement is the mental condition when a customer mentally, physically, or emotionally interacts with the brand and co-experiences the activities with the brand (Wijaya et al., 2023) Such interaction tremendously influences people's perception of the brand, their trust in it, and hence, their loyalty over time (Liao et al., 2024; Colicev et al., 2019). A few days ago, it was recognized that customer engagement is not only one kind of behavior but rather the combination of actions, thoughts, and feelings of the customer towards the brand (Kim et al., 2012; Kar et al., 2024).

To companies, it is crucial to develop a strong connection with their customers, as this deepens brand loyalty and makes people more likely to interact with the brand. Engaged customers are also very supportive and even become online brand advocates; thus, they contribute to the increase of the brand's value. In a market like Egypt, where the brand reputation largely depends on digital interaction among consumers, the influence of customer engagement on user-generated content and brand advocacy is still a vital and fascinating issue (Liao et al., 2024; Colicev et al., 2019).

Establishing a strong relationship with customers is a must-have for companies, especially with the proliferation of mobile-first platforms and the increase in influencer marketing campaigns in Saudi Arabia. Such campaigns are designed to establish genuinely engaging and valuable relationships between people and brands (Aljarah et al., 2024). In this sense, engagement serves as a link that connects the content with customer feedback. Hence, it is very important to figure out the impact of customers' previous knowledge about the brand on their trust and brand loyalty (Kim et al., 2022; Sutiadiningsih et al., 2024).

4. Brand Familiarity (BF)

Visibility and familiarity are the two aspects that mostly affect brand familiarity, which in turn lead to trust of the brand and the willingness to be its advocate. Namely, in Egypt and Saudi Arabia, familiarity is very much dependent on visibility (Agina et al., 2025) In Egypt, brands that are rooted deep and have a local heritage are the ones that get more familiarity, recognition, and even visibility. As an example, Baheeg and Laban brands have evolved and become so popular that many people now know and trust them. In Saudi Arabia, the old and well-established brands employ recognition and visibility to gain familiarity. When the brands start using influencer advertising to connect with the consumers, then trust gets built, which is why they are increasing consumer interaction and engagement (Goh, et al., 2013; AlRahman, 2025). Brand familiarity comes from the consumers' past experiences with a brand, the ads they have seen, or their interactions with it. It is a measure of how much a consumer knows, recognizes, or remembers a brand Familiarity is one of the main factors that influence consumers' choices (Al Zein et al., 2025). It lowers a consumer's perceived risk, views the brand with greater trustworthiness, and enhances trust in the brand (Kim et al., 2022). Schema theory explains the cognitive methods that consumers employ for encoding and recalling memories related to brands. These frameworks influence and shape consumer preferences, attitudes, decision-making, and loyalty (Aljarah et al., 2024). Within Sport Tourism, Brand Familiarity acts as a psychological anchor. Fans visiting for events often seek food brands they 'know' through social media to reduce perceived travel risks. Schema theory suggests that seeing a familiar brand like 'Blabn' or 'Baheeg' in a sporting context reinforces the consumer's trust and enhances their willingness to engage and advocate for the brand online. In the Egyptian market, competing firms are equally consistent and purposeful with user-generated content, cultivating the kind of brand loyalty that starts with familiarity and progresses to trust and advocacy, thereby enhancing market share and loyalty.

5. The impact of user-generated content (UGC) information dimensions and online brand advocacy

Normative According to (Hermanto et al., 2023), user-generated content (UGC) mirrors the opinions and views of former customers. Favorability is one of the most commonly described representation techniques in the normative dimension and can be calculated in terms of the likes and dislikes of a given product. Successful branding of a company on social media hinges on the positivity of comments and feedback a consumer provides (Goh et al., 2013). Trust in a brand and positive user-generated content (UGC) improve social media branding (Makrides, 2019).

Favorability is the social standing of a product or service offered within a peer group (Li, 2020). We recommend that you carry out the following operations: Online user reviews are considered a prominent signal of valuable user-generated content (UGC) by (Hermanto et al., 2023). The user-generated content (UGC) pieces have a massive influence on the view of potential buyers (Lu, 2014). A body of research in the eWOM area reveals that informational text attributes, that is, length, subjectivity, readability, and the emotional tone (positive or negative), can be used as the main characteristics for evaluating the quality of the information (Zhao et al., 2022). Negative reviews may elevate the level of uncertainty and the feeling of risk associated with making purchases online. This is because consumers, according to the negativity bias, tend to consider unfavorable information more than positive ones (Labrecque et al., 2022).

The research supporting this notion, indicates that shorter or more vague messages are usually regarded as less persuasive and of lower quality, whereas longer and more detailed texts help to dispel ambiguity and bolster the confidence in the decision-making process (Bevan et al., 2020). Purely subjectively oriented statements based only on personal preferences may look as if the communicators are concealing something from the consumers, thus leading to a decrease in credibility and trust (Scholz et al., 2019; Yu et al., 2021). Additionally, research concerned with how easily messages can be read indicates that extensively complicated materials might give a sense of higher authority; however, at the same time, they can lower the practical use of the materials and negatively impact product sales (Shen, 2022). Besides content characteristics, peer interactions have a decisive influence on the formation of consumer demand as well; for instance, on a platform like YouTube, users can get close to their peers through interactive communication and the comments (Kim, 2010). The first of these findings to be underlined is that both the quality and social aspect of UGC have the most considerable impact on consumer trust and their choice of buying.

6 .UGC and online brand advocacy and customer engagement:

Previous research has been studied cognitive consistency theory. The theory of cognitive consistency also postulates that customers, when they are subjected to psychological pain seek the harmony between their thoughts and their behavior and try to avoid the dissonance cognitive (Donsbach, 2008). Therefore, if a customer notices good while others are bad in accompanying (e.g., customer involvement), he or she will be more likely to do, other compatible actions with his or her beliefs, attitudes and behaviours (e.g., online brand advocacy) (Aljarah et al., 2024).

Theoretically, data support this position. (Samala & Singh, 2019) found in their study that customers who engage with a brand are more likely to promote it. Exposing customers to digital content marketing may lead them to brand involvement (Aljarah et al., 2024), which in turn may generate a belief-confirmation experience like online brand advocacy.

Therefore, it is logical that customer engagement acts as a facilitator between digital content marketing and online brand advocacy. Hence, we propose the subsequent hypothesis

7. UGC and online brand advocacy And Brand familiarity

Schema theory gives an insightful explanation of the impact of brand familiarity on consumer reactions. Consumers depend on mental frameworks (schemas) which are formed from their past experiences and these enable them to process familiar brand stimuli faster and with less cognitive effort, whereas unfamiliar stimuli need more evaluation and adjustment (Alba & Hutchinson, 1987). Therefore, knowing a brand is one that lessens uncertainty, increases trust, and makes it easier for good words and customer advocacy to spread (Acharya, 2020; Colicev et al., 2019). Recent research has similarly acknowledged that brand familiarity leads to customer engagement because it opens the customer's mind to the already existing mental connections, which in turn increases the brand's credibility and the customer's perceived value (Aljarah et al., 2024). Hence, using schema theory as a basis, the present research foresees that consumer advocacy behavior through digital content marketing will be affected by brand familiarity to different extents.

8. Customer engagement and OBA and brand familiarity

Brand familiarity has been identified as a key factor that brand marketers need to consider when they are targeting consumers through digital content marketing and social media. When consumers have little knowledge of a brand, digital content communication has a direct effect on brand advocacy since users are in need of more informational cues and are willing to try new experiences (Acharya, 2020). On the contrary, in situations where consumers are highly familiar with the brand, they can rely on their existing mental representations and previous experiences of trust, thus content marketing may have a reduced effect on the increment of brand advocacy (Aljarah et al., 2024).

The discoveries imply that brand familiarity may strengthen the relationship of digital content marketing and brand advocacy or it may weaken it, depending on the consumer's prior knowledge and trust in the brand. Consequently, the theory mentioned below is proposed: Continuing with the argument from the prior paragraph, one can clearly infer that User-Generated Content (UGC), Online Brand Advocacy (OBA), Customer Engagement (CE), and Brand Familiarity (BF) are interpersonal interaction models that significantly determine customer behavior in the digital market.

However, extant research has predominantly treated these factors as separate variables or single-market contexts, thus the interplay of these variables across culturally diverse but digitally connected regions like Egypt and Saudi Arabia still remains unexplored. This study answers that gap by creating a detailed model that looks into how user-generated content influences online behavioral advertising, environmentally friendly consumer behavior, customer engagement as a mediator and brand familiarity as a moderator. The comparative approach provides the valuable insight into cross-market consumer engagement and advocacy behavior in the food industry.

Research Model: (The effect of user-generated content on online brand advocacy mediated by customer engagement and moderated by brand familiarity).To address this gap, the study proposes the following hypotheses:

H1: User generated content (UGC) Information positively effect on Online brand advocacy.

H2: The positive effect of UGC and online brand advocacy mediated by customer engagement.

H3: The positive effect of UGC and customer engagement moderated by brand familiarity.

H4: The positive effect of UGC on online brand advocacy moderated by brand familiarity

The theoretical framework of the study is illustrated below in Figure 1.

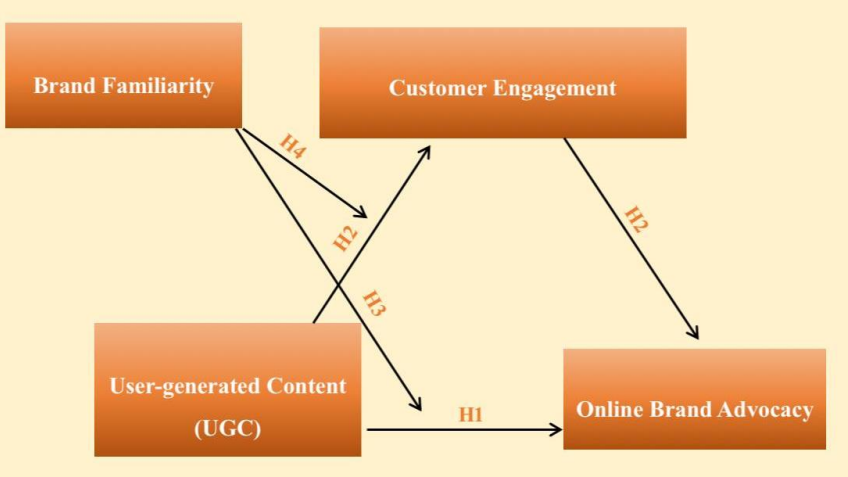


Figure 1. The study's conceptual model

METHODOLOGY

This study employed a quantitative method which is a research method where a participant discusses 3 food brand stores in Egypt and Saudi Arabia which were (1- Wahmy, 2- Blabn, 3- Baheeg) based on online surveys that primarily deal with the

collection and analysis of numerical data to explain phenomena, forecast, or test hypotheses by means of a convenience sample technique. Quantitative research frequently entails statistical analysis and is based on measurable units to arrive at conclusions that are capable of being verified and repeated, thereby ensuring objectivity, through the survey of 606 persons. The participants were specifically screened to include consumers who actively follow or participate in Sport Tourism activities and events in Egypt and Saudi Arabia, ensuring the data reflects the intersection of sports travel and food brand consumption."

The researchers relied on the questionnaire as the primary instrument for gathering data to analyze the relationships in the research model. The participants' answers were recorded on a five-point Likert scale (5 Strongly Agree and 1 Strongly Disagree). The scales used to measure the variables were taken from the literature and adjusted to be suitable for Arabic speakers. User-generated content is the independent variable. Customer Engagement, is the mediator, and Brand Familiarity, is the moderator. Finally, Online Brand Advocacy is the dependent.

RESULTS

This research led the way to combine survey data with an innovative statistical method named partial least squares-based structural equation modeling (PLS-SEM) implying tool PLS 3.3 to deal with the problem of data normality. PLS-SEM was chosen as the primary analysis method because of its capabilities in managing situations of small sample sizes and non-normal data which are characteristics of exploratory research.

Additionally, it is a perfect method to be used in a study with such a complex model as this one that aims at detangling the effects of variables customer engagement as a mediator and brand familiarity as a moderator. Their use here is strongly supported by the complexity of the model and the need for indirect effect measurement through mediation.

Furthermore, PLS-SEM can accept data from any distribution and, thus, it is an appropriate instrument for an exploratory study like this one. "Normalcy-related problems" signify the issues that emerge when individuals or societies attempt to live according to what they consider norms or average practices. These problems include the social pressure to conform, the feeling of inadequacy when one cannot meet societal standards, the discrimination of those who oppose the norm, and the suppression of one's individuality under the guise of conformity.

To determine the reliability and validity of the measurement approach, a comprehensive testing program was conducted. Multiple indicators confirmed the discriminant and convergent validity of the model. Cross-loadings, Composite Reliability, Cronbach's Alpha, the Average Variance Extracted (AVE), and the Fornell-Larcker criterion were used to conduct reliability and validity tests. Collinearity among formative indicators was also tested using the variance inflation factor (VIF). Sample profile in total, 606 survey responses were used in the analysis collected from the learners to test the pre-determined hypothesis. According to the descriptive analysis for demographic variables, the results illustrate that most of the sample is female (55%), while males account for only (45%).

As for age, the results show that the age of the majority is ranging between (20-29) years old, with (53.9%), followed by the age (30-39) years old (19.3%). In addition, the analysis showed that the income of the majority ranges between (11.000-30.000) per month (33.5%), followed by those whose income is (31.000-50.000) per month with (26.1%). for the country, the majority are from Egypt with (80.6%) and only (19.4%) are from Saudi Arabia. Finally, concerning the education level, the majority are college graduates (39.9%), followed by those who are graduates (36.6%).

Egypt Model

First, for the Egyptian model, the measurement model has strong internal reliability and validity, as shown in Table 1 and Table 2 . All the Cronbach alpha values are 0.7. Moreover, every composite dependability (CR) value exceeds 0.8. The rho_A1 values of all latent variables are less than 1. Each of the AVE values in Table 1 is higher than 0.5. The square root of the AVE values is compared to the latent variable correlations in the Fornell-Larcker discriminant validity criterion.

Table 1 shows that, in accordance with the Fornell-Larcker criterion, the square roots of the AVE for each construct (which indicates convergent validity) are greater than their greatest correlation value with any other construct.

There are no cross-loadings displayed in Table 2, and loadings are around 0.7. Additionally, Table 2 indicates that the VIF proves that none of the measures are greater than five. The diagonal figures in Table 1 meet the Fornell-Larcker discriminant validity requirement because they are greater than their greatest correlation value with any other notion. The model's convergent and discriminant validity are confirmed by the absence of cross-loadings and well-loaded dimensions on their constructs, with 0.45 being the lowest loading see Table 2.

Table 1. Latent variables correlation, reliability and validity

	Brand Familiarity	Customer Engagement	UGC	OBA
Brand Familiarity	1			
Customer Engagement	.773	1		
UGC	.432	.636	1	
OBA	.503	.633	.793	1
Cronbach’s Alpha > 0.7	.823	.922	.787	.853
Rho_A < 1	.834	.926	.802	.872
Composite Reliability > 0.8	.873	.934	.840	.887
Average Variance Extracted (AVE) > 0.5	.536	.566	.573	.549

Table 2. Variables Loadings, VIF

	Brand Familiarity	Customer Engagement	OBA	UGC	VIF
BF1	0.771				1.789
BF2	0.719				1.716
BF3	0.85				2.434
BF4	0.634				1.643
BF5	0.756				1.834
BF6	0.638				1.496
CE1		0.651			3.158
CE10		0.774			2.603
CE11		0.766			3.999
CE2		0.692			4.363
CE3		0.758			4.307
CE4		0.792			3.605
CE5		0.781			3.054
CE6		0.881			4.521
CE7		0.811			3.095
CE8		0.626			2.557
CE9		0.705			2.738
OBA1			0.718		2.895
OBA2			0.719		3.653
OBA3			0.824		2.707
OBA4			0.647		1.85
OBA5			0.587		1.519
OBA6			0.764		3.45
OBA7			0.657		2.961
OBA8			0.784		2.341
OBA9			0.39		1.416
UGC1				0.621	1.725
UGC10				0.501	1.756
UGC2				0.561	1.783
UGC3				0.451	1.26
UGC4				0.545	1.455
UGC5				0.652	3.58
UGC6				0.763	2.222
UGC7				0.604	3.453
UGC8				0.479	1.769
UGC9				0.665	2.391

Structural model

The significance and direction of the hypothesised relationships were tested using the bootstrap method with 5000 subsamples. PLS-SEM indices, for model fit, involved SRMR=0.09 ≤ 0.12 and NFI=0.711.

Figure 2 and Table 3 show that the UGC, positively significantly, affect OBA with (β= 0.769). So, UGC is responsible for 63.5 % of the variation that happens in the OBA.

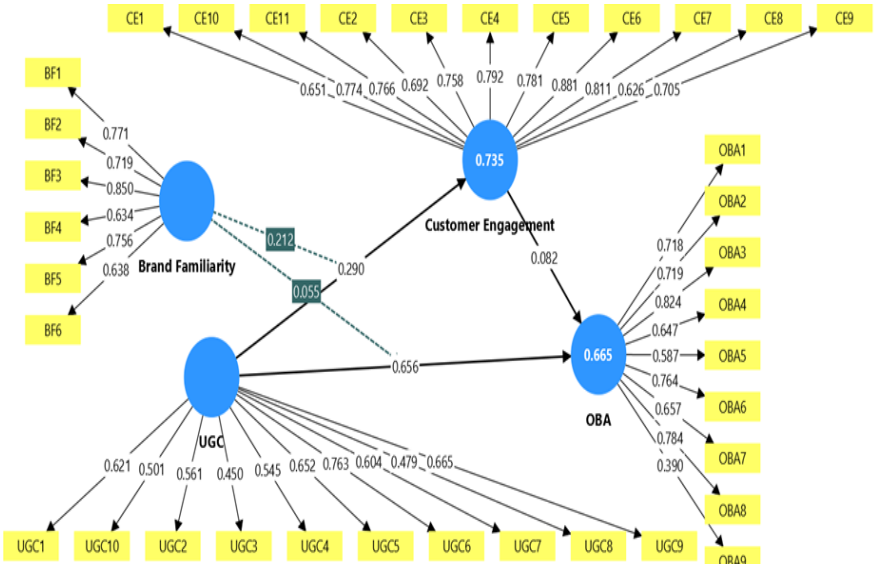


Figure 2. Model tested (Source: Smart PLS 3.3 output)

Direct and indirect relationships

First, for the direct relationship, Figure 2 and Table 3 show and confirm that UGC positively affects OBA. Hence H1: User-generated content (UGC) Information positively affects Online brand advocacy is accepted. Second, for testing mediation/ moderation relationships, bootstrapping with 5000, was conducted. Table 3and Table 4 is used in the mediation and moderation analysis. Table 4 shows significant indirect relationship between UGC and OBA (β=0.017, t= 3.317) through customer engagement, it ensures the mediation of customer engagement in the UGC and OBA relationship, indicating a full mediation. Hence, the mediation hypotheses H2: The positive effect of UGC and online brand advocacy mediated by customer engagement is accepted. In addition, Table 4 indicates a significant positive relationship between UGC and customer engagement (β=0.009 t= 4.119) moderated by brand familiarity, it ensures the moderation of brand familiarity in the UGC and customer engagement. Hence, the moderation hypotheses H3: The positive effect of UGC on customer engagement moderated by brand familiarity is rejected. Moreover, Table 4 also indicates a significant positive relationship between UGC and OBA (β=0.005, t= 2.129) moderated by brand familiarity, it ensures the moderation of brand familiarity in the UGC and OBA. Hence, the moderation hypotheses H4: The positive effect of UGC on online brand advocacy moderated by brand familiarity is accepted.

Table 3. Direct Relationships

Hypothesis		Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T-Statistic (|O/STDEV|)	P values	Accept / Reject
H1	UGC -> OBA	.769	.774	.092	8.366	0.000	Accepted

Table 4. Specific Indirect effects

		Original Sample (O)	**Sample Mean (M)**	**Standard Deviation (STDEV)**	**T-Statistic (|O/STDEV|)**	**P values**	**Mediation / Moderation**
H2	UGC -> Customer Engagement-> OBA	0.017	0.005	0.127	3.137	0.000	Mediation accepted
H3	UGC x Brand Familiarity -> Customer Engagement	0.009	0.02	0.079	4.119	0.000	Moderation accepted
H4	UGC x Brand Familiarity -> OBA	0.005	0.005	0.038	2.129	0.000	Moderation accepted

Saudi Arabia Model

First, for the Saudi Arabia model, the measurement model has strong internal reliability and validity, as shown in Table 5. All the Cronbach alpha values are 0.7. Moreover, every composite dependability (CR) value exceeds 0.8. The rho_A1 values of all latent variables are less than 1. Each of the AVE values in Table 5 is higher than 0.5. The square root of the AVE values is compared to the latent variable correlations in the Fornell-Larcker discriminant validity criterion. Table 5 shows that, in accordance with the Fornell-Larcker criterion, the square roots of the AVE for each construct (which indicates convergent validity) are greater than their greatest correlation value with any other construct. There are no cross-loadings displayed in Table 6, and loadings are around 0.6. Additionally, Table 6 indicates that the VIF proves that none of the measures are greater than five. The diagonal figures in Table 5 meet the Fornell-Larcker discriminant validity requirement because they are greater than their greatest correlation value with any other notion. The model's convergent and discriminant validity are confirmed by the absence of cross-loadings and well-loaded dimensions on their constructs, with 0.097 being the lowest loading.

Table 5. Latent variables correlation, reliability and validity

	Brand Familiarity	**Customer Engagement**	**UGC**	**OBA**
Brand Familiarity	1			
Customer Engagement	.459	1		
UGC	.541	.495	1	
OBA	.511	.591	.744	1
Cronbach's Alpha > 0.7	0.555	0.729	0.849	0.773
Rho_A < 1	0.563	0.767	0.864	0.828
Composite Reliability > 0.8	0.730	0.800	0.882	0.835
Average Variance Extracted (AVE) > 0.5	0.512	0.586	0.534	0.582

Table 6. Variables Loadings, VIF

	Brand Familiarity	Customer Engagement	UGC	OBA	VIF
BF1	0.614				1.311
BF2	0.479				1.319
BF3	0.547				1.222
BF4	0.601				1.230
BF5	0.598				1.252
BF6	0.497				1.261
CE1		0.649			1.403
CE10		0.415			1.373
CE11		0.097			1.38

CE2		0.595			1.371
CE3		0.544			1.358
CE4		0.558			1.275
CE5		0.483			1.539
CE6		0.624			1.247
CE7		0.529			2.417
CE8		0.722			1.556
CE9		0.396			1.346
OBA1				0.304	1.957
OBA2				0.541	1.564
OBA3				0.834	1.62
OBA4				0.765	1.607
OBA5				0.770	1.586
OBA6				0.597	1.663
OBA7				0.676	2.674
OBA8				0.527	1.522
OBA9				0.297	1.633
UGC1			0.392		1.467
UGC10			0.699		1.917
UGC2			0.787		2.376
UGC3			0.654		1.87
UGC4			0.666		1.958
UGC5			0.759		2.163
UGC6			0.722		2.414
UGC7			0.504		1.79
UGC8			0.616		2.242
UGC9			0.691		2.513

Structural model

The significance and direction of the hypothesized relationships were tested using the bootstrap method with 5000 subsamples. PLS-SEM indices, for model fit, involved SRMR=0.07 ≤ 0.12 and NFI=0.612.

Figure 3 and Table 3 show that the UGC, positively significantly, affect OBA with (β= 0.687). So, UGC is responsible for 60.2 % of the variation happens in the OBA.

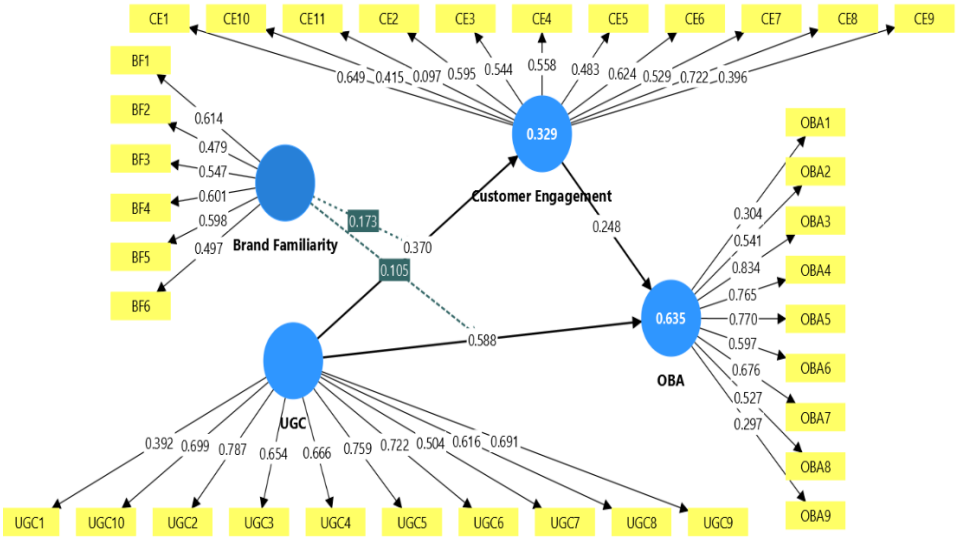


Figure 3. Model tested (Source: Smart PLS 3.3 output)

Direct and indirect relationships

First, for the direct relationship, Table 7 confirms that UGC positively affects OBA. Hence H1: User-generated content (UGC) Information a positive effect on Online brand advocacy is accepted. Second, for testing mediation/ moderation relationships, bootstrapping with 5000 was conducted. Table 4 is used in the mediation and moderation analysis.

Table 8 shows an insignificant indirect relationship between UGC and OBA (β=0.091 t= 1.175) through customer engagement, indicating no mediation effect. Hence, the mediation hypotheses H2: The positive effect of UGC and online brand advocacy mediated by customer engagement is rejected. In addition, Table 8 indicates a significant positive relationship between UGC and customer engagement (β=0.117, t= 2.337) moderated by brand familiarity, which ensures the moderation of brand familiarity in the UGC and customer engagement. Hence, the moderation hypotheses H3: The positive effect of UGC on customer engagement moderated by brand familiarity is accepted.

Moreover, Table 8 also indicates a significant positive relationship between UGC and OBA (β=0.055, t= 2.155) moderated by brand familiarity, which ensures the moderation of brand familiarity in the UGC and OBA. Hence, the moderation hypotheses H4: The positive effect of UGC on online brand advocacy moderated by brand familiarity is accepted.

Table 7. Direct Relationships

Hypothesis		Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T-Statistic (|O/STDEV|)	P values	Accept / Reject
H1	UGC -> OBA	0.687	0.681	0.112	6.160	0.000	Accepted

Table 8. Specific Indirect Effects

		Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T-Statistic (|O/STDEV|)	P values	Mediation / Moderation
H2	UGC -> Customer Engagement-> OBA	0.091	0.101	0.078	1.175	0.240	Rejected
H3	UGC x Brand Familiarity -> Customer Engagement	0.117	0.135	0.088	2.337	0.081	Moderation accepted
H4	UGC x Brand Familiarity -> OBA	0.055	0.04	0.048	2.155	0.098	Moderation accepted

Comparing Saudi Arabia and Egypt, some of the significant differences and similarities between the role of User-Generated Content (UGC) towards Online Brand Advocacy (OBA) can be identified. In Egypt, the findings validate a stronger direct role exhibited by UGC towards OBA (β=0.769), explaining 63.5% variation in OBA, as opposed to Saudi Arabia, which exhibits a lower level of impact (β=0.687), explaining 60.2% variation.

In addition, customer engagement fully mediated the relationship between UGC and OBA in Egypt, while the moderation effect was not significant in Saudi Arabia, uncovering that customer engagement was not a necessary mediating variable. However, brand familiarity provided a significant moderation effect in the relationship between UGC and customer engagement as well as between UGC and OBA, affirming brand awareness is a significant driver of strengthening these relationships. Overall, while UGC is predominantly affecting both realms of OBA in a positive way, Egypt portrays a stronger and direct influence with the customer interaction being a pivotal mediating factor, compared to Saudi Arabia where its influence was constrained.

DISCUSSION

User-generated content (UGC) impacts online brand advocacy directly as a result of which researchers suggest that consumers are more willing to trust and support a brand when they find authentic content from other users (Aljarah et al., 2024). Also, UGC through emotional and cognitive connections can escalate advocacy (Bahtar & Muda, 2016).

But, the quality and the personality of UGC matter, as bad writing or negative content may reduce the power of such content (Zhao et al., 2022). The research in Egypt confirmed the effect of UGC on customer engagement, which later resulted in advocacy, where consumer engagement was the full mediator of the relationship, and consumers were more likely to advocate when they felt emotionally and cognitively engaged (Rachbini, 2023; Marbach et al., 2019; Sureddy et al.,2026). The authors have shown that brand familiarity contributes to the strengthening of the UGC influence on both engagement and advocacy, as familiar brands evoke quicker and deeper engagement when supplemented with user-driven content (Colicev et al., 2019). Although brand familiarity usually escalates the influence of UGC on brand advocacy, excessive familiarity may lower the rate of response to new UGC (Schivinski et al., 2020).

The degree of a consumer's trust impacts the effect of customer engagement on brand advocacy, with the brand familiarity through either facilitating or hindering the connection between engagement and advocacy (Aljarah et al., 2024) User-generated content (UGC) impacts online brand advocacy directly as a result of which researchers suggest that consumers are more willing to trust and support a brand when they find authentic content from other users (Aljarah et al., 2024). Also, UGC, through emotional and cognitive connections, can escalate advocacy (Bahtar & Muda, 2016). But, the quality and the personality of UGC matter, as bad writing or negative content may reduce the power of such content (Zhao et al., 2022). The research in Egypt confirmed the effect of UGC on customer engagement, which later resulted in advocacy, where consumer engagement was the full mediator of the relationship, and consumers were more likely to advocate when they felt emotionally and cognitively engaged (Ayele & Singh, 2024).

The authors have shown that brand familiarity contributes to the strengthening of the UGC influence on both engagement and advocacy, as familiar brands evoke quicker and deeper engagement when supplemented with user-driven content (Colicev et al., 2019). Although brand familiarity usually escalates the influence of UGC on brand advocacy, excessive familiarity may lower the rate of response to new UGC (Schivinski et al., 2020). The degree of a consumer's trust impacts the effect of customer engagement on brand advocacy, with the brand familiarity through either facilitating or hindering the connection between engagement and advocacy (Aljarah et al., 2024)

Implications

1. Theoretical implications

The paper is a significant theoretical contribution as it establishes the fact that user-generated content (UGC) is a major driver of online brand advocacy (OBA), whereby customer engagement is the most important mediating factor. The findings

of the research extend cognitive consistency theory (Donsbach, 2008; Ruiz-Equihua et al., 2023) by demonstrating that when consumers are positively engaged with UGC, they adopt more active advocacy behaviors in line with their attitudes (Aljarah et al., 2024). Besides that, the brand familiarity as a moderating factor enriches schema theory (Lang, 2000), since consumers accessing familiar brands from their pre-existing mental frameworks which, in turn, makes the influence of UGC on engagement and advocacy more potent. The findings further underscore that UGC is not only a source of trust and authenticity but also a theoretical link that connects consumer participation, engagement, and advocacy in the digital realm.

2. Practical implications

The results from a managerial standpoint indicate that food industry marketers should vigorously promote such as customer reviews, testimonials, and interactive videos as a strategic tool to influence advocacy behaviors positively. To be most effective, brands need to create customer experiences that not only invite customers to share genuine stories but also emotionally engage with the content, hence, turning engagement into advocacy.

For food industry marketers, leveraging Sport Tourism calendars is essential. Brands should launch UGC-driven campaigns during major sporting events to capture the emotional engagement of fans, thereby converting spectator enthusiasm into Online Brand Advocacy (OBA). The thing is that it would be of no small consequence to mention the point that investing in the establishment and ongoing of brand recognition is absolutely necessary as it has been shown that familiar brands have a positive impact both, engagement, and, advocacy levels. Simply put, this implies that new brands have to get their name out and win the trust via the consistent use of UGC strategies while already established brands can leverage their familiarity to obtain better results from digital marketing. Overall, it can be said that the appointment of managers to the board of directors is to implement UGC-driven strategies which not only merge engagement initiatives with trust-building procedures but also ensure customer loyalty and advocacy in the long run in competitive markets.

CONCLUSION

The research prominently presents how the towering impact of User-Generated Content (UGC) that is mostly responsible for Online Brand Advocacy (OBA) in the food industry is made to be very clear. It mainly focuses on the markets of Egypt and Saudi Arabia. The findings suggest that UGC positively influences brand advocacy; however, the routes differ between the two countries. Customer engagement in Egypt was found to be a full mediator between OBA and UGC, therefore indicating that brands need to focus most on interactive experiences and co-creation activities so as to convert user content into advocacy behaviors. Egyptian consumers are more likely to be influenced by authentic content that emotionally connects with them, and as a result, they become more engaged and loyal.

While UGC influences OBA significantly in Saudi Arabia, customer engagement did not mediate this relationship, therefore a more direct influence of UGC is suggested. Nevertheless, brand familiarity was very powerful in both cases as a moderator, indicating that positive consumers with a prior association to a brand are the ones who will do advocacy behavior upon seeing UGC. The passage stresses the importance for brands to invest in familiarity and trust-building activities through, for example, quality communication strategies that are consistent.

Besides that, the study points out that authenticity, emotional connection, and cultural aspects are the key elements when one is looking to get the most out of UGC. Food brands must be in a position to not only motivate UGC but also control it in a way that they strengthen brand-consumer relationships and at the same time increase brand equity, especially in highly competitive and digital-oriented markets. The research paper is a great resource for mastering concepts related to online consumer behavior. It establishes the connections among UGC, customer engagement, brand familiarity, and brand advocacy and offers a wide range of suggestions for the marketing professionals who want to effectively employ UGC to brand loyalty and sustainable advocacy in a digitally competitive market place.

Limitations and future research

The research did not address several aspects that could be relevant to other magazines about restaurants and beverages in Egypt and Saudi Arabia. Future research should consider these financial aspects and include other types of projects in different fields, potentially utilizing different geographical areas, while taking into account competitive pressures and market changes. By using both qualitative and quantitative research methods, clearer understanding may emerge about the influence of non-cash support services given by governments on the performance and innovation of entities.

To focus mainly on the comprehension of the role of support services in the creative process as well as in the growth of startups businesses in various sectors, the paper propounds that subsequent research should explore the mediating and modifying factors as well as the effect of financing and assistance on the enterprises at different phases of their development. In most research, it is quite common to acknowledge that there are certain limitations. The primary point is that this research only looked at the influence of user-generated content (UGC) on online brand promotion (OBA), where customer interaction was the mediator and brand knowledge was the mediator. Subsequent research might provide a new model to investigate various variables, e.g., by considering gender, age, sociocultural values, and emotional attachment, technology knowledge, and the influence of artificial intelligence, thus possibly unfolding a deeper understanding of consumer behavior across different contexts. Moreover, an added measurement was utilized in this research to assess online brand marketing, which is not merely a local examination of brand advocacy, information sharing, or liking, but is rather more focused on understanding how consumers perceive the content type. The article proposes that subsequent inquiries would benefit from exploring this issue interaction more in-depth to users; so that, the researchers could get a more detailed

and nuanced view, which could be easily generalized to the different marketing fields. Thirdly, a large portion of the study sample came from one generation, and thus the results of the study might not be applicable to other generations.

The reason for this is that there are significant differences between generations in the way they use technology and in their trust in the opinions of content creators. Hence, it is advisable for subsequent research to investigate the different generations. Additionally, this research was limited to the food industry in Egypt and Saudi Arabia only. We, therefore, propose that subsequent research assess other industries such as fashion or cosmetics where the user-generated content is electrifying brand promotion. Consequently, exploring different cultural or geographical contexts can be a way to understand the significance of socio-cultural differences in consumer interaction and advertising behavior.

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CONSTRUCTED ENVIRONMENT AS A CATALYST FOR TOURISM EXCELLENCE AND STAKEHOLDER ENGAGEMENT IN NORTHEAST INDIA

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Abstract: In light of prevailing industry trends, the growing popularity of tourism, emerging regional challenges, and evolving policy frameworks, the constructed environment is examined as a practical and strategic foundation for advancing sustainable tourism development in Northeast India. This study emphasizes the role of the constructed environment in delivering performance excellence across the region's tourism sector. Grounded in a comprehensive review of Scopus-indexed literature, the research is guided by two primary objectives: first, to analyze the contribution of the constructed environment to tourism development in Northeast India; and second, to assess stakeholder awareness and engagement in regional tourism initiatives. A descriptive research design was adopted. Primary data were collected from 2,469 tourists across 29 selected destinations, while stakeholder perceptions were evaluated using an Opinion Synthesis Matrix. Analytical modeling was conducted using SPSS to assess the fit, validity, and feasibility of the proposed conceptual framework. The findings confirm the feasibility of the proposed model, as evidenced by multiple fit index criteria, demonstrating its practical applicability from the tourists' perspective. Insights derived from the Opinion Synthesis Matrix further highlight the need to align stakeholder strategies with tourist expectations to sustain tourism development through improvements in the constructed environment. The study underscores the necessity for greater stakeholder attention to deficiencies in both tangible and intangible components of the constructed environment across destinations. By systematically identifying existing gaps, the research provides a basis for corrective interventions and enhanced stakeholder awareness. A key contribution of this study lies in strengthening both the conceptual understanding and practical implementation of constructed environment principles among diverse tourism stakeholders, thereby supporting more sustainable and performance-driven tourism development in the region.

Keywords: Constructed Environment, Stakeholder, Model Fit, Opinion Synthesis Matrix, development

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INTRODUCTION

Tourism has emerged as a significant area of academic inquiry and global research interest (Sofronov, 2018; Jangra et al., 2021). In addressing the diverse challenges and opportunities within the tourism sector, the concept of the Constructed Environment (CE) has gained prominence as a critical analytical framework (Zimik et al., 2026). While the CE has already demonstrated notable influence across tourism-related industries, this study aims to deepen scholarly engagement by systematically evaluating its potential and practical applications. A distinctive contribution of this research lies in its focus on stakeholder perspectives—particularly those directly involved in tourism—highlighting the necessity of integrating their insights into development strategies (Zimik, 2026).

The study undertakes a focused examination of Northeast India, a region of strategic importance due to its geographic, cultural, and ecological diversity (Jamir, 2024; Tasung, 2024; Nath & Saikia, 2025). By considering both tourist expectations and their implications for quality of life and regional development, the research adopts a comprehensive and context-sensitive approach (Donaire et al., 2024; Font & McCabe, 2017; Alsaloum et al., 2024).

The CE framework, encompassing both tangible (infrastructure, architecture) and intangible (cultural practices, policy environment) dimensions, is employed to explore innovative and conscious strategies for sustainable tourism growth. A notable strength of the CE lies in its capacity to integrate advanced technologies and forward-looking strategies—components that are essential but often underutilized in traditional tourism planning (Zimik & Barman, 2025). By illuminating the multifaceted role of the CE, this study aims to provide actionable insights that enhance tourism development in Northeast India, fostering competitiveness with more developed regions while promoting sustainable and inclusive growth.

Background

Although the Northeast region of India constitutes only about eight percent of the country's total area; tourism has proven to be a key contributor to the regional economy (Ahmad et al., 2026). This prominence is largely attributed to the

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region's abundant natural resources, rich cultural diversity, and a wide range of tourism trends that continue to evolve. Figure 1 show the selected 29 destinations in northeast India selected for the study. However, the region also faces persistent challenges, including prolonged monsoon seasons and complex geographical terrain, which have hindered consistent tourism growth and infrastructure development. Despite the increasing inflow of tourists and rising investment interest—which have catalyzed growth in tourism and related industries (Nguyen, 2021; Rasool et al., 2021)—there remains a lack of focused research addressing the infrastructural shortcomings and identifying optimal strategies for policy-making and investment.



Figure 1. Selected 29 Destinations in Northeast India (Source: Compiled by authors; image sources accessed via Google Images in 2026)

The absence of a clear framework for sustainable development limits the potential of the tourism sector to operate efficiently and achieve long-term growth. To bridge this gap, the present study selected 29 representative tourist destinations across the region for in-depth exploration. These sites were analyzed to better understand their current status, infrastructural needs, and the potential of targeted policy interventions to enhance tourism performance and regional economic development.

LITERATURE REVIEW

To support and strengthen the research framework in the field of tourism, a systematic approach was employed. Data were collected from the Scopus database, which served as the primary source for identifying scholarly contributions related to tourism (Timur et al., 2025). The collected data were then processed using VOSviewer software to generate a comprehensive bibliometric analysis. This approach provided a broader perspective on existing tourism research, highlighting thematic concentrations and identifying potential gaps that the current study aims to address (Beegum & Aboobaker, 2026; Kaldeh et al., 2025). A key insight emerging from the review is the urgent need for a well-defined and integrative conceptual framework that encompasses the diverse facets of the tourism industry in the region. Various research contributions indexed in Scopus were critically examined to inform this framework.

For instance, Feng et al. (2024) emphasize that tourist demand is closely linked to the structure and efficiency of the tourism network. Their study applies trend flow analysis and the spatial mismatch index to illustrate demand distribution patterns. Similarly, Wang et al. (2024) employed the DPSIR model, concluding that a thriving tourism industry requires robust inter-sectoral support. In parallel, studies in green tourism management have gained momentum. Qasim et al. (2024) conducted extensive empirical research, collecting and analyzing substantial data to evaluate the effectiveness of sustainable tourism practices. These studies collectively inform the present research, offering foundational insights for further exploration and application in the context of Northeast India.

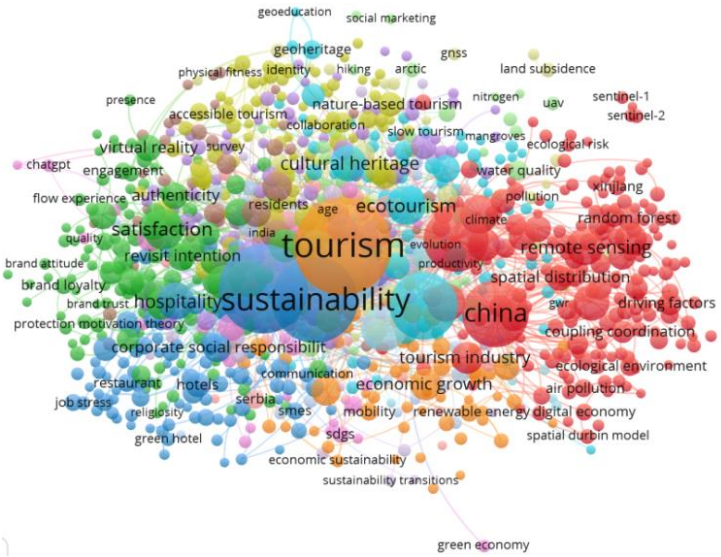


Figure 2. Research Contribution in Tourism Industries (Source: SPSS report from Scopus Data Base)

To align with the selected study area, Abidin et al. (2024) identified eco-tourism as a sustainable and effective strategy for improving community welfare, particularly in low-income regions as shown in Figure 2.

Their study employed the QSPM to prioritize actionable initiatives. Similarly, Ahmad et al. (2024) examined the impact of tourism on local communities and well-being using a combination of NVivo software for qualitative data analysis and the SWOT matrix framework, supported by an interview-based methodology. Recognizing the growing importance of intangible assets in tourism development, Tonini et al. (2022) emphasized the role of digital and social technologies as powerful marketing tools. Their study demonstrated how visual and digital media can significantly enhance tourism appeal and industry engagement. In an effort to move beyond traditional frameworks, Ajmera (2017) integrated the TOPSIS and MADM methodologies to overcome the limitations of conventional SWOT analysis.

His findings revealed that incorporating new technologies and adaptive administrative models offers an ideal path for tourism development. Stakeholder awareness and commitment to infrastructure development—supported by effective policies and strategic investments—are essential for sustainable progress (Sautter & Leisen, 1999; Alvarez, 2025; Tran, 2025). Tourist demand is dynamic and constantly evolving, requiring destinations to manage their systems with heightened attention, responsiveness, and proactive engagement from host stakeholders (Bisht et al., 2025; Christou et al., 2025; Nicolau, 2025). Despite these advancements, a review of the literature revealed a clear gap: no significant research to date has addressed the implementation and potential of the CE concept within the context of Northeast India. This gap justifies the need for further investigation, forming the basis for the present study's focus on CE as a strategic framework for sustainable tourism development in the region.

Objectives

1. To analyse the role of the constructed environment in facilitating tourism development in Northeast India.
2. To assess the level of awareness and engagement among various stakeholders involved in tourism development within the region.

METHODOLOGY

Figure 3 portraits the methodology steps adoption of the research design, formulated in response to the objectives identified and the gaps observed in the existing body of literature. A mixed-methods approach—comprising both quantitative and qualitative techniques—was employed to ensure a comprehensive understanding of the research problem. Primary data were collected from tourists who had visited 29 selected destinations across Northeast India with 2462 respondent for the analysis. This data collection aimed to assess the current status of the CE from the perspective of end users—tourists. Their opinions, based on past visits and comparative experiences with other destinations, were instrumental in evaluating satisfaction levels and the perceived economic and non-economic benefits of tourism infrastructure (Yuan et al., 2021; Villamor et al., 2025). In parallel, the consciousness and competence of key tourism stakeholders—including government officials, contractors, labor associations, investors, and local communities—were assessed through semi-structured interviews (Novianti & Syahid, 2026; Khater et al., 2025; Basyar et al., 2025; Salazar et al., 2025).

The responses were systematically organized and analyzed using an Opinion Synthesis Matrix (OSM), offering insights into stakeholder engagement as relevant to CE development (Günther et al., 2024; Barros et al., 2021; Owojori & Okoro, 2022; Tumpa & Naeni, 2025; Kish & Miller, 2025). As illustrated in Figure 3, the adoption of a mixed-method approach is particularly significant in addressing the complexity of the study. It offers greater flexibility for comprehensive investigation and analysis, especially when incorporating perspectives from both stakeholders and tourists (Pagliara et al., 2025; Jena, 2025; Esposito et al., 2025). To enrich the scholarly context of the study, a bibliometric analysis was conducted using data sourced from the Scopus database, supplemented by books, journal articles, and other credible academic sources.

The integration of literature-based findings with primary field data allowed for a multi-dimensional analysis, thus enhancing the validity and depth of the study in light of its stated objectives.

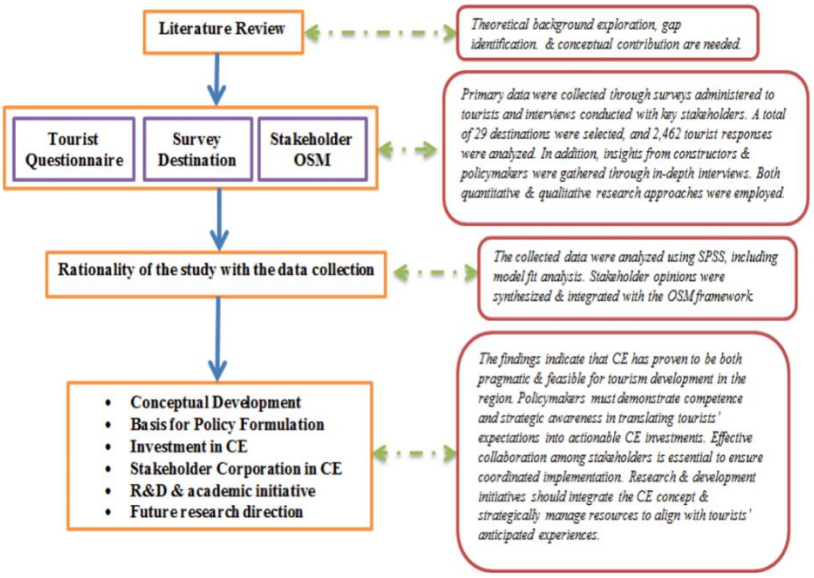


Figure 3. Research Design Flow Chart (Source: Author Compilation)

FINDING AND DISCUSSION

To investigate the complex interrelationships between the CE and various aspects of tourism development, a SEM approach was employed. This method enabled the analysis of both latent variables (unobservable constructs) and observed variables (measurable indicators), thereby offering a comprehensive view of the underlying structure of tourist perceptions and experiences. For this study, several latent variables were identified, reflecting key dimensions of the tourist experience.

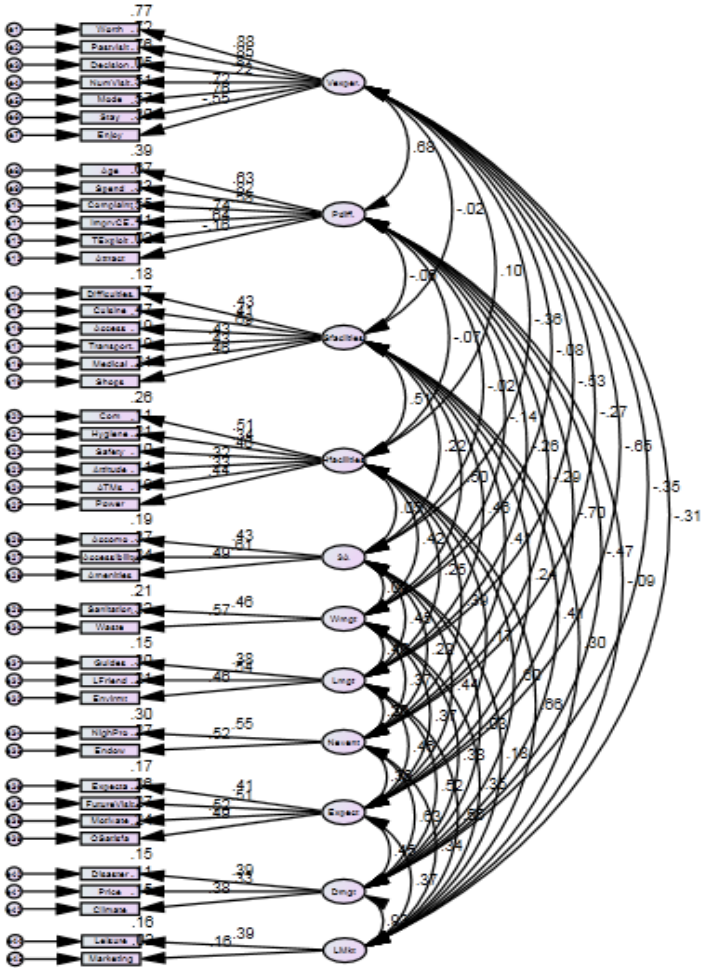


Figure 4. Model of CE (Source: Hypothetical AMOS -Based Report)

Data for each construct were gathered directly from tourists who had visited selected destinations in Northeast India. Given the limited existing research on CE within the Northeast Indian context, this study marks a significant initial effort to classify and quantify the impact of tourism infrastructure and management practices in the region.

These include: Visitor Experience Tourist Personal Difficulties and Challenges Service and Hygiene Facilities Accessibility, Amenities, and Attractions (3A's) Waste Management Systems Local Management Practices Visitor Expectations Nighttime Events and Activities Leisure Market Offerings Damage Management and Preservation Efforts These variables collectively represent critical components of the CE and their influence on tourism satisfaction and sustainability.

The responses obtained from tourists were analyzed and visually represented in Figure 4, which illustrates the SEM diagram and highlights the relationships between key variables. This model provides a valuable framework for understanding how the CE influences overall tourism development and visitor satisfaction in the region.

The proposed CE model demonstrates a strong model fit, effectively bridging theoretical foundations with empirical insights derived from primary data. The model not only validates key constructs relevant to the tourism sector but also illustrates the practical feasibility of CE concepts in promoting sustainable tourism development across Northeast India.

As depicted in the model, it encapsulates tourist experiences and perceptions, emphasizing the sensory and emotional responses elicited by their visits to the destinations. These insights offer a nuanced understanding of how the built and managed environment contributes to overall satisfaction and engagement. However, the successful enhancement and maintenance of the CE are contingent upon active state intervention and heightened consciousness among policymakers. The roles and responsibilities of diverse stakeholders—including government agencies, infrastructure developers, local communities, and tourism operators—are instrumental in shaping the effectiveness of CE-related initiatives.

To further investigate stakeholder awareness and capacity, the study incorporates findings from semi-structured interviews, as detailed in the methodology. These responses were synthesized into OSM, which captures key skill attributes, perceptions, and levels of commitment toward tourism development. This matrix serves to assess whether the implementation of CE frameworks is not only feasible but also supported by the necessary institutional and community competence required for long-term success in the region. To validate the robustness of the proposed CE model, a range of model fit indices were assessed and are presented in Table 1. These indices confirm the appropriateness of the structural model and reinforce its empirical alignment with the theoretical framework.

Table1. Model Fit Indices (Source: Hypothetical AMOS -Based Report)

Fit Index	Model Values	Threshold	Interpretation
CMIN/DF	2.53	<3	Acceptable model fit
RMSEA	0.059	<0.08	Good fit and close to ideal range
CFI	0.93	0.90-0.95	Acceptable to good fit as it falls between 0.90 (good) and 0.95 **(**excellent**)**
TLI (NNFI)	0.91	>0.9	Good- specified model
SRMR	0.062	>0.08	Good fit with low residual in the differences
GFI	0.89	>0.9	Marginal acceptable
AGFI	0.86	>0.9	Slightly below the threshold and complexity accepted

The feasibility of the CE model is examined in Table 1, which demonstrates its strong potential to support the strategic development of tourism in the region. To ensure robustness and credibility, multiple fit indices were applied and validated against established scholarly standards. The results, derived from data collected from tourists across 29 destinations, confirm a satisfactory model fit and reinforce its practical applicability. Evaluating this model represents a distinctive contribution, particularly given the limited empirical research conducted in the domestic context of Northeast India. The findings offer valuable insights for policymakers, encouraging more responsive and evidence-based tourism planning. The strong model fit underscores the importance of aligning CE strategies with evolving tourist demands, positioning the constructed environment as a strategic instrument for sustainable destination management.

By examining both tangible and intangible dimensions of the constructed environment, the study highlights the need for more rigorous and professional research to guide policy formulation. The framework proposed can serve as a strategic compass for policymakers, helping transform tourist destinations into more competitive, efficient, and smart systems. With sustained commitment and strategic investment in CE, Northeast India has the potential to shift from being among the least preferred destinations to becoming one of the most attractive tourism regions.

Furthermore, resource planning must align with the evolving expectations and dynamism of tourists. Timely allocation of financial resources and efficient project execution are critical for effective destination management. Delays in project completion—currently a significant challenge in the region—have contributed to cost overruns and budget deficits, underscoring the need for stronger governance and monitoring mechanisms.

An additional contribution of the study is its emphasis on the use of local resources in CE development. Strengthening local resource management and promoting self-reliant supply chains can reduce dependence on imports, a challenge presently faced by the region. Enhancing local sourcing and supply chain resilience will not only support sustainable tourism development but also stimulate regional economic growth.

The results also underscore the importance of bringing tourism-related activities into the scholarly spotlight—particularly the roles of contractors, local communities, management authorities, and policymakers, all of whom are central to the objectives of this study. To capture ground-level realities, various critical parameters were explored through direct engagement with respondents. These include funding availability, technological capacity, stakeholder

competence, skill levels, project scheduling, and operational challenges. These dimensions are essential for enabling a functioning and sustainable CE, especially in the tourism context of Northeast India. Stakeholders—ranging from worker associations, contractors, and local community groups to NGOs—were surveyed using customized questionnaires tailored to their specific roles and responsibilities within the CE ecosystem. Infrastructural development requires strategic and continuous management of the 4Ms: Money, Men, Machine, and Materials. This underscores the necessity of timely project planning, formal documentation, and streamlined execution processes.

Delays in fund allocation and disbursement were identified as key constraints, often leading to operational setbacks or underperformance by contractors. These challenges are further compounded by prolonged monsoon seasons and difficult terrain, which intensify the need for destination planning around accessible transport hubs such as railway stations and highways. A spontaneous and transparent flow of funds, along with awareness of tourist expectations during construction periods, is crucial. Both voluntary and paid labor forces are actively engaged in tourism development, and their coordination with other government departments is vital for ensuring industry sustainability.

Current policy and investment strategies are largely reactive, informed by past challenges and economic considerations, but often lack a forward-looking, integrated CE framework. Tourists consistently demand high-quality infrastructure and amenities, reinforcing the importance of CE as a foundational pillar for tourism development. However, the seasonal nature of tourism-related employment and income raises concerns about long-term investment returns, warranting greater attention from both public and private sectors.

Moreover, the environmental impact of unchecked tourism growth—such as habitat degradation and overcrowding—requires urgent intervention. Security and visitor confidence can be improved through CCTV surveillance and youth engagement programs, which foster a safe and welcoming environment. While scholarly and expert recommendations have long highlighted the need for strategic improvement in tourism infrastructure, such insights have rarely been translated into actionable policy. A shift toward policy consciousness and executional accountability is urgently needed to align tourism growth with sustainable development in the region.

The study presents a hypothesis-driven analysis that justifies the advancement of the CE as a strategic instrument for tourism development. It advocates for a systematic and calculated approach to resource management, infrastructure maintenance, and logistics and supply chain coordination, with the aim of overcoming domestic inefficiencies and expanding the sector in a structured manner. Through this lens, CE enables each destination to be managed under the guidance of competent and conscious policymakers, ensuring development that is context-specific and locally grounded. Empirical evidence from the model's fit indices supports the validity of CE as a strategic framework, offering policymakers a sound analytical basis for formulating responsive and forward-looking policies.

The study also highlights the importance of collaborative engagement among constructors, workers' associations, NGOs, and bureaucratic institutions. Insights generated through the OSM reveal multiple operational and structural challenges affecting development projects across the region. A key objective of CE is to align development initiatives with tourist psychology and expectations. However, the study finds that much of the technology currently used in the region is outdated and requires modernization, automation, and professional training to match contemporary advancements. Persistent logistical constraints—such as prolonged delays, overdependence on imports and inter-state supply chains, and seasonal disruptions caused by monsoons—further complicate project execution.

These factors increase project costs, extend timelines, and place additional pressure on workforce capabilities and innovation. Infrastructure maintenance remains another pressing concern. For instance, maintenance efforts at Dzukou Valley have been minimal over the past two decades, despite the site's growing tourism significance. While some urban destinations benefit from policy initiatives such as the Act East Policy and Smart Cities Mission, remote and ecologically sensitive areas continue to face neglect. This disparity calls for a reassessment of planning priorities, particularly in logistics and connectivity. Transportation challenges are especially acute in Sikkim, where road connectivity remains the primary mode of access, posing serious risks during adverse weather conditions.

Similarly, ecotourism destinations such as Loktak Lake, Kaziranga National Park, and various destinations in Meghalaya require development approaches that are closely integrated with local communities to ensure ecological balance and sustainability. CE emphasizes the need for professional coordination and effective collaboration, even in short-term development initiatives, to position destinations as smart and competitive.

It promotes a systematic planning framework that aligns infrastructure development with tourist expectations, seasonal fluctuations, and projected visitor flows—taking into account both monthly and annual cycles. Given that many destinations in Northeast India are located in rural and tribal-dominated areas, the study underscores the importance of empowering local communities to understand and implement CE at the micro level.

By fostering localized participation and capacity-building, CE can establish performance benchmarks for stakeholders and strengthen grassroots ownership of tourism development. Ultimately, the study positions the Constructed Environment not merely as a physical infrastructure concept, but as a strategic and academic framework essential for advancing sustainable, inclusive, and competitive tourism development in the region.

The extent to which both tangible and intangible dimensions of the CE are integrated across the 29 selected destinations depends largely on policy effectiveness, stakeholder competence, and sound decision-making capacity. The findings indicate that strategic policy direction and institutional capability are critical in strengthening CE's role in tourism development. As illustrated in Figure 4, the elements of CE are highly interrelated and require coordinated collaboration. Achieving balance among these interconnected components provides a strategic advantage, enabling destinations to design CE strategies that respond effectively to emerging trends and contextual demands.

This integrated support system enhances adaptability and long-term sustainability. The implementation of CE is grounded in scholarly validation, as demonstrated by the empirical findings of the study. With stronger academic engagement and evidence-based guidance, CE can be more effectively operationalized.

The research confirms that CE functions as a catalyst for sustainable tourism development by offering practical and structured mechanisms to understand tourist expectations and achieve sectoral excellence in alignment with global standards. Furthermore, stakeholders involved in CE—including policymakers, constructors, worker associations, and allied institutions—are encouraged to collaborate under a unified platform.

Such coordinated engagement strengthens strategic responsiveness, improves execution capacity, and enhances professional competence in project implementation. Through integrated action and shared accountability, CE can more effectively address regional challenges and elevate the competitiveness of tourism destinations.

CONCLUSION`

Tourism in Northeast India has demonstrated significant potential and garnered growing interest on the global stage. However, sustainable and innovative approaches are essential to ensure the region's long-term tourism development. The rapid expansion of the tourism industry, coupled with inconsistent stakeholder performance, presents critical challenges that must be addressed. In this context, the CE emerges as an ideal and rational framework to guide the sustainable growth of tourism in the region. By systematically examining the opinions, awareness, and competencies of various stakeholders, this study contributes to both academic scholarship and practical knowledge.

Recognizing tourists as the central focus of the industry, the research incorporates both micro and macro perspectives of tourist psychology. Data collected from multiple destinations were analyzed within the CE conceptual framework, with model fit indices (presented in Table 1) affirming the robustness of this approach. The CE model effectively integrates academic rigor with practical implementation, offering a pragmatic pathway to enhance the wellbeing and sustainability of tourism industries in NER. The study highlights the importance of aligning management policies and development projects with tourist expectations and psychological needs.

Addressing systemic failures and delays requires a heightened level of professionalism and stakeholder consciousness—core objectives underscored throughout this research. Ultimately, this study concludes by advocating for the institutionalization of CE principles as a foundational strategy for sustainable tourism development in Northeast India. By fostering a deeper understanding of tourist behavior and reinforcing stakeholder collaboration, the CE model promises to significantly advance the region's tourism sector in both sustainable and competitive terms.

Appendix: Opinion Synthesize Matrix (Source: Primary data collected via open interview from the field visit)

No.	Particular	Opinions	Summary
1	Contractor	1. The workforce available in the region is adequately skilled and demonstrates strong potential for innovative design and creativity in CE-related projects. 2. The monsoon season, which commences after spring and continues for approximately three months, significantly hampers construction activities. This seasonal constraint often leads to project delays and affects the timely completion of CE developments for visitors. 3. Destinations located far from railway and road connectivity, such as Dzuko, Aizawl, and Shirui, experience considerable challenges in the maintenance and timely development of CE due to logistical constraints. 4. The timely availability of financial and material resources is critical for successful project completion. Contractors frequently encounter substantial difficulties due to delayed disbursement of funds and late supply of materials, posing a serious risk to the sustainability and quality of CE. 5. Locations such as Kangla, Kamakhya, Jorethan, and Sella Pass require minimal construction interventions, primarily because of their strategic positioning along highways and comparatively lower pressure from leisure tourism. Consequently, CE maintenance in these areas is relatively manageable. 6. Road infrastructure plays a pivotal role in enhancing tourist satisfaction at major destinations including Gangtok, Elephant Falls, Loktak Lake, Kangla, Neer Mahal, Sibsagar, and Aizawl. While two-lane roads have been developed in several areas, the expansion to four-lane highways is strongly recommended to accommodate increasing tourist inflow. 7. A significant proportion of resources are dependent on imports, which contributes to procurement delays. These delays are particularly pronounced in rural destinations, affecting the timely delivery of goods and services. 8. The policies formulated by relevant authorities demonstrate a clear commitment toward sectorial development through CE initiatives. 9. The systematic development of road infrastructure is expected to substantially increase tourist arrivals in the region. 10.It is essential that policy formulation processes incorporate tourist opinions and feedback to ensure sustainable and demand-driven development.	Contractors face considerable challenges in completing development projects due to delayed funding and resource provision, the disruptive effects of the monsoon season, and high transportation costs associated with remote railway access. Many CE projects are further constrained by limited financial allocation, although the workforce demonstrates the necessary skills and expertise to execute tasks efficiently. Minimal construction is required at locations such as Imphal and Sella Pass, owing to their strategic positioning along highways and relatively low appeal to leisure tourists. CE (road infrastructure) plays a crucial role in enhancing tourist satisfaction, particularly at destinations like Gangtok and Loktak Lake, with the expansion of road capacity strongly recommended. CE project timelines are also impacted by procurement delays, reliance on imported resources, and logistical challenges in rural areas. Despite these obstacles, laborers exhibit notable competence and adaptability for making CE pragmatic. Policymakers recognize the significance of CE (tourism-driven development, and infra-structure improvements) combined with the integration of tourist feedback, are essential for maximizing positive outcomes and attracting increased visitor inflow.

2	Worker Association	1. Proper training in new automated technologies is recommended, along with the replacement of outdate machinery with modern automated equipment to enhance operational efficiency and improve CE. 2. CE projects require diverse and short-term engagement of various skilled labourers. This necessitates a high level of professionalism, effective coordination, and systematic workforce management. 3. The successful implementation of CE requires clearly defined competencies and adherence to standardized project timelines. However, such structured time-bound project practices are not widely adopted in the region. 4. Workers demonstrate diligence and a strong work ethic in carrying out their assigned responsibilities, contributing positively to project execution.	Most volunteers and workers lack formal training, affecting task efficiency. Additionally, the transient and diverse nature of development projects results in short-term workforce engagement, impacting continuity and expertise. Despite these challenges, the labour force demonstrates strong competence, diligence, and work ethic, consistently completing projects on schedule and showing high commitment in overcoming obstacles. All would align in making the CE improve in the region.
3	Stakeholders	1. There is a noticeable lack of effective follow-up mechanisms after policy formulation, which limits the successful implementation of planned initiatives of CE in the region for the sector sustainable development. 2. CE directly benefits from the growth of the tourism industry, generating significant positive impacts on regional development. 3. Infrastructure enhancement (CE) is imperative to ensure higher levels of tourist satisfaction and sustainable destination management. 4. The engagement of local communities during policy formulation is crucial, particularly as many destinations are inhabited by tribal populations whose participation ensures inclusive and sustainable development. 5. Policies are formulated based on tourism activity requirements and comprehensive analysis of various reports, resulting in broad community consensus and contributing to CE development. 6. Tourism has significantly contributed to job creation, revenue generation, and the development of amenities and recreational facilities in the North-Eastern region. 7. Tourists seek well-maintained CE, including quality infrastructure, adequate amenities, warm hospitality, hygienic food services, and reliable telecommunication facilities. 8. Rapid progress in road construction is being undertaken to enhance accessibility and attract more tourists, particularly to remote destinations such as Dzuko, Kaziranga, Kanchenjunga, Tawang, and Gangtok, where road transport remains the primary means of access. 9. Despite proposed policies and planned projects, delays in completion frequently arise due to factors such as the pandemic, local interventions, untimely funding, supply chain disruptions, and monsoon conditions. 10.With adequate departmental support and developmental initiatives, numerous unexplored destinations can be brought into prominence beyond the currently selected sites. However, additional support from CE is required to facilitate this expansion. 11.Tourism industries boost revenue and generate employment opportunities through CE initiatives such as homestays, hotels, recreational services, and the sale of local products. 12.The enhancement of CE provides a vital platform for showcasing local culture, promoting indigenous products, and creating employment opportunities. 13.Tourist opinions encompass diverse preferences and expectations; therefore, CE must be sufficiently developed to address a wide range of needs. 14.Increased tourist influx has led to environmental concerns, including the exploitation of natural resources and rising pollution levels, particularly in Loktak, Umiam Lake, Kaziranga, Dzuko, and Shirui. 15.Strengthening CE will yield positive outcomes for both the tourism industry and local communities. 16.Local governments should prioritize effective promotion and partnership strategies to advance sustainable tourism development.	The development of CE faces several challenges, including limited interdepartmental collaboration and slow follow-up after policy implementation. While tourism industries benefit directly from CE, the enhancement of infrastructure is essential to meet tourist expectations and ensure satisfaction. Tourism policies are generally well-designed, supporting activities effectively, but active engagement of local communities, particularly tribal groups, is crucial during policy formulation to ensure inclusivity. Policies based on tourism needs and comprehensive reports help build community consensus, while constructors and worker associations strive to meet tourist demands. Tourism has positively contributed to job creation, revenue generation, and the development of amenities across the North-Eastern region. However, challenges persist, including inadequate infrastructure, project delays caused by external factors, and the environmental impact of increasing tourist influx, causing the CE to be un-organized. To address these issues, targeted road and facility development, particularly in destinations such as Tawang, is vital. The local government should prioritize promotion, partnerships, and comprehensive policies that balance tourism growth with environmental sustainability and community well-being.

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ASSESSMENT OF THE POTENTIAL OF ECO-CULTURAL HERITAGE IN THE DEVELOPMENT OF SUSTAINABLE TOURISM IN AZERBAIJAN (ON THE EXAMPLE OF SHUSHA CITY, TUGH, TAGHLAR AND AZYKH VILLAGES)

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Abstract: This study examines the utilization of cultural, ecological, and ethno-cultural heritage in the development of sustainable tourism in Azerbaijan, with a particular focus on the spatial organization of the natural-ecological, cultural, and ethno-cultural heritage potential in the Karabakh region. It also outlines methodological approaches for transforming areas with concentrated eco-cultural and ethno-cultural potential into tourism destinations. The research explores the applicability of modern methodological frameworks at the local level in promoting cultural and eco-cultural tourism. A multi-criteria assessment of existing resources is conducted using the Fuzzy Analytic System (FAS) method. Through integral calculations within the FAS method, the competitive advantages and strengths of destinations rich in cultural and eco-cultural heritage across the study region are identified. The study further analyzes the role of stakeholders in the formation of the city of Shusha as a cultural and creative tourism center, evaluating both advantages and challenges using the FAS method. Additionally, the advantages of efficient resource utilization in the development of the villages of Tugh, Taghlar, and Azykh as eco-cultural, ethno-cultural, and ecological tourism centers are substantiated. The principles guiding the planning of the research area and the zoning of its primary functional components were established, and key priorities for tourism development were identified. The results of the integrated assessment were substantiated as a central component for future tourism development, emphasizing the active participation of local communities in settlement processes, comprehensive management of cultural heritage resources, enhanced opportunities for official designation, and improvements in infrastructure and accessibility. Therefore, it is clear that the FAS method helped to identify areas of priority within the decision-making process for the project. The research was carried out based on an evaluation of cultural and eco-cultural potential in the region. Additionally, the framework ensures sustainability in tourism development.

Keywords: cultural, ecological, eco-cultural, ethno-cultural, FAS method, Shusha, Tugh, Taghlar, Azykh

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INTRODUCTION

Eco-cultural heritage tourism promotes the conservation of natural, cultural and ethnic heritage (ethno-heritage), as well as the sustainable use of registered heritage through the tourism sector, ensuring its ecological and social sustainability. This type of tourism provides visitors with the opportunity to travel to natural and cultural heritage sites and contributes to the protection of the environment and the development of local communities. Eco-cultural tourism (ECT) combines environmental protection, promotion of cultural heritage, development and sustainability of local communities. Eco-cultural tourism destinations on a global scale can be noted both in destinations where natural and cultural heritage is concentrated, which are included in the UNESCO heritage, and in other countries.

Thus, national parks combining Maori culture and natural heritage in New Zealand, destinations covering indigenous culture and natural heritage in Costa Rica, Bali Island in Indonesia, Serengeti National Park in Tanzania, etc. can be noted (Demkova et al., 2022). At the same time, the Shusha and Khojavend regions, which were selected as research areas, are rich in cultural, ethno-cultural, eco-cultural, and ecological heritage, and the city of Shusha, Turshsu settlement, Tugh, Yukhari and Ashaghi Taghlar, Azykh estate complex, the surroundings of Gulabli village, as well as the archaeological heritage of the Aghdam region are suitable for organizing eco-cultural tourism destinations.

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RELEVANCE OF THE RESEARCH

It is relevant in terms of environmental protection, the application of sustainable development in the transformation of cultural and ethno-cultural heritage into tourism products, increasing the activity of local communities in the tourism business, and expanding the concept of "green" tourism. Eco-cultural tourism consists of the protection of natural resources and ecosystems, tourists' discovery of natural wealth, the use of local culture and traditions, historical-cultural, artistic and creative heritage. Supporting the concepts of sustainable development in global tourism makes it necessary to involve local communities, which in turn stimulates economic development and promotes local eco-cultural heritage to a wider audience, ensures a balance of protection and use, and protects it for future generations without harming the ecological and cultural heritage. It should also be noted that the encroachment of natural and cultural heritage in the study area, and the complete destruction of some of them, has led to the emergence of "grey" zones from an ecological and economic point of view. In this regard, the application of the eco-cultural heritage concept in the development of sustainable tourism in the region would be more effective in terms of restoring and protecting existing resources.

METHODS

The conducted studies show that research on eco-cultural heritage mainly reveals three scientific approaches, which are ecological, cultural and community oriented. In addition, the concept of sustainability is taken as the basis for the use of eco-cultural heritage as a tourism product. The following theoretical and methodological approaches can be noted in the research on the use of eco-cultural heritage in tourism:

- **The theory of sustainable development** is widely used in the transformation of eco-cultural heritage into a tourism product, which researchers note the need to protect natural, ecological, cultural, traditions, as well as improve the socio-economic well-being of local communities (Weaver, 2016).
- **Theory of ecosystem services**. This theory is based on the assessment of ecosystem services of natural areas and heritage objects. Thus, the mentioned theory requires the protection and development of the natural environment in the formation of eco-cultural tourism products, which is similar to the concept of ecological and "Soft" tourism. This approach offers tourists the opportunity to use natural and cultural heritage in a regulated manner without harming nature, and to jointly benefit from natural and cultural heritage (Honey, 2019).
- **Theory of cultural and traditional heritage protection**. This approach promotes the preservation of cultural heritage, traditions and local lifestyles in tourist destinations, and the protection of cultural property (Hao et al., 2019).
- **Holistic theory (Holism)**. This approach emphasizes the inextricable link between cultural and natural heritage and is based on the advantage of joint use in eco-cultural tourism. Thus, eco-cultural heritage tourism seeks to ensure the protection and use of both natural and cultural values, considering the mutual effects of nature and culture (Jopp et al., 2022).
- **Theories of natural heritage promotion and community development**. This theory is aimed at increasing the value of natural heritage and its protection. It is aimed at regulating natural tourism activities in relation to the sustainability of natural heritage and ecosystems and preventing disruption of their self-recovery processes. At the same time, the benefits of eco-cultural tourism activities to local communities include not only tourism revenues, but also social, cultural and economic benefits for the local population, support and stimulation of their development (Rotherham, 2013).

In addition, eco-cultural tourism studies have highlighted the importance of sustainable tourism strategies, increasing the role of local communities, protecting cultural heritage and presenting it as a tourism product, in many ecological, ecotourism, cultural and ethno-tourism studies.

LITERATURE REVIEW

Studies conducted in the field of cultural and ecological tourism highlight the concept of a combined approach and, in some cases, the possibility of joint use. From the analysis of the literature, research on eco-cultural tourism began at the beginning of the 21st century and provided the formation of destinations based on the principles of the concept of sustainable development. According to Cajee, eco-cultural tourism encompasses the concept of sustainability by forming the basis of environmental, cultural and economic sustainability (Cajee, 2014). Here, the advantages of using tourism services by communities and protecting the environment in the form of regional development are shown (Jopp et al., 2022).

Rotherham based on the development concepts and examples of eco-cultural tourism, noted the advantages of cultural heritage, the use of local traditions as a tourism product and proposed a "circular solution" model in the destination (Rotherham, 2013). Tiberghien, Bremner and Milne noted eco-cultural tourism as the advantages of attractive factors, tourist behavior, environmental protection and ensuring the participation of communities (Tiberghien et al., 2017).

Hao, Wang and Ren put forward the concept of joint use of existing resources in the formation of eco-cultural tourism products, which allows for the creation of new innovative products. The authors attached special importance to such models as geographical environment, landscape-ecological factors, socialization, increasing the role of communities, transformation of cultural and traditional heritage into a tourism product, and advantages in the global market as UNESCO heritage (Hao et al., 2019). Dargahov, Talibov and Mammadov support the concept of transformation of eco-cultural heritage into a tourism product by considering the environment, eco-landscape, lifestyle of communities, demand for cultural and ethno-culture in the global market and propose "green" and "circular solutions" tourism models (Dargahov et al., 2021). Institute of Economics Ministry of Science and Education of the Republic of Azerbaijan analyze the institutional foundations of the post-conflict economy, focusing on structural transformation, infrastructure restoration, human capital development, and regional economic integration through a systematic approach. The authors identify priority areas for

economic growth based on the theory of comparative advantage and propose strategic development models for their implementation. Within this framework, the tourism sector is highlighted as a priority area of the economy, and the economic effects of its attractive factors are comprehensively examined (Institute of Economics, 2023).

Gavurova and others proposed a hybrid model integrating multi-criteria analysis for the assessment of regional sustainable tourism development. Their approach emphasizes the importance of incorporating sustainability-oriented criteria into regional tourism evaluation frameworks. The mathematical analysis, based primarily on expert assessment methods, prioritizes multi-criteria indicators when comparing alternative development scenarios. The expert-based evaluation model for determining the level of sustainable tourism in a region was developed and empirically tested using data structured around four principal groups of criteria: cultural, ecological, tourism-specific, and socio-cultural indicators (Gavurova et al., 2025).

DISCUSSION

Cultural tourism on a global scale allows for the development of urban destinations, the transformation of historical and cultural heritage into a tourism product. Cultural tourism accounts for 35-40% of international tourist flows and the annual growth rate is 3-5%. Analysis of World Tourism Organization data shows that UNESCO heritage and traditional cultural tourism destinations have retained their importance in cultural and ethno-cultural tourism (Eggleton et al., 2023).

The peak in inbound tourist arrivals to Azerbaijan was recorded in 2019, reaching approximately 2.8 million visitors. Following the COVID-19 pandemic, the recovery process progressed gradually, albeit with comparatively modest indicators. Over the past four years, the tourism sector has not fully regained its pre-pandemic performance levels, and a substantial growth rate in inbound tourism has yet to be observed.

Table 1. Dynamics and main indicators of tourists visiting Azerbaijan (The State Statistical Committee of the Republic of Azerbaijan, 2025)

Indicators	2019	2020	2021	2022	2023	2024	2025
Total number of foreigners arriving for tourism purposes (thousand persons)	2863.5	519.4	461.7	1058.1	1402.6	1855.1	2081.4
Leisure and entertainment	1164	164.9	132.4	398.5	858.3	1161.6	1243.1
Business	850.5	150.4	176.7	340.5	156.6	261.0	270.3
Visiting relatives and friends	519.9	98.5	90.5	154.8	160.7	203.8	250.6
Cultural and other tourism activities	265.2	88.9	53.9	150.3	207.1	208.5	274.2
Treatment and health	63.9	10.2	8.2	14.0	19.9	23.2	43.2
Spending by incoming tourists (thousand manats)	2971.4	414.7	492.6	1340.2	2439.2	3403.5	4334.2
GDP share of the tourism sector (%)	4.5	1.9	2.1	2.9	4.1	4.7	4.6

Analysis of international tourist flows in Azerbaijan shows that in the post-pandemic period, an increase in the dynamics of arrivals was observed (Imrani et al., 2025). The number of people arriving in the country for tourism exceeded 2.1 million people in 2025, which is 67.5% compared to 2019, the highest period of tourist flows. Among tourists arriving in the country, those arriving for recreation and entertainment purposes amounted to 1243.1 thousand people (Figure 1). Among those arriving for recreation, cultural tourism indicators are determined by the dynamics of foreign tourists arriving in the cities of Baku, Sheki, as well as reserves under the State Tourism Agency (STA). In particular, the number of tourists visiting the country for cultural tourism purposes reached more than 274 thousand in 2025, exceeding the peak level recorded in 2019. This trend is consistent with the broader tourism–economic development nexus, wherein sustained growth in tourist arrivals correlates with expansion in the sector's contribution to national GDP (Sokhanvar et al., 2018).

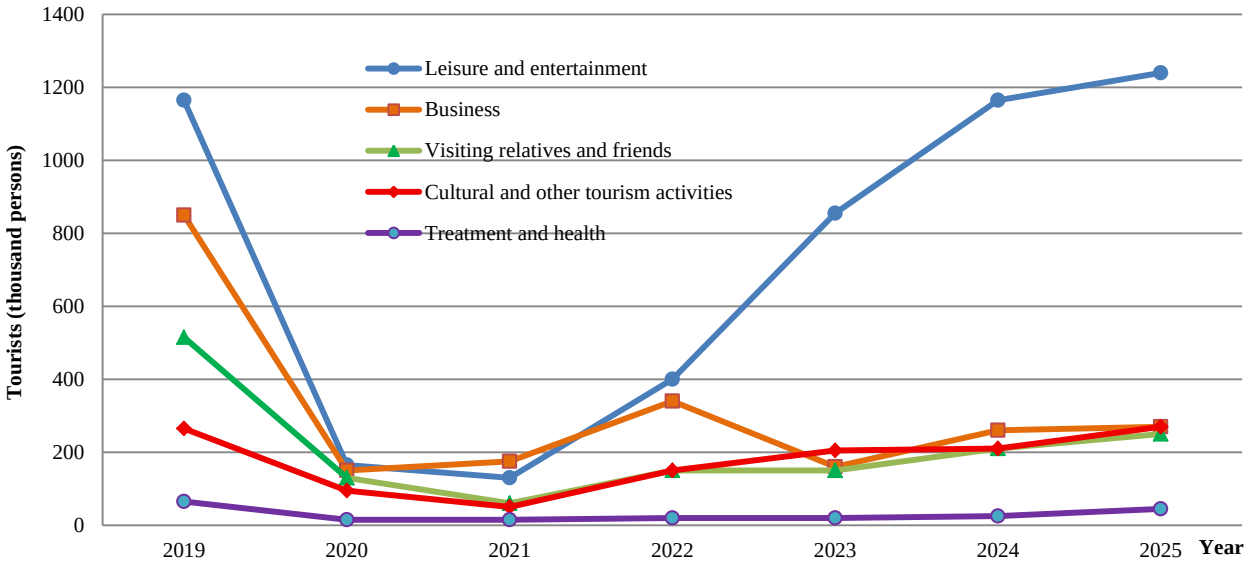


Figure 1. Structure of Inbound Tourist Arrivals by Purpose in Azerbaijan (Source: SSCRA, 2025)

At the same time, it is possible to determine the dynamics of visitors to historical and cultural reserves and archaeological monuments under the Ministry of Culture based on the analysis. Thus, the number of visitors to reserves under the STA amounted to 663.5 thousand people in 2024, which is a 35% increase compared to the previous year. 460.3 thousand incoming tourists were foreign tourists. Foreign tourists visiting the country amounted to 2.4 million people in 2024, of which 19.2% traveled to cultural tourism facilities (SSCRA, 2025).

Along with this, an increase in the dynamics of tourists visiting historical and cultural reserves under the Ministry of Culture is also observed, which can be considered an indicator of the increase in tourists visiting the country with cultural motives. The number of tourists visiting the 13 historical and cultural reserves under the Ministry of Culture was 223.4 thousand people in 2024, of which 102.6 thousand were foreign tourists. It should also be noted that the main part of those visiting historical and cultural reserves falls on the Gobustan Historical and Artistic Reserve, which is 132.4 thousand (State Tourism Agency of the Republic of Azerbaijan, 2025).

It should also be noted that the number of tourists visiting the Icherishahar (Old City in Baku) historical and cultural reserve, which is included in the UNESCO intangible heritage, was 235.6 thousand people in 2024. It can be noted that more than half of the tourists visiting the museums and other historical heritage of the Old City were foreign tourists. Also, the number of tourists visiting the city of Shusha, which has the status of a historical and cultural reserve, was 78.4 thousand people in 2024 (State Service for Protection, Development and Restoration of Cultural Heritage, 2025).

It is clear from our research that the development of cultural tourism destinations in the country, especially the presentation of historical and cultural reserves under the STA as a tourism product, and the implementation of a digital market have allowed tourists to be attracted. In addition, although 13 historical and cultural reserves under the Ministry of Culture have been restored, low indicators of marketing planning and lack of information have affected the low number of visitors (State Service for Protection, Development and Restoration of Cultural Heritage, 2025).

The advantage of the cultural and natural heritage potential in the Karabakh economic region, which is the study area, and its favorable location for organizing tourism activities ensure the development of tourism in the region. In this regard, the organization of tourism activities requires a multi-criteria assessment (MCA) of the existing potential using the FAS methodology. The multi-criteria assessment approach using the FAS methodology allows us to determine the comparative advantages of cultural, ethno-cultural, ecological, and other resources in tourism (Perles-Ribes et al., 2024). The formation of tourism-recreation zones in such regions parallels the broader practice of establishing special economic zones as a mechanism for stimulating regional tourism development (Plisetsky, 2012).

The assessment of tourism potential using the FAS methodology is an analytical analysis approach based on factors, assets and investments. In assessing the potential in the study region, preference was given to the rating and integral approach method, which determines the advantages of the FAS method of resources. Development directions are determined using the assessment of the cultural and creative heritage potential of the city of Shusha. Thus, it is carried out based on the FAS method and the analysis of indicators shows prospects.

The use of the FAS method in assessing the potential of the city of Shusha allows for the development of a basic concept including relief, climate, landscape, upper and lower infrastructure, hospitality and cultural characteristics of the population, security situation, legislation and state policy.

The mild climate in the city of Shusha in summer, cold in winter, high dry and comfortable indicators in the summer months, the presence of a dry climate and rich oxygen have led to its formation as a mountain-climatic resort. The fact that the city of Shusha covers an area of 4.5 km^2 on the plateau of the same name and is surrounded by forests and forest-steppe landscapes creates an attractive landscape in terms of tourism (Dargahov et al., 2023). The infrastructure of Shusha city was vandalized and destroyed during the occupation. The infrastructure is being restored, which consists of the restoration of the city's main energy supply, utilities, communications, and internal city roads.

Currently, the city's Karabakh street has been reconstructed, and a certain part of the main museums and buildings has been restored. Four mosques, one church, three museums, and 14 historical and architectural buildings have been restored in the city, which are presented to tourists visiting the city (Dargahov et al., 2023).

In determining the weight coefficient of factors in accordance with the FAS methodology, resource assessment and analysis capabilities have been determined based on integral approach methods. Here, the weight coefficient of cultural heritage indicators determines the cultural tourism opportunities of Shusha city. In this regard, based on the FAS methodology, the city's tourism potential and cultural tourism opportunities are assessed based on integral score indicators and added value creation. The integral assessment is calculated by the following formula (Baltagi, 2021):

$$P = \sum (W * Q)$$

P-Integral evaluation index;

W-Weight coefficient;

Q-Quantitative indicator.

Based on the above formula, the results of the factor analysis can be calculated:

$$P = (0.25 \times 9) + (0.15 \times 7) + (0.20 \times 6) + (0.10 \times 8) + (0.10 \times 5) + (0.10 \times 7) + (0.10 \times 6)$$

$$P = 2.25 + 1.05 + 1.20 + 0.80 + 0.50 + 0.70 + 0.60 = 7.10$$

The horizontal X-axis represents the factors applied in the multi-criteria evaluation and constitutes a nominal variable. The vertical Y-axis ranges from 0 to 2.5 points and is calculated as the product of the assigned weight and the corresponding quantitative value.

Table 2. Weighting coefficient and evaluation of cultural tourism potential in Shusha city

Factors	Weighting coefficient (W)	Quantitative score (Q)	Evaluation (WxQ)
F1 (Exotic nature and landscape)	0.25	9	2.25
F2 (Historical and cultural heritage)	0.15	7	1.05
F3 (Creative heritage and art)	0.20	6	1.20
F4 (Accessibility & Infrastructure)	0.10	8	0.80
F5 (Tourism infrastructure)	0.10	5	0.50
F6 (Tourism Services & Facilities)	0.10	7	0.70
F7 (Safety & Political Stability)	0.10	6	0.60
Total:	**1**	**48**	**7.10**

From the analysis of the table, although Shusha city has a high cultural tourism potential and has historical and cultural heritage and security as its strengths, the weak infrastructure and digital marketing and shortcomings do not fully support the development of tourism. Therefore, it is important to organize cultural events at an international level in the city, promote investments in tourism infrastructure (hotels, catering and transport), strengthen digital marketing and branding activities, and involve the local population in cultural tourism activities.

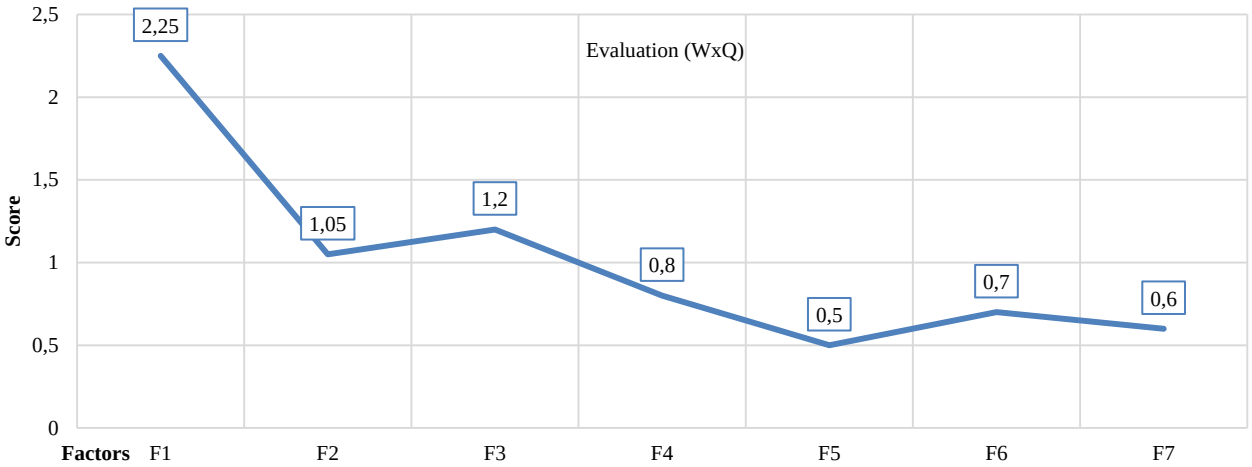


Figure 2. Evaluation scores based on FAS MCA methodology

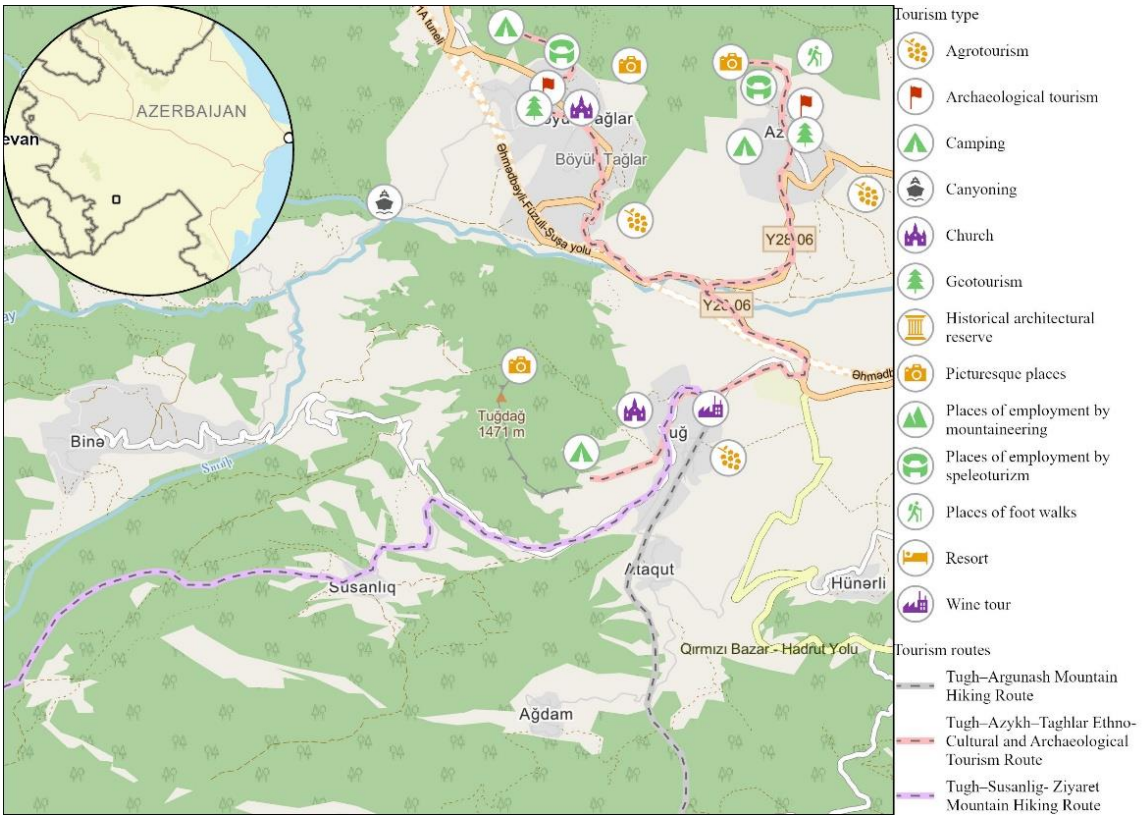


Figure 3. Map of the investigation area (Source: Author's own elaboration)

In addition, the institutional support of the state, the implementation of tourism management strategies, and various projects create conditions for the identification of new directions for the presentation of tourism opportunities. The holding of three international festivals per year in Shusha, the operation of three hotels, one hotel-restaurant complex, and the holding of many state and international events increase its importance in terms of tourism.

In the areas of Tugh, Taghlar, Azykh villages (Figure 3) and Hadrut settlement of Khojavend region, which are the study area, it is possible to note the wide spread of natural-climatic and attractive landscapes. In addition, the destruction of natural monuments and forest landscapes, and the vandalism of cultural heritage resources have reduced the attractiveness in terms of tourism. The location of the study area in the foothills, the mild climate, comfortable temperature and climatic conditions, the presence of historical-cultural and ethno-heritage, ancient Albanian monuments and mosques, the presence of ethno-, agri-heritage, natural monuments, caves, archaeological samples create a basis for the development of tourism (Dargahov et al., 2022, Imrani et al., 2024). The assets of the FAS method include natural resources (exotic and attractive factors), cultural, ethno-cultural and historical heritage, attractive and unique festivals and mass events, traditional crafts and local cuisine, which are also included in the established integral assessment. Socio-economic factors include human capital (tourism education staff, language skills), institutional support (tourism management, strategies and projects), and financial investment (public and private sector investments) (State Tourism Agency of the Republic of Azerbaijan, 2023).

At the same time, in recent years, the restoration and repair of roads to the mentioned settlements, the construction of some infrastructure facilities have improved tourism opportunities. It should also be noted that the lack of public transport, the exclusion of these villages and settlements from tourist routes, create conditions for more private car owners to come for tourism purposes (Dargahov et al., 2023). From a socio-economic point of view, the transfer of the village of Tugh to the STA, the interest of the returning population in the tourism sector, the preservation of carpet weaving, national cuisine and traditions, which are components of cultural heritage, will determine the development of the tourist service sector in the future. Also, there are favorable conditions for the development of eco-agro, outdoor, archaeological, speleotourism (caving, spelunking), cultural and ethno-cultural tourism in the villages of Tugh, Taghlar, Azykh.

In the assessment of the tourism potential of Tugh, Azykh, Taghlar settlements as eco-cultural tourism centers using the FAS method, the development directions are determined by conducting an analysis of the main factors. In this regard, the historical and cultural heritage of the settlements, attractive landscape ecological features allow for the organization of cultural, ethno-cultural, eco-cultural tourism activities.

Table 3. Assessment of tourism potential and organization of eco-cultural tourism activities in the villages of Tugh, Azykh and Taghlar using FAS methodology

Settlements	Physical factors	Accessibility factors	Socio-economic factors	Tourism activities
Tugh	-foothill exotic forest landscape ancient -Albanian monuments historical settlement -local architecture landscape and ecologically clean nature	- road rehabilitation - weakness of infrastructure - no tourism infrastructure - seasonal difficulties - not on tourist routes	- STA reserve status - protection of historical and cultural monuments - restoration of mining as heritage - community participation is desirable - restoration of agri-heritage	- cultural awareness - ecological - outdoor - eco-cultural - tourism routes
Taghlar	- attractive forest landscape - natural monuments (caves) - Albanian churches - local architecture and archaeology	- poor road infrastructure - no under infrastructure - no tourism infrastructure - seasonal difficulties - not on tourist routes	- traditional village life - community engagement - ecological heritage protection - cultural heritage restoration	- ecotourism - picnic - hiking and trekking - caving - tourist routes
Azykh	- Forest landscape - UNESCO cave - attractive ecological conditions and biodiversity	- access to the cave is possible, information is poor - roads have been restored - infrastructure is poor - tourism infrastructure is absent	- UNESCO World Heritage -preservation of historical and cultural heritage - a basis for economic revival	- Caving; - Ecotourism - Outdoor tourism - Hiking; - Picnic - Camping - Cultural tourism - Tourist routes
Integral assessment	**7,3**	**4,2**	**5,3**	**7,6**

From the analysis of the table, although the tourism potential of the mentioned settlements is high, the weakness of the basic infrastructure, the absence of overnight accommodation and catering services for tourists do not allow the organization of tourism activities. On the other hand, the presence of physical factors, direct support from the state, and the implementation of stimulating measures for business entities will support the development of tourism in the future.

The analysis of general socio-economic factors shows that the involvement of communities in tourism activities, the protection of cultural and natural heritage, and the restoration of traditional lifestyles will support the increase in tourism potential and the creation of added value. The existence of the potential for organizing various cultural, ecological, agri-eco and outdoor tourism activities in the study area will ensure its formation as an eco-cultural destination.

CONCLUSION

In conclusion, it should be noted that the higher ecological, cultural, ethno-cultural, eco-cultural tourism potential of the research points allows for the formation of new tourism products and increases competitiveness in the global tourism

market. The formation of tourist destinations in the research region, the joint use of cultural and eco-cultural heritage potential in the organization of TRZ is possible, which determines the advantages of tourism types in accordance with the FAS methodology. In this regard, it allows for the formation of the city of Shusha as a creative industry and cultural tourism destination, the formation of the Tugh settlement as a cultural and ethno-cultural center, the villages of Taghlar and Azykh, the surrounding areas as a caving, ecological, eco-cultural tourism zone. Here, the joint organization of ecological and outdoor tourism activities, the involvement of communities in agri-eco tourism will create added value for the region.

The integrated utilization of multiple destinations within the study area generates relative advantages among different tourism types by fostering interaction mechanisms and synergistic effects through the application of the FAS methodology in the comprehensive assessment of tourism potential. Development trajectories were identified by applying an integrative development model that combines cultural and eco-cultural heritage components in the formation of regional tourist destinations. Within this framework, the organization of tourism-recreation zones (TRZ) is based not solely on natural resource endowment but also on tangible and intangible cultural heritage assets. This approach enhances the distinctiveness of destinations and strengthens their competitive positioning in the international tourism market.

The results of the FAS-based assessment demonstrate that the strategic development of the city of Shusha as a hub for creative industries and cultural tourism is well justified. The city's rich historical and architectural heritage, strong musical and artistic traditions, and significant festival and event potential provide a solid foundation for its evolution as a creative economy center. This enables the promotion of innovative forms of cultural tourism, including event tourism, creative workshops, thematic cultural routes, and international festivals.

Simultaneously, the development of Tugh settlement as a cultural and ethno-cultural destination requires the integration of local ethnographic characteristics, folklore traditions, craftsmanship, and rural lifestyles into the tourism product. This direction supports the establishment of an inclusive, community-based tourism model through the synthesis of ethno-tourism and rural tourism elements, thereby reinforcing regional identity and socio-cultural continuity.

The villages of Taghlar and Azykh, together with their surrounding landscapes, possess substantial potential for speleotourism, ecological tourism, and eco-cultural tourism development. In particular, the presence of Paleolithic archaeological sites, such as the Azykh Cave, provides opportunities for positioning the region within the international scientific and educational tourism market. The organization of ecological and outdoor tourism activities—including hiking trails, geo-ecological excursions, biodiversity observation, and agro-ecotourism initiatives integrated with agricultural practices—can generate additional economic value and diversify tourism offerings.

The active involvement of local communities in agro-ecotourism processes enhances socio-economic sustainability, supports employment growth, and contributes to income diversification. A community-based tourism model simultaneously promotes the preservation of cultural heritage and the rational management of natural resources. Consequently, this integrative and multi-criteria assessment approach not only facilitates the sustainable formation of the region as a competitive tourism destination but also establishes a scientific foundation for long-term strategic development and increased competitiveness in the global tourism market.

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FROM CLOSED BORDER TO TOURISM DESTINATION: THE BARANJA TRIANGLE'S TRANSFORMATION FROM TRIANON TO SCHENGEN

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Abstract: Border regions in the post-socialist parts of Central and Eastern Europe have long been shaped by geopolitical fragmentation, infrastructural discontinuities, and economic peripheralization. The Baranja Triangle, located at the intersection of Hungary, Croatia, and Serbia, provides a particularly relevant case study due to its history of geopolitical fragmentation and the recent removal of both administrative and infrastructural border barriers. Recent developments, including Croatia's accession to the Schengen Area in 2023 and the completion of the M6–A5 motorway connection in 2025, have significantly improved the region's accessibility. This study examines whether these changes create realistic conditions for the tourism-based reintegration of the Baranja Triangle within a broader cross-border regional framework. A mixed-methods approach was applied, combining geopolitical and spatial analysis, GIS-based accessibility modeling, a questionnaire survey among local residents (n = 60), and twelve semi-structured interviews with regional stakeholders; the findings were synthesized in a TOWS matrix. Results indicate that although physical and administrative barriers have largely disappeared, the creation of an integrated cross-border tourism destination depends primarily on institutional coordination and strategic development frameworks. Survey results show a moderately positive local attitude toward tourism, cross-border cooperation, and infrastructural improvements, while correlation analysis indicates that residents perceive these factors as interconnected elements of regional development. The study concludes that heritage tourism, ecotourism, cycling tourism, and wine–gastronomic tourism offer realistic pathways for sustainable development, enabling the Baranja Triangle to gradually transform from a peripheral borderland into a competitive tourism destination within the Danube region.

Keywords: cross-border tourism, Schengen Area, Baranja Triangle, infrastructure development, regional integration, sustainable tourism, geopolitical changes

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INTRODUCTION

The Baranja Triangle (Hungarian: Baranya-háromszög) is situated on the northeastern periphery of Croatia, at the tri-border intersection of Hungary, Croatia, and Serbia. The region is bounded by the Hungarian-Croatian land border to the north, the Danube River to the east, and the Drava River to the south and southwest. Today, the area comprises the city of Beli Manastir (Pélmonostor) and eight municipalities. Its geographical position—characterized by the floodplains of two major rivers and lowland topography—fundamentally determines both its natural endowments and its socioeconomic development trajectory. The Bansko Hill (Bansko brdo / Báni-hegy), at 245 meters in elevation, and its surrounding area offer favorable conditions for viticulture and wine tourism.

The region's geographically strategic position astride multiple borders has profoundly shaped its development throughout the twentieth century. Border changes, political instability, and economic marginalization have resulted in prolonged regional isolation, which in turn has contributed to significant demographic decline and economic stagnation.

Similar to border regions across post-socialist countries, the Baranja Triangle has demonstrated acute vulnerability to processes of population loss and economic contraction. In recent years, tourism development has emerged as one of the most significant instruments for counteracting these trends. European Union-supported CBC (cross-border cooperation) programs (notably Interreg) have created new opportunities for peripheral regions to strengthen their economic position through transnational partnerships that transcend political boundaries (Tóth et al., 2020; Nemes & Happ, 2024). For the Baranja Triangle, the Danube and Drava rivers form a natural axis that could connect tourist attractions on both sides of

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the border and provide a foundation for developing water-based tourism, cycling routes, and other thematic initiatives, notably wine tourism, across the region. In recent years, the region's geopolitical situation has shifted markedly: Croatia's accession to the Schengen Area on January 1, 2023, and the interconnection of the Hungarian M6 and Croatian A5 motorways in October 2025 have opened new transportation and economic perspectives for CBC initiatives.

These developments remain exceptionally recent, and the academic literature has not yet examined their impacts on the Baranja Triangle. This juncture therefore offers a unique opportunity to explore the economic and tourism-based reintegration of a region hitherto characterized by geopolitical isolation.

The aim of this study is to examine whether, in light of Schengen accession and new transport infrastructure, the Baranja Triangle's integration into a broader cross-border regional framework based on tourism development is realistic. Furthermore, it investigates whether a sustainable tourism economy, rooted in local assets, can be established in the region.

Theoretical Framework

Prior to the fall of the Iron Curtain, economic development in the border regions of Eastern Europe was constrained by insufficient investment and limited CBC (Tóth et al., 2020). These conditions frequently resulted in peripheralization and outmigration (Lang, 2015). Following the European Union accession of Eastern Bloc countries, however, programs designed to address structural disparities imparted new momentum to these regions (Wastl-Walter, 2009).

Although a significant portion of the EU population resides in border areas, their economic performance continues to lag behind the continental average; consequently, the 2014–2020 programming period allocated substantial resources—approximately €6.6 billion—toward their development (European Commission, 2017).

Similar spatial disparities are particularly pronounced along the Danube corridor, where regions with markedly different levels of economic development coexist, making macro-regional cooperation an essential framework for reducing territorial inequalities and fostering coordinated development (Hardi, 2012).

Tourism has emerged as one of the most widely adopted instruments of CBC, particularly in contexts of shared historical heritage (Kozak & Buhalis, 2019; Studzieniecki & Mazurek, 2007). This approach, however, necessitates novel forms of state coordination (Zaitseva et al., 2016). According to Timothy (2000), the border itself may function both as an independent motivational factor in travel and, as Ryden (1993) emphasizes, as a facilitator of the experiential distinctiveness of simultaneous presence in multiple nation-states. In the case of the Baranja Triangle, the fundamental question—following Matznetter's (1979) typology—is whether two independent destinations will persist on opposite sides of the border, or whether their convergence will produce an integrated tourism destination.

Social innovation plays a critical role in CBC initiatives: it strengthens local identity, facilitates the adoption of best practices, and supports sustainability objectives (Pentz, 2023; Marton et al., 2021). This process generates interaction between communities and tourists, thereby fostering peaceful coexistence (Michalkó et al., 2018), as exemplified by the network-based development model of the Veszprém-Balaton region (Lőrincz et al., 2023).

Tourism innovations typically emerge from complex network collaborations—including tourism destination management (TDM) organizations and clusters (Nagy, 2022; Nagy & Aubert, 2025)—within which consumers actively shape experiences through co-creation mechanisms (Marien & Papp, 2024).

Beyond open-ended experience innovation (Hoarau-Heemstra, 2011; Nagy, 2014), the development of the Baranja Triangle may be significantly shaped by smart destination frameworks and digitalization (Marinac et al., 2025). Innovation is driven not only by competition and technological advancement but also by public sector support (Hall & Williams, 2008). Finally, the ascendancy of alternative tourism forms—such as ecotourism (Szabados & Merza, 2023)—may represent a substantial breakthrough opportunity for the region (Csapó & Marton, 2010).

Considering established best practices in the tourism-led development of formerly closed border regions, the Baranja Triangle could draw valuable lessons from the Austria–Slovenia–Hungary tri-border area. In this region, numerous local initiatives have gradually evolved into EU cofinanced rural development programs linked to the tourism sector.

These initiatives have contributed not only to the gradual mitigation of border-area peripheralization but also to the broader socio-economic upscaling of the territory. The underlying development drivers in the Baranja Triangle closely resemble those observed in the Őrség and Neusiedler See regions, where development strategies are rooted in well-preserved natural and cultural landscapes, local traditions, and principles of ecological sustainability. EU-funded initiatives such as 'Iron Curtain Cycling' integrate the area and the local attractions into internationally visible context and tourism products (EuroVelo, 2025), projects like 'From Mill to Mill' build upon existing heritage assets to create new tourism attractions (Interreg Slovenia-Hungary Program, 2025), while programs such as 'PaNaNet+' integrate previously fragmented nature-based assets into internationally visible tourism products and promote environmental awareness and sustainability education through cross-border cooperation (Interreg V-A AT-HU Program, 2025).

METHODS AND SOURCES

Our research examined the impact of geopolitical changes and transformations in transport infrastructure on the tourism potential of the Baranja Triangle. We also analyzed the role of CBC in the region's tourism sector, assessed existing forms of tourism and their developmental opportunities, and explored the attitudes of the local population toward tourism and cross-border collaboration (Figure 1). A mixed-methods approach was employed. For spatial analyses, we utilized QGIS 3.40 ("Bratislava") software to map tourism attractions in the Baranja Triangle and its immediate surroundings, and to examine the region's transportation infrastructure and accessibility. For travel time-based accessibility analysis, we used a combination of the TravelTime API and QGIS, which enabled route and isochrone calculations based on current road network data.

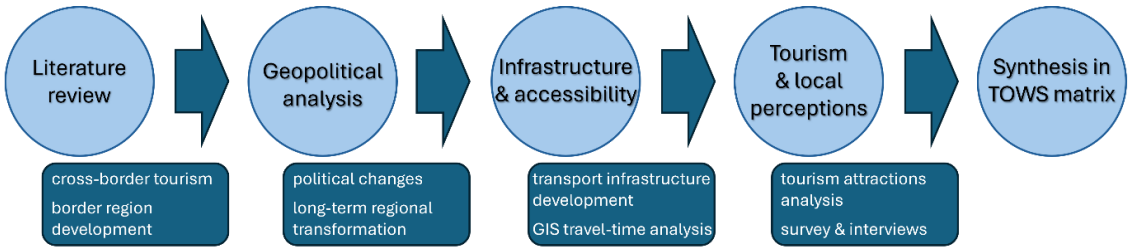


Figure 1. Flowchart of the methodology (Source: Own illustration)

To gauge local perspectives on tourism, CBC, the connection of the M6 and A5 highways, and Croatia's accession to the Schengen Area, we conducted a quantitative survey. Secondary sources included relevant academic literature and documents from European Union CBC programs. The questionnaire was administered online using Google Forms. Participation was voluntary and anonymous. Eligibility required respondents to be at least 18 years old and residents of the Baranja Triangle. Data collection relied partly on Facebook advertising and primarily on snowball sampling. While this method is suitable for reaching hard-to-access populations, a key methodological limitation is its deviation from classical principles of representative sampling; thus, findings cannot be generalized to the entire population (Atkinson & Flint, 2001).

The questionnaire comprised two sections: the first collected demographic data, while the second addressed respondents' assessments of their economic situation, the relationships between CBC, tourism, and transport infrastructure development, and the perceived impacts of these factors on their livelihoods and the development of the Baranja Triangle. Quantitative data were analyzed using Jamovi 2.6.44 statistical software, employing descriptive statistics as well as non-parametric comparative (Mann-Whitney U) and correlational (Spearman's rank correlation) methods.

To compensate for the small questionnaire sample size (n=60), we conducted twelve semi-structured interviews in the region to refine our findings. Interviewees represented a diverse range of local stakeholders, including agricultural producers, entrepreneurs, educators, and representatives of local public and civic life. The sample also included a winemaker, a municipal council member, organizers of cultural and gastro-tourism events, as well as church and community representatives, allowing tourism-related perceptions to be explored from multiple social and economic perspectives. Finally, results from the various sources were synthesized in a TOWS matrix to identify the region's key development opportunities and challenges.

RESULTS AND ANALYSIS

1. Geopolitical Analysis: The Impact of Historical-Political Changes on Tourism Potential

The Baranja Triangle has been shaped by numerous geopolitical changes throughout its history, which continue to influence its demographic processes, ethnic composition, economic situation, and tourism potential. Within the broader Danube region, such historical discontinuities are not exceptional. The region has repeatedly experienced periods of fragmentation and reintegration shaped by shifting political borders, imperial structures and geopolitical conflicts (Hardi, 2012). From the founding of the Hungarian state in 1000 until 1541, the territory of the present-day Baranja Triangle was under the sovereignty of the Kingdom of Hungary; however, over the subsequent approximately 500 years, the region was ruled by six different state formations. The twentieth century alone witnessed five shifts in sovereignty.

This turbulent past has resulted in a significant historical heritage, while the continuous transformation of the ethnic structure has produced a culturally diverse landscape that persists to this day.

- 1000–1541 – The Period of the Kingdom of Hungary: Agricultural prosperity and the development of the settlement network established a long-term foundation for the region's agricultural traditions and cultural heritage. The historical roots of the contemporary settlement structure were laid during this period, and a wine-region identity already characterized the Bansko Hill (Báni-hegy) area.
- 1541–1687 – The Period of Ottoman Rule: The region's military-logistical significance—evidenced by Suleiman I's bridge connecting Osijek (Eszék) and Darda (Dárda), the Osijek fortress, the military road traversing the region, and the proximity to the battles of Mohács (1526, 1687)—created considerable heritage tourism value. The settlement of South Slavic peoples and the strengthening of Reformed communities continue to define the region's ethnic, cultural, and religious diversity.
- 1687–1920 – The Era of the Habsburg Empire and the Austro-Hungarian Monarchy: The Belje Estate as a modern agricultural enterprise, along with church construction and infrastructural development, left behind a substantial volume of built heritage. The agricultural and historical legacy of this period remains a potential tourism resource.
- 1920–1991 – The Period of the Kingdom of Serbs, Croats and Slovenes, the Kingdom of Hungary, and Yugoslavia:

Border changes, Yugoslav land reform, and isolation due to a lack of transportation infrastructure hindered the area's development. However, the multiethnic society and cultural imprints of the Yugoslav era created a unique identity that could be integrated into contemporary tourism offerings. An example is Yugonostalgia, a form of longing for the past—a bittersweet nostalgia for the positive, idealized aspects of the former socialist Yugoslav state.

- 1991–1998 – The Years of War: The Serb-Croatian conflict, emigration, and economic collapse severely damaged the region's general and tourism infrastructure. Nonetheless, the major clashes that occurred in the area can serve as important sites of remembrance and education regarding the war.
- 1998 to the Present – The Period of Independent Croatia: Croatia's accession to the European Union and the Schengen Area, along with the significant improvement in transportation infrastructure (the M6–A5 highway), has substantially enhanced the region's accessibility. CBC and cultural-gastronomic tourism have gained new development opportunities.

2. Infrastructure development relevant to tourism

Following the Treaty of Trianon, the Baranja Triangle was incorporated into the Kingdom of Serbs, Croats, and Slovenes in 1920 (Hajdú, 2011; Végh et al., 2021; Bali & Matucza, 2021). The region entered a period of persistent marginalization, driven by the division of the previously integrated Baranya County and the Belje Estate (Székely, 2014; Végh et al., 2021), the dissolution of landholding structures after Yugoslav land reform, the diminished political-economic role of the Hungarian and German landowning class, and the continuous deterioration of transportation connections (Bali & Matucza, 2021). Until 1941, the Baranja Triangle remained under Serbian administration (as part of Vojvodina, Bačka, and later the Danube Banovina) but lacked functional transportation links to these core territories (Hajdú, 2011, Végh et al., 2021). Notably, no road or railway bridge crossed the Danube in the region at that time. Until 1962, access from Croatian territories was limited to a single railway bridge in Osijek that also carried road traffic, reinforcing the area's pronounced isolation.

This isolation began to ease with key infrastructure projects. The first road bridge across the Drava toward Croatian territories was constructed in Osijek (Eszék) in 1962, followed by a bridge at Batina (Kiskőszeg) across the Danube toward Serbian territories in 1974 (Végh et al., 2021). Following Croatian independence, the state played a pivotal role in further improving connectivity. Strategically important road bridges across the Drava were built in the Belišće (Belistye) area in 2001 and near Osijek (Eszék) in 2007. A highway bridge crossing the Drava was completed near Petrijevci (Petróc) in 2016 (Pirisi & Reményi, 2008; Végh et al., 2021).

While the 2015 European refugee crisis temporarily led to stricter border controls and enhanced surveillance at the Croatian-Hungarian border, Croatia's accession to the Schengen Area on January 1, 2023, ultimately enabled complete free movement across this border section.

The combination of border-free travel and the connection of the M6 and A5 motorways—completed in October 2025 as part of the Vc corridor—has significantly advanced the accessibility of the Baranja Triangle. As demonstrated by the isochrone map from our GIS travel-time analysis, the Hungarian regional tourism hub of Pécs is now reachable within a 60-minute drive from Beli Manastir (Pélmonostor). Furthermore, five of the eight municipal centers of the Baranja Triangle—Petlovac (Baranyaszentistván), Popovac (Baranyabán), Jagodnjak (Kácsfalu), Kneževi Vinogradi (Hercegszőlős), and Čeminac (Laskafalu)—are also located within this 60-minute travel-time threshold from Pécs (Figure 2).

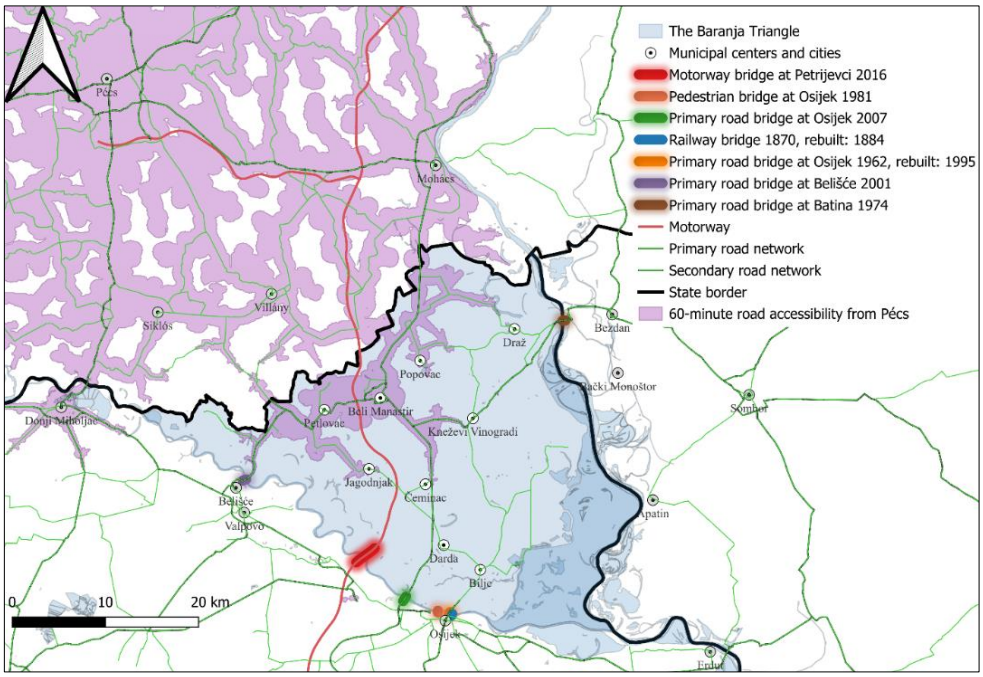


Figure 2. The road network and accessibility of the Baranja Triangle (Source: Own illustration)

This represents a profound change. During periods of armed conflict, the border was completely impassable. Even during times of Yugoslav-Hungarian political confrontation, administrative barriers posed significant obstacles. The current situation—featuring the most open border in the past 100 years—was achieved not primarily through infrastructural development, but through administrative measures and a fundamental transformation of the border regime. This highlights a key limitation of isochrone analysis in this context: the 2025 highway connection builds upon a baseline where, during past political crises, crossing the Hungarian border into the region was not possible at all.

Croatia's accession to the euro area does not currently constitute a primary driver of tourism development in the Baranja Triangle, as the region forms a functional cross-border unit with adjacent Hungarian territories where euro adoption is not anticipated in the near future. Nevertheless, the introduction of the euro increases the transparency and comparability of price levels for Western European visitors. Given that tourism-related prices in the Baranja area remain generally lower than in most parts of Croatia and Western Europe, this may enhance the region's attractiveness and generate moderate increases in short-term inbound tourism from euro-area markets.

3. Institutional Connections Analysis: The Role of Cross-Border Cooperation in Development and Territorial Cohesion Processes in the Baranja Triangle

The socioeconomic changes of the past two decades—particularly Hungary's and Croatia's accession to the European Union and Croatia's subsequent accession to the Schengen Area in 2023—have created the most favorable geopolitical and financial conditions for the Baranja Triangle along the Hungarian-Croatian border in the past hundred years. This favorable position rests on two pillars:

- Institutional sister-city relationships established since the 1970s.
- Initiatives promoting cooperation along the EU's external borders (e.g., the 2002 External Border Initiative) and continuously growing Interreg funding.

3.1. Institutional and Twinning-Type Cooperation

Sister-city relationships established from the 1970s onward (e.g., Mohács–Beli Manastir, 1970; Pécs–Osijek, 1973; Baranya County–Osijek-Baranja County, 1995; University of Pécs–Josip Juraj Strossmayer University, renewed in 2024) are primarily of sociocultural significance, with limited economic impact (Reményi, 2008; Pámer, 2019). Twinning relationships among smaller municipalities can facilitate economic convergence only in the long term; in the absence of declared political will, project-based cooperation currently remains limited.

3.2. Organizational-Based Cooperation

- Danube-Drava-Sava Euroregion (c. 1998–2010): A top-down initiative that exceeded the region's institutional maturity and resources—representing a "missed opportunity" (Síkfői, 2011). During the pre-Schengen period, it failed to resolve the region's peripheral position and generated no significant socioeconomic impacts.
- Pannon EGTC (European Grouping for Territorial Cooperation) (2010–present): An organization blending bottom-up and top-down approaches within an EU legal framework, representing the common interests of border counties. Its activities are primarily project-based (e.g., CBJointStrategy, UPSCALE DDS, Amazon of Europe Biketrail, Pannon Future Forest) and focused on maximizing EU funding, making it potentially the region's most important shared development organization in the short to medium term. On this basis, there is a need for a transnational development program independent of temporary grant funding that integrates the Baranja Triangle's strategic strengths and actively involves the two county-level and national governments (see the TOWS matrix later).

3.3. Relevant Outcomes of EU Co-Financed Interreg Programs in the Baranja Triangle

- Pre-2004 (Phare CBC and Interreg III Slovenia–Hungary–Croatia): Focused on capacity building and pilot projects; despite pressing infrastructure needs, these programs prioritized "soft" development.
- 2007–2013 IPA CBC (€52M, 164 projects): The most significant project for the Baranja Triangle was the "De-Mining" initiative. In tourism, Pécs–Osijek cooperation occurred without generating meaningful territorial cohesion effects.
- Interreg V-A (2014–2020, €60M): Exhibited low territorial relevance to the Baranja Triangle; projects were primarily cultural and focused on cycling/water tourism in the larger hubs of Pécs, Osijek, and Mohács.
- Interreg VI-A (2021–2027, €58M): Characterized by a late start and strong competition; notable projects include the Amazon of Europe bicycle route (involving visitor center expansion in Osijek and infrastructure in Siklós, etc.) and joint projects linking Mohács, Belišće, and Osijek. Interregional and transnational Interreg programs (Danube, Central) are available but difficult to access due to their complexity and currently represent marginal funding sources for the region. For the Baranja Triangle to achieve a genuine transformation in scale, integrated development programs are necessary. These must be prepared with the involvement of local stakeholders, transcend particular interests, and strategically exploit the barrier-free physical and legal environment of the Schengen Area and the coordination capacity of the Pannon EGTC, particularly in the areas of wine, eco-, water, and heritage tourism.

4. Attraction Analysis: Forms of Tourism and Their Development Opportunities in the Baranja Triangle

The role of tourism as a tool for CBC and regional development continues to strengthen within the European Union (Bujdosó et al., 2015). For the Baranja Triangle, Croatia's accession to the Schengen Area and the elimination of border controls have created favorable conditions for cross-border tourism cooperation. Cross-border tourism networks supported in Croatian-Hungarian CBC projects—such as green routes or various thematic tourism trails—were initially developed to foster social innovation and the rapid adoption of neighboring "best practices" (Csapó et al., 2015; Szabó et al., 2014). However, most of these initiatives subsequently collapsed due to a lack of proper management, although certain elements persist today. Tourism in the Baranja Triangle and southern Baranya is not significant in either country, yet the region possesses considerable development potential (Figure 3). In our view, a shared, cross-border tourism destination created through coordinated development could provide a competitive advantage and greater international appeal.

The region’s strong embeddedness in Hungarian socio-cultural traditions may represent a measurable driver of inbound tourism from Hungary, particularly if tourism products are strategically integrated with nearby flagship destinations on the Hungarian side, such as the city of Pécs, the Villány–Harkány tourism area and Mohács. This potential is primarily rooted in shared cultural heritage and historical ties, rather than in the relatively small number of ethnic Hungarians currently residing in the area. The examination of tourism in the Baranja Triangle also demonstrates that regional tourism development requires broad, multi-level cooperation (Marton et al., 2016). With the end of its previous isolation, the region's cultural and natural heritage has become a viable resource for tourism development.

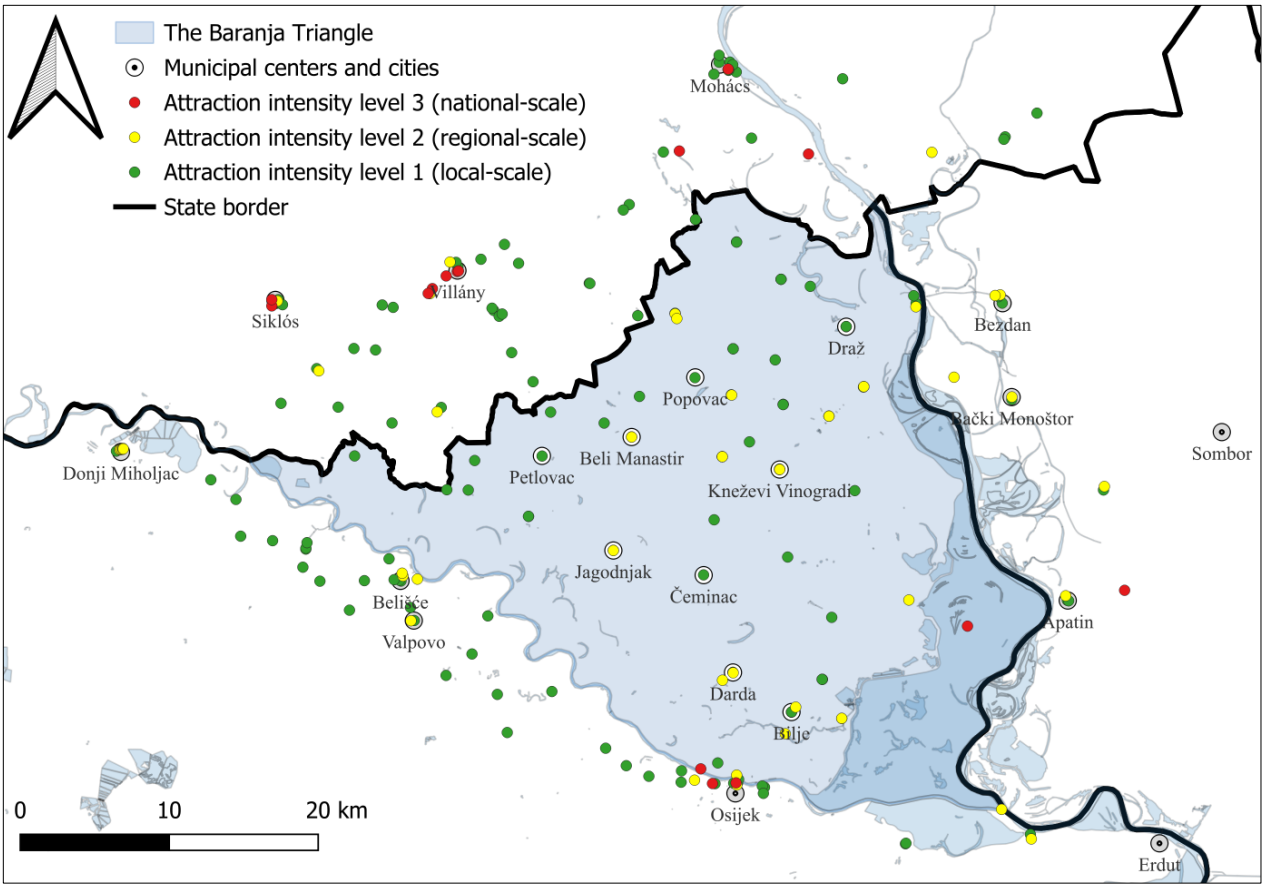


Figure 3. Attractions of the Baranja Triangle and its immediate surroundings (Source: Own illustration)

Nevertheless, despite substantial support, increases have been observed primarily in excursion traffic, while the number of tourists and overnight stays remains very low (Zsibók & Egyed, 2024). The Baranja Triangle's tourism product portfolio is diverse. It is primarily linked to leisure tourism and largely based on natural resources, with the exception of cultural tourism. Identical product types appear on both sides of the border, yet cooperation between them is limited, and partnerships formed within CBC projects typically do not survive beyond the mandatory project maintenance period. The coordinated development of these products and the creation of a shared, cross-border destination could establish the region's unique selling proposition—a characteristic that could also attract international market interest (Spiegler et al., 2023).

The territory's tourism products can be fundamentally divided into three main categories:

- Cultural Tourism Built on Shared Historical Past and Heritage Values:

Border regions are often connected by shared history, identity, culture, traditions, and mixed population composition (Varga et al., 2025). This observation applies strongly to the examined region. The Danube area has been an important military route since Roman times, and heritage values from multiple periods exist on both sides (e.g., the Limes and Ottoman-era monuments). Building on these, cultural tourism can be developed through mirror projects. The main sub-products include:

- Heritage tourism. The region contains a significant concentration of archaeological heritage and forms part of the Roman Danube Limes cultural landscape, sections of which were inscribed on the UNESCO World Heritage List in 2021. However, the Batina–Ilok sector (Ad Militare–Cuccium) remains under nomination and currently plays only a marginal role in regional tourism development. Most archaeological remains are still located on agricultural land, and the timing and format of their future public presentation remain uncertain. In the longer term, these sites may become an important component of the region's cultural tourism portfolio, complementing its existing natural and cultural attractions. The "Roman Emperors and Danube Wine Route"—a European Cultural Route—may similarly represent an additional, currently underutilised opportunity for integrating the region into wider international heritage tourism networks.
- Dark tourism. The 500th anniversary of the Battle of Mohács directs attention to the region's Ottoman-era devastation. The development of this memorial site could strengthen dark tourism, and the coordinated development of monuments found on both sides of the border could create international appeal.
- Festival tourism. The region's festivals are diverse, with nearly every settlement hosting some form of gastronomic event. These currently have primarily local and regional appeal. Through program coordination and joint marketing, they could generate greater interest. The Busójárás in Mohács—listed as Intangible Cultural Heritage—is the flagship event of festival tourism and could have significant drawing power for tourism in the Baranja Triangle.

- Active and Ecotourism:

Outstanding examples of cross-border development can be realized in the fields of active and ecotourism.

- Bicycle tourism. The region's infrastructural conditions are favorable. Two EuroVelo routes (EuroVelo 13 and 6)

increase international visibility. Improved visitor facilities and targeted marketing could encourage cyclists from border regions to explore the area. With the spread of electric bicycles, the target audience expands to include a more prominent senior demographic, for whom the Baranja Triangle can be a favorable destination.

- Walking tourism / Green routes. Two green routes were established through CBC projects (Baranya Green Route and Ormánság Green Route). Development based on local resources can be effective, but without appropriate management organizations, their tourism and rural development role remains limited.
- Ecotourism. Development is led by the Danube-Drava National Park and the Kopački Rit Nature Park. Previous CBC projects have fostered strong professional cooperation, and the ecotourism offerings on both sides of the border are innovative and have generated significant interest.

- Wine and Gastronomic Tourism:

The Baranja Triangle has a significant tradition of viticulture and winemaking (Tarnai, 2025). Building on this and the region's rich gastronomic culture, a unique offering can be developed. Beyond wine, paprika, kulen sausage, and smoked carp, numerous local products create demand. The development of local festivals (kulen festival, paprika festival, Fish Days in Kopačevo, Wine Marathon in Zmajevac, etc.) could result in broader appeal.

5. Local Society's Supportive Attitude toward Tourism and Cross-Border Cooperation Programs

Our questionnaire survey aimed to explore the attitudes of residents in the Baranja Triangle regarding tourism, CBC, Croatia's accession to the Schengen Area, and the expected impacts of the M6–A5 highway connection on both individual living conditions and the region's overall development.

- Sample Characteristics:

A total of 60 individuals participated in the survey (30 women, 50.0%; 30 men, 50.0%). The mean age of respondents was 45.3 years (range: 22–67 years). Regarding the highest level of educational attainment, 2 individuals (3.3%) completed primary education or less, 3 (5.0%) completed vocational training, 7 (11.7%) completed general secondary education, 16 (26.7%) completed technical secondary education, and 32 (53.3%) completed tertiary education or higher (college, university, or doctoral degree). As noted in the methodology section, snowball sampling does not yield a sample representative of the entire Baranja Triangle population, a limitation reflected in the educational attainment distribution. Due to the voluntary nature of the survey, individuals with greater interest in tourism, CBC, and transportation/economic development likely participated at higher rates, explaining the overrepresentation of respondents with tertiary education.

- Descriptive Results:

Respondents provided answers on a 7-point Likert scale (1 = worst, 7 = best). Based on descriptive analysis, respondents overall assessed the development of the Baranja Triangle as moderately positive (mean = 4.42), while expressing relative dissatisfaction with their own current economic situation (mean = 3.87). Respondents assessed tourism's impact on the Baranja Triangle as moderately positive (mean = 5.03); however, they viewed tourism's impact on their own material situation more negatively (mean = 3.67). Regarding expected benefits from tourism development, respondents most frequently highlighted local infrastructure development (n=35, 57.4%), expansion of work and business opportunities (n=34, 55.7%), improvement of the settlement environment (n=33, 54.1%), and revitalization of cultural and community life (n=32, 52.5%). CBC along the Croatian–Hungarian and Croatian–Serbian borders was assessed as having a moderately positive impact on the region (mean = 4.28), while its impact on personal quality of life was viewed as moderate (mean = 3.98). Primary expectations from CBC centered on the revitalization of cultural and community life (n=33, 55.0%), expansion of social networks (n=31, 50.8%), improvement in work and business opportunities (n=29, 47.5%), and local infrastructure development (n=26, 42.6%). Overall, respondents evaluated Croatia's accession to the Schengen Area and the realization of the M6–A5 highway connection as rather positive for the Baranja Triangle's development (mean = 5.20), while viewing their impact on personal living conditions as moderately positive (mean = 4.58).

The most frequently anticipated effects included local infrastructure development (n=30, 49.2%), expansion of work and business opportunities (n=21, 34.4%), improved accessibility of services (n=19, 31.1%), expansion of social networks (n=18, 29.5%), and a general improvement in the daily quality of life of the local population (n=18, 29.5%).

- Analysis of Gender Differences:

Following descriptive analysis, we examined gender differences in responses to the Likert-scale items. As the data did not consistently meet assumptions of normality, we employed the Mann–Whitney U test. Results indicated no statistically significant difference between male and female responses for any of the examined items ($p > 0.05$ in all cases), with low effect sizes, suggesting minimal gender-based variation in attitudes.

- Correlational Analyses:

Finally, we examined associations between variables using Spearman's rank correlation analysis. Results demonstrated moderate to strong positive correlations between assessments of the individual and regional impacts of tourism development, CBC, transportation infrastructure improvements, and Croatia's Schengen accession ($\rho \approx 0.42–0.69$; $p < 0.001$).

Overall, the results suggest that in respondents' perceptions, tourism development, CBC, improved transportation infrastructure, and Schengen accession are closely interconnected factors in assessments of both individual living conditions and the Baranja Triangle's economic and social development.

Insights from the semi-structured interviews broadly reinforced these findings. Interviewees emphasized that the region’s economic profile remains predominantly agricultural, with tourism currently playing a supplementary role. At the same time, several respondents highlighted potential resources that could support future tourism development, including cultural festivals and community events, wine-related tourism, and the region’s rich historical and cultural heritage.

Overall, the interviews suggest that local actors perceive tourism as a promising development opportunity which, although not yet a dominant economic sector, may contribute to the long-term economic diversification of the Baranja Triangle.

Analysis: Development Matrix Based on External and Internal Environmental Factors of the Baranja Triangle—TOWS Matrix

	Strengths	**Weaknesses**
Opportunities	**SO Strategies** (Leveraging Strengths)	**WO Strategies** (Counterbalancing Weaknesses)
1. EU and national development funding (e.g., Interreg CBC/ Danube/Central, RRF etc.). 2. Climate adaptation, green transition, and renewable energy utilization. 3. Cultural and tourism momentum (Mohács 2026 commemorations, legacy of Pécs European Capital of Culture, growing demand for soft tourism—wine, cycling, eco-, and water-based). 4. Unified Schengen territory (Croatia-Hungary).	**1. Develop joint heritage tourism products with international appeal by linking key assets** (e.g., Zsolnay Cultural Quarter in Pécs, Busójárás in Mohács, Mohács 500 commemorations, Tvrđa in Osijek) through EU-funded programs. **2. Develop integrated wine, gastronomic, eco-, and cycling tourism products with international appeal** (e.g., Villány–Siklós Wine Route with Slavonia; Amazon of Europe cycling route; Kopački Rit–Béda-Karapancsa floodplain reserve). **3. Joint development of the cross-border logistics hub function** – Mohács bridge and port + Osijek Airport (Pécs–Pogány Airport, "Vojvodina's Smile" motorway, etc.).	**1. Jointly lobby for the implementation of missing transport links to mitigate peripherality** (e.g., connecting the M60 motorway to the Croatian A13, motorway developments in Vojvodina, upgrading Pécs Airport). **2. Launch joint vocational training programs to reduce outmigration by fostering high value-added local products (primarily food),** involving the University of Pécs, University of Osijek, and vocational training centers. **3. Create a joint "Smart-Eco" digital eco-region—establish a digital platform centered on Osijek–Pécs,** leveraging 5G and smart tourism technologies.
Threats	**ST Strategies** (Protecting Strengths)	**WT Strategies** (Minimizing Threats)
1. Outmigration, demographic aging. 2. Climate change (droughts, flash floods, etc.). 3. Competition with the Croatian coast and Lake Balaton (lower-cost tourism) 4. Geopolitical tensions (border traffic, migration)	**1. Launch transnational Croatian–Hungarian and local (municipal-level) youth retention programs—** establish a Pécs–Osijek startup incubator and subsidized housing initiatives (public sector). **2. Create and promote an independent, joint "Baranja Triangle" eco-experience soft tourism brand,** incorporating elements such as Villány–Slavonia wine tourism, Kopački Rit, Mohács floodplain areas, and cycling tourism. **3. Further develop port infrastructure—**expand promenade boat ports in Mohács, Batina, and Osijek; develop floodplain free ports.	**1. Develop a joint Croatian–Hungarian demographic pact project—**introduce state-involved subsidies and incentives to counteract population decline. **2. Establish a climate adaptation and disaster management pact—**a Croatian–Hungarian state and county-level agreement for flood protection in floodplain areas and drought management.

CONCLUSION

Croatia's accession to the Schengen Area and the completion of the M6–A5 motorway connection have enabled the Baranja Triangle to reclaim its historical role as a relational space along the Danube's north–south axis, moving beyond its status as a peripheral dead end over the past century. Following the imperial shifts, conflicts, and physical border closures of the twentieth century, the removal of physical and political barriers presents a reintegration opportunity of historical significance. However, seizing this opportunity is not automatic.

Our findings indicate that improved motorway connectivity and the Schengen opening alone do not resolve the socioeconomic problems stemming from long-term isolation; rather, they represent necessary but insufficient conditions for convergence. The decisive factor lies in the institutional management of geopolitical reintegration.

This requires stronger cooperation frameworks anchored in the EGTC and Interreg programs, coordinated governance across state, county, and local levels, and the implementation of an integrated cross-border development program—one that articulates objectives transcending particularistic interests.

The moderately positive and supportive attitude of local society (scoring 4–5 on a 7-point scale), corroborated by insights from the semi-structured interviews, suggests that CBC-based tourism development initiatives possess social legitimacy. At the same time, the population expects tangible outcomes in the form of job creation, entrepreneurial opportunities, infrastructure improvements, and an enhanced quality of life. Correlation results indicate that residents perceive tourism, CBC, Schengen accession, and the M6–A5 motorway as mutually reinforcing elements of a shared development pathway, which is conducive to the acceptance of complex, multi-faceted tourism strategies.

Analysis of the TOWS matrix and our empirical findings clearly identifies dark tourism, the expansion of cycling networks, wine tourism, and ecotourism as locally grounded development directions that align realistically with the characteristics of the Baranja Triangle. Combining these forms points toward a sustainable and diversified tourism model capable of partially mitigating outmigration and population aging, even if it cannot fully offset underlying demographic and structural challenges. The future success of the Baranja Triangle hinges on its ability to transform geopolitical openness and the infrastructural turning point into a jointly articulated cross-border vision and effective institutional cooperation frameworks. Tourism emerges as a historically novel yet rapidly integrating function within the region's economy and self-image. The "recovery" of its Danube-oriented relational role, coupled with smart, heritage-focused destination development, jointly charts the region's long-term trajectory from Trianon to Schengen and beyond.

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List of Abbreviations: CBC – Cross-Border Cooperation; EGTC – European Grouping of Territorial Cooperation; EU – European Union; GIS – Geographic Information System; QGIS – Quantum Geographic Information System; RRF – Recovery and Resilience Facility; TDM – Tourism Destination Management; TOWS – Threats–Opportunities–Weaknesses–Strengths; Abbreviations used in the TOWS matrix: SO – Strengths–Opportunities; WO – Weaknesses–Opportunities; ST – Strengths–Threats; WT – Weaknesses–Threats;

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AN INTEGRATED ML AND GEOSPATIAL FRAMEWORK FOR CONTEXT-AWARE SHORT-TERM CONGESTION FORECASTING IN TOURISM-HEAVY URBAN MOBILITY NODE

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Abstract: Tourism-heavy urban mobility nodes often experience short, intense congestion spikes where visitor surges interact with commuter-related traffic. Despite growing interest in smart mobility management, few studies integrate real-time computer vision sensing with uncertainty-aware machine learning to support operational decision-making at tourism-intensive urban nodes. This study aims to develop and validate a real-time, uncertainty-aware traffic prediction framework that provides actionable, short-horizon (15-minute) congestion intelligence in such areas. Town Quay (Southampton, UK) is used as a case study. Three months of continuous webcam footage (July–September 2025) were processed with a YOLO + SORT pipeline to generate 15-minute vehicle counts. Counts were enriched with contextual features capturing weather (clear/foggy/rainy), day–night cycle, and day type (business vs. leisure). CatBoost and LightGBM were trained using a chronological split (first two months for training, third month for testing). Uncertainty quantification combined conformal prediction intervals with Gaussian Mixture Model (GMM). Traffic volumes varied systematically with context, with the highest average loads occurring during clear-weather daytime business periods. The framework achieved MAE = 43.62, R^2 = 0.902, and CCC = 0.94. These findings demonstrate that integrating computer-vision traffic sensing with contextual feature engineering and uncertainty-aware learning yields reliable, interpretable 15-minute congestion forecasts. This enables proactive, risk-informed interventions (e.g., port-arrival coordination, adaptive traffic control) that help protect the physical carrying capacity and heritage-setting quality of tourism-intensive areas while maintaining everyday urban mobility.

Keywords: traffic prediction, tourism mobility, urban mobility node, geospatial analysis, machine learning, intelligent transport systems, urban sustainability

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INTRODUCTION

Tourism presents a range of challenges for urban environments, including traffic, environmental degradation, and strain on local infrastructure and services (Kibiro & Mwangi, 2025). In many tourist destinations, vehicle congestion can spike dramatically during peak seasons or local events. These surge traffic flows not only slow down vehicle movement and create long queues but also disrupt the daily lives of local residents. This challenge is increasingly documented in mobility-and-tourism studies (Nyong et al., 2024; Artemyev et al., 2025). Ghazali et al. (2019) found a significant correlation between traffic congestion and reduced quality of life in Seri Kembangan, Malaysia, citing frustration, time loss, and increased health risks due to pollution. Within tourism geography, mobility is a central component of destination management, as the efficiency of tourist movement directly affects visitor experience and the spatial distribution of tourism flows. Congestion in touristic areas is therefore not only a transportation problem but also a spatial management challenge. This is particularly evident in historic urban centres, where the form and size of inherited road networks cannot accommodate the passenger flows generated by modern travel and tourism demand, so that mobility constraints become an obstacle to both local development and tourism (Chelabi et al., 2025).

Tourism-intensive urban mobility nodes are transport-network nodes (e.g., gateways/hubs/destinations) where tourist flows concentrate and where tourism peaks can amplify congestion and interact with commuter traffic (Lohmann & Pearce, 2010; Cui & Zhang, 2025). Jo et al. (2016) reported that tourists who experienced more than two hours of congestion were

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more likely to support vehicle bans in touristic zones based on 440 survey responses. Their findings highlight how the spatiality of congestion, arising from specific street layouts, attraction clustering, and pedestrian–vehicle interactions, can shape tourist behavior and attitudes toward mobility policies. This underscores the need to understand congestion as a spatial process embedded in urban morphology rather than as an isolated flow problem. Further studies emphasize that traffic congestion in tourist cities significantly affects tourists' satisfaction. For example, Chong (2016) showed that foreign tourists perceived traffic congestion negatively, which influenced their travel behavior, where many chose destinations within walking distance or avoided congested areas altogether. This behavioral shift highlights how congestion can affect tourist experiences and how it can potentially restructure tourism flows. Moreover, traffic congestion significantly influences tourist consumer behavior, particularly in destinations experiencing rapid tourism growth.

Putra et al. (2025) examined how emotional regulation associated with Stoic principles and the traditional Balinese philosophy of Sad Ripu relates to tourists' responses to traffic congestion. Based on structured questionnaires completed by 200 tourists in Bali, the study found significant relationships among emotional self-regulation, perceptions of traffic congestion, and tourist consumer behaviour. Traffic congestion mediated the relationships between Stoic principles and tourist consumer behaviour and between Sad Ripu control and tourist consumer behaviour. Tourists reporting stronger emotional control also reported less congestion-related stress and more positive tourism experiences, suggesting that congestion affects not only travel conditions but also tourists' emotional responses and behavioural decisions.

To address these challenges, researchers have applied a range of systematic approaches. For instance, Gao et al. (2021) used regression models to demonstrate how different types of tourism land use (such as accommodations and shopping areas) affect traffic patterns, mostly during peak tourism periods. Their findings support targeted land-use planning to manage congestion. Likewise, in their bibliometric analysis, Krabokoukis & Polyzos (2023) found that interdisciplinary collaboration and data-driven strategies are essential for managing tourism-related mobility sustainably. By applying these approaches, cities can mitigate the negative impacts of tourism on traffic while enhancing the quality of life for residents and the experience for visitors. These studies reveal that tourism-related traffic congestion is not only a planning challenge but also a technological challenge. As cities grow and tourist flows intensify, traditional traffic management systems often struggle to keep up with the fast-changing demands of urban mobility. Kulkarni (2024) highlights that, as urban populations rise, conventional traffic management approaches often fail to alleviate congestion effectively. This has led cities to adopt Intelligent Traffic Management Systems (ITMS), which use adaptive technologies to respond to real-time traffic conditions, improving flow and reducing emissions.

To monitor and manage urban mobility, major cities around the world have adopted traffic cameras and CCTV systems. However, these systems are often used for surveillance or retrospective analysis, such as reviewing accidents or traffic violations, rather than as proactive analytical tools for traffic management Fedorov et al. (2019). This reactive approach limits their potential to improve real-time decision-making and congestion mitigation. On the other hand, the advancement of artificial intelligence (AI) is transforming these systems into contextually aware, real-time traffic management tools, an innovation particularly relevant for tourism-heavy urban mobility nodes where seasonal surges and multimodal flows create complex mobility patterns. The integration of AI-driven analytics enhances both efficiency and safety in urban mobility. For instance, Khule et al. (2025) presented a real-time traffic monitoring system using CCTV cameras and the deep learning model You Only Look Once (YOLO), which integrates live dashboards and automated signal adjustments to overcome the limitations of traditional deterministic systems. In their study, Shahi et al. (2024) propose a smart camera network that uses AI and real-time data combination to dynamically manage traffic, contrasting with older systems that rely only on post-event footage review.

Recent studies highlight the transformative impact of AI in evolving traffic systems from reactive mechanisms to predictive and adaptive frameworks. For example, Talaat et al. (2025) employed YOLOv11 for real-time vehicle detection, achieving a mean Average Precision of 92.4%, enabling adaptive signal control and rerouting. Additionally, El Mokhi et al. (2025) examined AI techniques such as fuzzy logic and deep reinforcement learning. Their findings revealed that these techniques can lead to remarkable improvements, including up to 28% reductions in both queue lengths and CO_2 emissions, demonstrating the powerful role of intelligent systems in enhancing urban mobility and sustainability.

While previous research has explored AI-based traffic monitoring, few studies have incorporated tourism-related contextual factors into predictive models. This work addresses that gap by applying machine learning to real-world traffic conditions in a tourism-intensive urban mobility node. Through the analysis of video footage, this study offers practical insights into how cities with high tourist activity can better anticipate and manage traffic challenges, eventually improving mobility for both residents and visitors. From a tourism geography perspective, traffic congestion represents a spatial manifestation of visitor pressure on urban infrastructure. Integrating AI-based traffic forecasting within geospatial frameworks allows for a better understanding of tourist mobility flows and their temporal–spatial variability across destinations. This approach aligns with Stoyanova et al. (2025), who used GIS to assess transport accessibility to cultural sites in Sofia, demonstrating how spatial analysis can inform mobility planning and congestion mitigation in urban tourism contexts.

Tourist areas present unique challenges due to seasonal surges, diverse transport modes, and the need for seamless mobility experiences. By applying intelligent traffic systems in these contexts, we seek to enhance both operational efficiency and the overall tourist experience, contributing to more sustainable and adaptive urban tourism infrastructure.

This study aims to develop a real-time, context-aware traffic forecasting framework for tourism-heavy urban mobility nodes, using computer vision and ensemble learning to predict short-term congestion patterns. Specifically, it seeks to (1) extract high-frequency traffic data through YOLO–SORT detection and tracking, (2) integrate contextual features such as weather, time of day, and day type to enhance predictive accuracy, (3) evaluate model performance using CatBoost and

LightGBM for 15-minute-ahead forecasts, and (4) classify congestion regimes and quantify uncertainty through Gaussian Mixture Models GMM and conformal prediction, providing actionable insights for tourism mobility management. The case study focuses on Southampton, UK, a city whose geography and economy are dominated by its port. Southampton's waterfront functions as a port–city interface where cruise activity, local travel, and service traffic converge on a constrained street network. Town Quay sits between the Old Town and cruise facilities, operating as a tourism-heavy urban mobility node that concentrates arrivals, departures, and pedestrian/vehicle mixing. This setting intensifies peak-period pressure on access and circulation, making congestion a recurring management problem rather than an isolated traffic anomaly.

RESEARCH METHODOLOGY

The research methodology illustrated in Figure 1 follows a structured, data-driven framework for traffic analysis and prediction. The data acquisition and processing stage involves video data collected from the Town Quay webcam undergoing a vehicle detection and tracking pipeline using the YOLO algorithm and the Simple Online Realtime Tracking SORT tracking model, as detailed in Section 2.2. The derived vehicle counts are then combined with contextual data (such as weather conditions, time of day, and day type (business or leisure)) in the contextual data integration phase, as detailed in Section 2.3. Subsequently, this dataset feeds into the predictive modeling framework, where CatBoost and LightGBM are employed. The framework includes model training and evaluation using chronological data splits and assesses performance using metrics such as MAE, RMSE, Bias, and R^2.

Finally, uncertainty quantification is performed using conformal prediction and Gaussian Mixture Model (GMM) thresholds to ensure robustness and reliability in traffic forecasting, as detailed in Section 2.4.

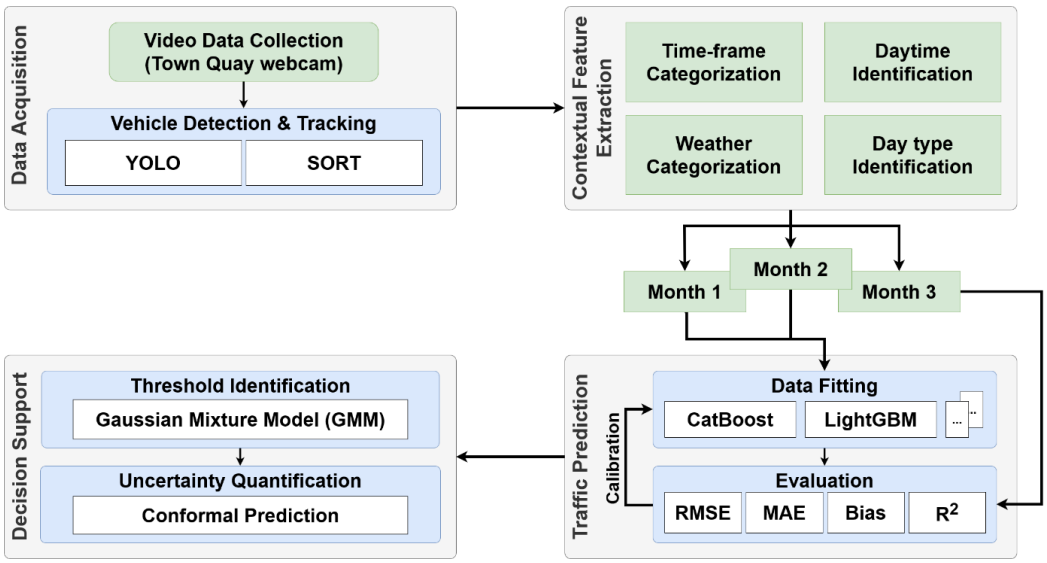


Figure 1. Research Methodology - Grey: Module, Blue: Model, Green: Input



Figure 2. Map illustration of the case study geospatial location, showing geospatial data source (surveillance camera) Town Quay in Southampton, UK.

1. Research Area and Context

This research examines traffic dynamics at Town Quay in Southampton, UK. This tourism-heavy urban mobility node is a vibrant waterfront district where cruise ship operations and seasonal tourism create recurring congestion challenges. It represents a complex and dynamic traffic environment, shaped by the constant flow of visitors, port operations, and local commuters. Cruise ship arrivals bring surges of tourists, while nearby businesses and offices generate steady work-related traffic, creating short-term fluctuations that make congestion management particularly challenging. Figure 2 illustrates the geospatial location of the case study and indicates the geospatial data source (surveillance camera).

Crucially, the study area borders Southampton's medieval defensive walls and the old town heritage zone. Consequently, traffic queuing at this junction creates a visual and atmospheric barrier between the maritime entry point (the port) and the cultural heritage site (the old town). This spatial proximity classifies Town Quay as a tourism-heavy urban mobility node where modern mobility friction directly degrades the historic landscape's interpretative value. To address these challenges, this research develops a real-time, data-driven framework designed to predict congestion patterns 15 minutes in advance. Continuous video feeds are used to monitor traffic flow, turning raw data into actionable insights.

2. Data Acquisition and Processing

2.1. Video Data Collection

The primary data source consists of real-time video footage obtained from a publicly accessible online webcam located at the Southampton Town Quay junction, as shown in Figure 3. The video footage provides continuous visual coverage of the intersection, capturing diverse traffic conditions under varying temporal and environmental contexts. We collected data for a three-month period between July–September 2025.

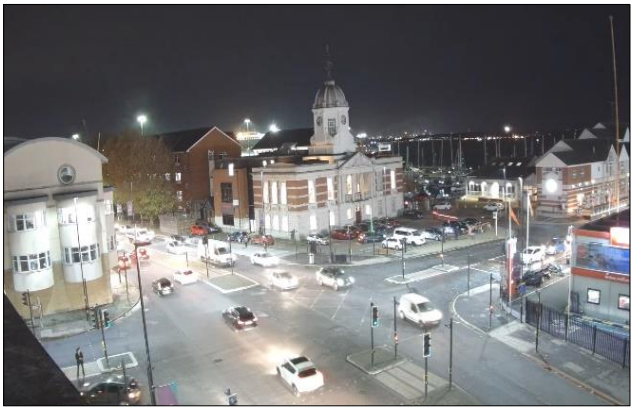
(a)   (b)

Figure 3. Screenshots from the Southampton Town Quay Junction live webcam. (a) nighttime, (b) daytime
(Source: Authors' own processing, July-Septemper, 2025; https://www.skylinewebcams.com/en/webcam/united-kingdom/england/southampton/southampton-town-quay.html)

2.2. Vehicle Detection and Tracking

The machine learning models employed include YOLOv5 for object detection and SORT for vehicle tracking across consecutive video frames. YOLOv5 is selected for its high detection accuracy and computational efficiency, making it suitable for real-time applications (Jaiswal & Agrawal, 2024). SORT complements YOLO by maintaining consistent vehicle tracking across frames.

This methodology demonstrates how machine learning models can be leveraged to analyze real-world traffic dynamics in tourism-heavy areas, offering a scalable and adaptive solution for urban mobility management. In particular, the use of YOLO is highly advantageous compared to traditional manual counting or sensor-based methods. YOLO enables real-time, automated vehicle detection from video feeds, providing accurate, high-frequency data without requiring costly infrastructure or labor-intensive surveys (Adhithya, 2025). By employing machine learning models such as YOLO and SORT, urban planners and local authorities in tourism-heavy areas can obtain timely and accurate insights into mobility patterns. This data-driven approach supports more responsive traffic management, smarter resource allocation, and an overall improved experience for visitors. To ensure reliability, the detection and tracking results were validated against manual counting on randomly selected video samples, confirming the accuracy of the automated approach.

3. Contextual Feature Extraction

In addition to vehicle counts generated by the YOLO–SORT processing pipeline, the research integrates a comprehensive set of contextual variables to capture the multifaceted nature of urban traffic dynamics. By incorporating weather conditions, time-of-day segmentation, and day-type classification, the model achieves a more realistic representation of traffic behavior in real-world environments.

Weather conditions are set as categorical features distinguished between clear, foggy, and rainy periods. Weather plays a crucial role in shaping driving behavior and road capacity (Romanowska & Budzyński, 2022). Rain, for example, can reduce visibility and speed, causing localized slowdowns even in non-peak hours. Integrating weather data enables the model to account for such external perturbations, improving both the accuracy and interpretability of congestion prediction.

In coastal cities like Southampton, which attract large numbers of tourists, especially during warmer months, weather also directly affects touristic traffic patterns. Warmer, sunnier conditions tend to attract more visitors to outdoor attractions, increasing traffic volumes and congestion in key areas (Wilkins & Horne, 2024). Conversely, adverse weather such as heavy rain or fog can deter discretionary travel (Peng et al., 2018), leading to reduced tourist mobility and shifting traffic burdens to indoor venues or alternative transport modes. In this research, weather conditions were systematically extracted from video footage spanning the entire observation period.

The daytime versus nighttime distinction (06:00–18:00 and 18:00–06:00, respectively) captures the cyclical patterns associated with human activity and mobility demand. Daytime periods generally correspond to higher vehicle counts due to commuting, commercial deliveries, and tourism-related travel, whereas nighttime periods exhibit reduced traffic intensity and different vehicle composition (Goerguelue et al., 2025). By including this temporal feature, the model is able to learn context-dependent traffic behaviors and adapt its forecasts to diurnal variations. Moreover, traffic patterns at Town Quay strongly depend on day type, classified as business or leisure. Business days (weekdays) feature regular commuting and logistics, while leisure days (weekends and holidays) coincide with higher tourist movement. This distinction helps the model capture shifts in traffic driven not only by time but also by behavioral patterns.

By combining contextual variables with vehicle counts, the model gains a richer understanding of traffic behavior, enabling accurate short-term predictions and better generalization. This integration transforms it from a purely data-driven tool into a context-aware forecasting system that adapts to dynamic urban conditions. Although based on computer vision, the framework can be extended into GIS workflows to map predicted congestion zones and link them to tourism hotspots.

4. Predictive Modeling Framework

4.1. Model Selection

In this research, two ensemble learning algorithms, CatBoost and LightGBM were analyzed. These models are widely recognized for their ability to handle structured tabular data, capture complex nonlinear relationships, and deliver computational efficiency in large-scale predictive tasks (Bentéjac et al., 2021). CatBoost is particularly effective in managing categorical features and mitigating overfitting (Prokhorenkova et al., 2018), whereas LightGBM is optimized for speed and memory efficiency, making it suitable for high-dimensional datasets for the traffic domain (Cheng et al., 2022).

4.2. Model Data Fitting and Evaluation

The prediction framework produces short-term forecasts of traffic conditions 15 minutes in advance. The dataset includes time-stamped entries with the following explanatory variables: date x_1, time x_2, day type x_3, day/night classification x_4, and weather conditions x_5. The target variable y is the observed vehicle count in each 15-minute interval. The analysis follows a temporal split: Data from the first two months, $t_1$and t_2, are used for model fitting, while data from the third month, t_3, are reserved for evaluation. Let n denote the number of days in $t_1 \cup t_2$. Since each day contains 96 intervals of 15 minutes, the training feature matrix is $X = (\mathbf{x}_i)_{i=1}^{96n}$, where each feature vector is $\mathbf{x}_i = \{x_1^i, x_2^i, x_3^i, x_4^i, x_5^i\}$, and the corresponding target value is the vehicle count y_i. For validation, let m denote the number of days in t_3. The evaluation matrix is $\ddot{X} = (\ddot{\mathbf{x}}_i)_{i=1}^{96m}$, constructed analogously from the same five explanatory variables. This formulation follows the standard supervised-learning design-matrix representation for regression modelling (James et al., 2021).

Both models were evaluated using standard regression performance metrics, including Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), Bias, and the Coefficient of Determination (R^2). These metrics collectively evaluate prediction accuracy, quantify error magnitude, and measure the models' ability to generalize to unseen data.

4.3 Conformal Prediction and Gaussian Mixture Model (GMM) Integration

Following the selection of CatBoost as the optimal model, a conformal prediction framework is implemented to extend point forecasts into uncertainty-aware outputs. Traffic congestion levels are identified using a GMM applied to the predicted traffic volume distributions. The model estimated five components, each representing a distinct congestion regime, with transition thresholds at approximately 113.4, 240.6, 363.8, and 441.0 vehicle counts. Conformal prediction intervals are computed alongside point forecasts to quantify uncertainty, adapting dynamically to traffic intensity. Narrow intervals during low-flow periods indicate high confidence, whereas wider intervals during peak congestion reflect increased variability. This combined approach enables both probabilistic uncertainty assessment and multi-level classification of traffic states, supporting robust interpretation of congestion dynamics.

Model alignment with observed traffic volumes is assessed using three complementary statistical measures: Pearson's correlation coefficient (r), Spearman's rank correlation (ρ), and the Concordance Correlation Coefficient (CCC). Pearson and Spearman correlations are computed to assess relational strength and ranking preservation, whereas the CCC serves as an integrated measure of accuracy and precision. Comparative analysis across CatBoost and LightGBM models enables identification of the model with superior concordance for subsequent uncertainty quantification and risk classification.

RESULTS AND ANALYSIS

1. Traffic Volume Trends Derived from YOLO-SORT Processing

This section presents findings from the YOLO-SORT model applied to Town Quay traffic footage. The analysis examines how contextual factors (day type, weather, and time of day) affect congestion, measured by vehicle count. The dataset spans three months, with traffic aggregated at 15-minute intervals. Each record includes attributes such as date, day type (business or leisure), time of day (daytime or nighttime), and weather (clear, foggy, or rainy).

As shown in Table 1, on business days, daytime traffic under clear weather conditions exhibits the highest total volume (572,913 vehicles), with an average of 265.23 vehicles per 15-minute interval, reflecting the intensity of commuter flows and commercial transport activity in this port-adjacent urban corridor. Nighttime traffic on business days declines sharply, consistent with reduced professional mobility outside working hours. Leisure days show elevated traffic volumes during daytime hours, particularly under clear and foggy conditions, suggesting strong touristic engagement with the surrounding attractions. The relatively high average vehicle counts during foggy leisure periods (233.28 vehicles per interval) indicate that recreational travel persists even in suboptimal weather, likely driven by planned visits and seasonal tourism demand. The high traffic on 'foggy' leisure days suggests tourists are less deterred by weather than commuters, a key behavioral insight for tourism and transport managers. Nighttime traffic on leisure days, while lower, remains notable and may be attributed to evening leisure activities, hospitality services, and ferry-related movements. These findings underscore the dual function of Town Quay as both a commuter hub and a tourism gateway.

The observed traffic distribution suggests that leisure periods, typically associated with increased tourist activity, exert a notable influence on vehicular flow. Daytime traffic volumes on leisure days under clear weather conditions (average 220.95 vehicles per 15-minute interval) approach those recorded on business days (265.23 vehicles), despite the absence of routine commuting. This pattern indicates that tourism-driven mobility substantially contributes to daytime congestion, particularly in favorable weather scenarios conducive to recreational travel. Conversely, nocturnal traffic remains consistently low across all conditions, reflecting limited tourist movement during late hours. Although adverse weather conditions, such as rain and fog, reduce overall traffic volumes, the persistence of leisure-related travel under these circumstances suggests that tourism demand is less sensitive to meteorological variability than business-related commuting.

Table 1. Traffic Volume Summary by Day Type, Time of Day, and Weather Conditions

Day Type	Time of the Day	Weather Condition	Total Vehicle Count	Average Vehicle Count per 15 Minutes
Business	Day	Clear	572913	265.23
		Foggy	27212	188.97
		Rainy	190443	220.42
	Night	Clear	143521	66.44
		Foggy	6733	46.75
		Rainy	48746	56.41
Leisure	Day	Clear	194439	220.95
		Foggy	7465	233.28
		Rainy	62625	186.38
	Night	Clear	46538	52.64
		Foggy	1389	49.60
		Rainy	14935	44.44

Table 2. Comparative Performance Metrics of CatBoost and LightGBM Models

Model	RMSE	MAE	Bias	R^2
CatBoost	43.62	28.06	3.59	0.902
LightGBM	46.12	28.40	0.89	0.891

2. Predictive Performance of Ensemble Learning

The predictive results confirm the effectiveness of ensemble learning in capturing traffic congestion dynamics in tourism-intensive urban settings. As shown in Table 2, the CatBoost model outperformed LightGBM achieving lower RMSE and MAE values alongside a higher R^2, indicating stronger explanatory power. Although LightGBM exhibited slightly lower bias compared to CatBoost, both models maintained minimal error levels. As illustrated in Figure 4, the one-to-one plots confirm that both models capture the overall relationship between observed and predicted vehicle counts.

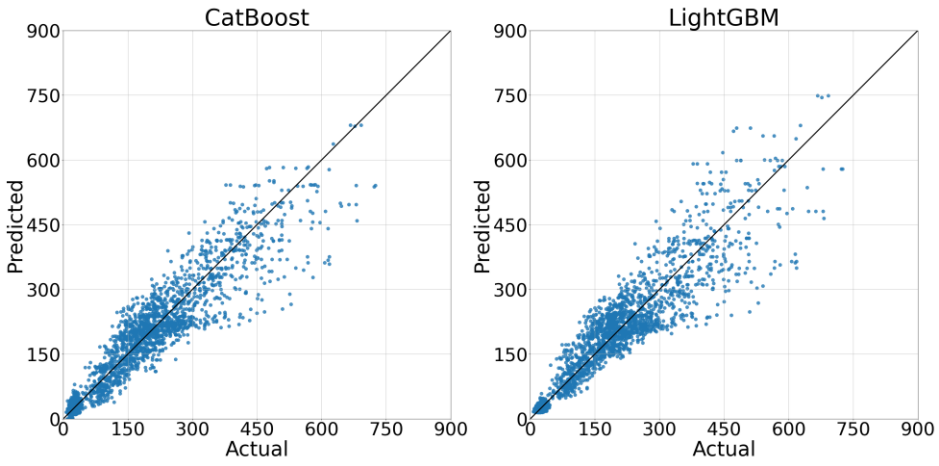


Figure 4. One-to-One Comparison of Predicted Traffic Volumes: CatBoost vs. LightGBM (Source: Authors' own processing, 2025)

The majority of points align closely with the identity line, indicating limited deviations across most of the range. The most noticeable discrepancies appear at higher traffic volumes, where both models tend to slightly misestimate actual counts. CatBoost provides slightly closer adherence to the identity line in this upper range, consistent with its stronger fit, whereas LightGBM produces a smoother trend but with marginally larger deviations from the observed values.

Further insights are provided in Figure 5, which compares the kernel density estimates of the observed and predicted distributions. The bandwidth for these estimates is determined using Silverman's rule of thumb (Silverman, 1986) to achieve an optimal balance between smoothness and detail. The close alignment between the actual and predicted curves indicates that both algorithms accurately reproduce the underlying traffic volume patterns. However, CatBoost demonstrates marginally superior performance. CatBoost's predicted distribution aligns closely with actual data, especially in the lower range (0–150), where peaks nearly overlap, indicating better capture of fine traffic variations. LightGBM produces a smoother curve but slightly underestimates the first peak and over-smooths around the second mode (~250 vehicles). Overall, both models generalize well, but CatBoost offers marginally higher accuracy and sensitivity to local variations.

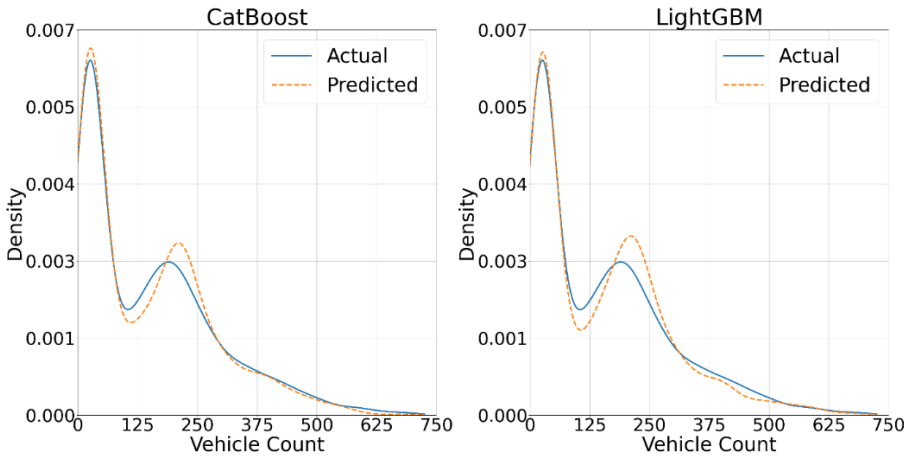


Figure 5. Kernel Density Estimates of Traffic Volume Distributions: Observed vs. Predicted (CatBoost and LightGBM)
(Source: Authors' own processing, 2025)

These outcomes suggest that the framework effectively incorporates predictive models to capture congestion dynamics under conditions of variability and peak demand. The ability of both methods to approximate the underlying distributions while keeping systematic bias low ensures that the predictions provide a realistic basis for subsequent analysis. Importantly, the models are not the primary focus of evaluation but serve to demonstrate that the framework operates reliably with advanced machine learning tools. This establishes the foundation for extending the approach toward higher-level tasks, such as translating continuous predictions into categorical assessments of congestion risk.

3. Threshold Identification and Uncertainty Quantification

The GMM identifies four transition thresholds at approximately 113.4, 240.6, 363.8, and 441.0 vehicle counts, corresponding to five distinct congestion levels. The fitted component statistics are summarized in Table 3. The component means (35.9, 178.5, 286.6, 425.0, and 607.8) increase monotonically with traffic intensity, whereas the mixture weights show that most observations belong to lower and mid-level regimes. The relatively uniform variance across components indicates consistent dispersion within the identified traffic states.

Table 3. Statistical properties of the fitted Gaussian components used to define congestion thresholds

Component	Mean Count	Variance	Weight	Congestion Level
0	35.9	1,394.4	0.503	Level 1 (Very Low)
1	178.5	1,394.4	0.265	Level 2 (Low)
2	286.6	1,394.4	0.142	Level 3 (Moderate)
3	425.0	1,394.4	0.064	Level 4 (High)
4	607.8	1,394.4	0.026	Level 5 (Severe)

The conformal prediction intervals show that the majority of observed traffic counts fall within the estimated uncertainty bounds, indicating consistent calibration across all congestion regimes. The intervals adjust adaptively to variations in traffic intensity: they remain narrow during stable, low-traffic periods, reflecting lower predictive uncertainty, and expand considerably during high-density periods to capture the increased variability typical of peak congestion.

The multi-level classification derived from the GMM thresholds provides a finer segmentation of traffic conditions compared to the conventional three-class (Low–Medium–High) scheme. The first two levels correspond primarily to nighttime and off-peak hours, where traffic flow is smooth and model confidence remains high. Intermediate levels represent transitional states, often associated with the buildup and dissipation phases of morning and evening peaks. The highest level captures sustained congestion, where traffic counts are high and prediction intervals widen substantially, reflecting the increased uncertainty inherent in unstable flow conditions.

4. Alignment with Ground Truth

To assess model fidelity, we evaluated concordance between predicted and observed traffic volumes using Pearson's correlation (r), Spearman's rank (ρ), and the Concordance Correlation Coefficient (CCC). CatBoost achieved r = 0.951, ρ = 0.921, and CCC = 0.949, indicating excellent agreement and strong preservation of rank and scale. LightGBM also performed well (r = 0.945, ρ = 0.929, CCC = 0.944), with slightly better rank ordering but marginally lower overall concordance. Both models align closely with ground truth, confirming the effectiveness of gradient boosting for traffic prediction. CatBoost's higher CCC and Pearson values support its selection for uncertainty quantification and conformal prediction.

DISCUSSION

The proposed framework effectively captures how contextual and temporal factors shape traffic dynamics in tourism-heavy urban environments. Variations in vehicle counts across day types, weather, and time periods reveal the multidimensional nature of congestion at Town Quay, where tourist surges and commuter peaks overlap. Increased daytime traffic on business days reflects commuter flows linked to the port and city center, while sustained volumes on leisure days (even under foggy conditions) underscore tourism's resilience and socio-economic significance.

A key behavioral insight is the persistence of high vehicle counts during foggy leisure days. Despite adverse weather conditions, leisure-driven mobility remains strong (average vehicle count = 233.28 per 15-minute interval). This indicates hedonic resilience among tourists: even when travel is discretionary, fixed schedules such as cruise or ferry departures drive mobility. For tourism and transport managers, this underscores that traffic mitigation cannot rely on unfavorable weather to naturally suppress demand; proactive interventions are required to maintain site accessibility and carrying capacity.

From a predictive perspective, CatBoost outperformed LightGBM, demonstrating the value of categorical feature handling and contextual variables for accurate short-term forecasting. Its lower RMSE and higher R^2 indicate strong sensitivity to local traffic fluctuations, though slight underestimation at peak volumes reflects the stochastic nature of congestion during cruise arrivals or weather disruptions.

The integration of conformal prediction and GMM-based classification adds significant interpretive value. Narrow intervals during off-peak periods and wider intervals during volatile conditions demonstrate adaptive confidence estimation, crucial for real-time decision-making in tourism-heavy areas. the GMM thresholds translate continuous predictions into actionable congestion levels, supporting interpretable alerts for urban traffic management and tourist routing.

High concordance metrics (Pearson, Spearman, CCC > 0.92) validate predictive reliability, confirming that the model captures both magnitude and structural relationships in traffic data. By differentiating leisure-day (tourist-driven) traffic from business-day (commuter-driven) traffic, the framework enables planners to implement dynamic routing strategies during cruise arrivals, reducing resident frustration and environmental impacts.

These tourism-sensitive insights have theoretical and practical implications: for urban tourism geography, congestion is conceptualized as a spatiotemporal manifestation of visitor pressure, revealing patterns that inform sustainable destination planning; for destination management, short-term predictive insights allow adaptive routing, smart signal control, and proactive mobility management; and for policymakers, the evidence supports event-based traffic interventions that maintain carrying capacity of a mobility node without reducing tourist satisfaction. In practical terms, city planners could use the 15-minute forecasts to trigger dynamic traffic routing on cruise ship arrival days and integrate predictive congestion analytics into urban tourism management systems to support adaptive visitor routing, reduce environmental stress on tourism corridors, and enhance the destination's sustainability profile.

However, this study has two key limitations. First, classifying days as simply "business" or "leisure" ignores hybrid scenarios (such as cruise arrivals on weekdays) where tourist flows spike despite being business days.

Second, reliance on video-based vehicle counts excludes pedestrian and multimodal traffic, which are critical in tourism-heavy urban mobility nodes. Future research should adopt event-based categorization and integrate multimodal mobility data to better capture complex demand patterns.

CONCLUSION

Conceptually, this study reframes congestion at a tourism-intensive urban mobility node as a spatiotemporal manifestation of visitor pressure on maritime built heritage. By integrating computer vision, contextual features and uncertainty-aware forecasting, the framework extends previous tourism mobility studies that relied on static accessibility indices or survey data. Instead of treating traffic as an exogenous constraint, congestion becomes a measurable, short-term indicator of node carrying capacity that can be monitored and anticipated in real time.

This research demonstrates the effectiveness of a geospatial machine learning framework for modeling and forecasting traffic dynamics at a tourism-heavy urban mobility node. Using computer vision-based detection (YOLO–SORT), contextual enrichment, and ensemble learning, the framework captures distinct mobility patterns: commuter-driven peaks on business days and sustained tourism flows on leisure days. A notable insight, the persistence of high traffic during foggy leisure periods, reveals tourists' lower sensitivity to adverse weather, underscoring the need for proactive traffic management even under suboptimal conditions.

CatBoost emerged as the most accurate predictive model, complemented by conformal prediction and GMM-based classification for uncertainty quantification and congestion categorization. These components collectively provide a scalable, interpretable solution for short-term traffic forecasting in complex urban environments. However, limitations include the binary day-type classification, which overlooks hybrid scenarios such as cruise arrivals on weekdays, and the

exclusion of pedestrian and multimodal flows. Future research should incorporate event-based categorization, multimodal mobility indicators, and real-time data streams to enhance predictive accuracy.

Integration with GIS dashboards and advanced geo-visualization tools could further support adaptive traffic management, eventually contributing to a 'Digital Twin' of the tourism-intensive urban mobility node. This would allow destination managers to simulate the impact of cruise schedules on carrying capacity before the vessels even arrive.

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ECONOMIC GROWTH, TOURISM PERFORMANCE, AND CRISIS SENSITIVITY IN ASEAN: A REGIONAL PANEL ANALYSIS

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Abstract: This study examines the long-run relationship between economic growth and tourism performance in ASEAN countries, with particular attention to crisis sensitivity and regional heterogeneity. Using balanced panel data for eight ASEAN member states over the period 1999–2023, the analysis employs pooled ordinary least squares and fixed-effects estimators to assess how macroeconomic conditions and structural tourism intensity shape tourism outcomes. The results reveal a strong and robust positive association between economic output and tourism receipts, with estimated elasticities close to unity across specifications. This near-proportional relationship indicates a structurally embedded linkage between tourism performance and overall economic capacity, rather than a unidirectional tourism-led growth mechanism. Tourism intensity further reinforces tourism performance, highlighting the structural role of tourism within national economies. Crisis episodes exhibit asymmetric impacts on tourism dynamics, with the COVID-19 pandemic generating the most severe and persistent contraction, particularly in developing ASEAN economies. Comparative analysis indicates that while tourism intensity contributes similarly across development groups, developing countries display greater vulnerability to crisis shocks. The findings underscore the importance of macroeconomic stability, diversification, and regionally differentiated tourism policies to enhance resilience in crisis-prone environments. This study contributes to the regional tourism literature by clarifying the demand-side economic drivers of tourism performance in ASEAN under conditions of systemic shocks and developmental heterogeneity.

Keywords: tourism performance, economic growth, ASEAN, regional analysis, crisis impacts, tourism geography, panel data

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INTRODUCTION

Tourism has emerged as a dynamic driver of regional economic transformation across Southeast Asia, reinforcing the nexus between growth, integration, and sustainability. Recent evidence highlights that tourism receipts, foreign direct investment, and green innovation significantly enhance long-term economic expansion and spatial development within ASEAN economies (Trung, 2025; Zagoto et al., 2025). Empirical studies confirm that the tourism–growth relationship is bidirectional, strengthening local employment and infrastructural networks (Indriani, 2022; Maulana et al., 2025). Moreover, regional integration and SEZ-based tourism projects have restructured peripheral economies through capital inflows and community participation (Park, 2024). The interplay between digital infrastructure, policy harmonization, and sustainable tourism practices continues to define ASEAN's competitive advantage, generating inclusive growth across diverse territorial contexts (Keorodom, 2023; Mohammad Nurul Huda et al., 2013; Titovich & Toropygin, 2023; Trifan, 2023).

Despite its growing importance, ASEAN's tourism landscape remains spatially uneven, shaped by diverse institutional capacities, governance quality, and infrastructural readiness. Empirical analyses reveal that territorial disparities persist as advanced economies such as Singapore and Malaysia exhibit greater tourism productivity and environmental innovation compared to less developed members like Laos or Myanmar (An & Kim, 2022; Trung, 2025).

Studies employing spatial econometric and competitiveness frameworks highlight how innovation intensity, FDI spillovers, and institutional strength amplify regional clustering effects within tourism economies (Soh et al., 2023).

However, geopolitical risk and governance asymmetry exacerbate uneven participation in regional tourism networks, deepening intra-ASEAN heterogeneity (Chen et al., 2024). These dynamics underscore the urgency for territorially nuanced policies that integrate competitiveness, sustainability, and inclusiveness into ASEAN's tourism-led growth agenda. The vulnerability of ASEAN's tourism systems to external shocks has been acutely demonstrated through global crises that disrupted regional mobility and income structures. COVID-19, in particular, revealed deep asymmetries in recovery capacity and institutional resilience across member states, with uneven rebounds between advanced and tourism-dependent economies (Huynh et al., 2023; Polyzos et al., 2021). Empirical analyses emphasize how regional crises reshape

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spatial tourism flows and reconfigure destination hierarchies within the ASEAN bloc (Fornari & Allis, 2022; Koepke & Balasundharam, 2021). Case studies from Vietnam and Cambodia highlight that resilience is contingent on adaptive governance, social networks, and local entrepreneurial innovation (Ford & Im, 2023; Huynh et al., 2022). From a broader policy lens, strengthening systemic resilience requires coordinated regionalism, diversified markets, and digital transformation to mitigate exposure to future disruptions (OECD, 2022, 2023).

From a theoretical standpoint, the relationship between tourism activity and economic performance is widely acknowledged to be bidirectional rather than unidirectional (Bui Hoang, 2024; Kuok et al., 2023). While the tourism-led growth hypothesis has traditionally framed tourism as a driver of economic expansion, recent empirical studies increasingly emphasize the role of broader macroeconomic conditions in shaping tourism performance, particularly in regionally integrated economies (Jaroensutasinee et al., 2025; Nguyen & Le, 2026). Economic scale, income levels, and structural stability influence tourism demand, investment capacity, and destination competitiveness across ASEAN (Alsabhan et al., 2025; Indriani, 2022). Accordingly, tourism is better understood not only as a potential growth catalyst but also as an economic activity that responds to demand-side macroeconomic dynamics, especially under conditions of structural heterogeneity and external shocks (Phob-udom et al., 2025; Rohan & Suyanto, 2025).

Existing ASEAN tourism literature remains fragmented, often prioritizing national case studies or short-term econometric analyses that overlook spatial interdependencies and systemic crises. Recent studies underscore that crises such as COVID-19 reconfigured tourism's regional role, amplifying inequalities and exposing governance asymmetries (Liyushiana et al., 2022; Tuli & Vadiyala, 2022). Spatial analyses reveal persistent territorial disparities and the limited capacity of regional coordination mechanisms to foster balanced development (An & Kim, 2022; Chen & Zhang, 2023). Meanwhile, cross-country assessments identify that tourism's economic contribution fluctuates under crisis conditions, particularly in peripheral or tourism-dependent regions (Akita & Alisjahbana, 2023). Collectively, these findings point to a pressing need for integrative frameworks that combine regional resilience theory, territorial development, and tourism geography to capture ASEAN's evolving spatial-economic dynamics (Hoang, 2024).

Addressing this gap, the present study adopts a regional and territorial perspective to examine tourism–economic dynamics in ASEAN over a long-term period. By combining panel data analysis with explicit consideration of major crisis episodes, the study seeks to capture both structural relationships and temporal disruptions. The focus on spatial differentiation between developing and more advanced member states further strengthens the geographic relevance of the analysis. Accordingly, this study aims to address three core questions: first, how economic growth and structural tourism intensity shape tourism performance across ASEAN in the long run; second, how major crisis episodes affect tourism dynamics at the regional level; and third, whether these tourism–economic relationships differ across development groups. By addressing these questions, the study contributes to tourism geography and regional development literature, offering empirical insights relevant for spatially informed tourism planning and policy formulation.

While tourism is often conceptualised as a potential driver of economic growth, the relationship between tourism activity and economic performance is inherently bidirectional. In the ASEAN context, where development levels and structural characteristics differ substantially, understanding how economic growth conditions shape tourism performance becomes particularly relevant. Rather than testing tourism-led growth in a strict causal sense, this study focuses on identifying robust long-run structural associations between economic output, tourism intensity, and tourism receipts within a regional panel framework. By incorporating major crisis episodes, the analysis further captures how external shocks modify these relationships across heterogeneous economies.

LITERATURE REVIEW AND THEORETICAL BACKGROUND

Tourism has long been recognised as an important driver of economic activity, particularly in regions with strong natural, cultural, and environmental assets (Lee & Chang, 2008; Sobirov et al., 2025). Within economic geography and tourism studies, tourism is increasingly viewed not merely as a sectoral activity but as a spatially embedded system that interacts with regional structures, labour markets, and territorial governance (Kyophilavong et al., 2018; Saarinen & Rogerson, 2021). This perspective highlights the relevance of tourism in shaping regional development trajectories, especially in emerging and heterogeneous regions such as ASEAN (Fan & Ha, 2025; Maneejuk et al., 2022).

Tourism-led growth hypothesis in a regional and spatial context

The tourism-led growth hypothesis posits that tourism development stimulates economic growth through multiple channels, including foreign exchange earnings, employment creation, and infrastructure investment (Mahadevan et al., 2017; Wu et al., 2025). Early empirical studies provide evidence of a positive relationship between tourism receipts and economic growth, particularly in small open economies and developing regions (Li et al., 2016). These findings have positioned tourism as a potential engine of regional economic expansion (Bhatt et al., 2024; Paramati & Nguyen, 2024).

Subsequent research has extended this hypothesis by incorporating spatial and regional dimensions. From a geographic perspective, tourism-led growth is not spatially neutral, as benefits tend to concentrate in specific regions or destinations Lin et al., 2019; Yang & Fik, 2014). Agglomeration effects, accessibility, and territorial endowments influence how tourism contributes to regional economies. Studies grounded in regional economics suggest that tourism may reinforce existing spatial inequalities if supporting institutions and regional linkages remain uneven (Adeleye, 2023; Calero & Turner, 2020; Tung, 2021). In multi-country regional settings, such as ASEAN, the tourism–economy relationship is increasingly recognised as bidirectional rather than strictly unidirectional. While tourism-led growth provides an important theoretical foundation, recent empirical evidence highlights that broader macroeconomic conditions, including economic

scale, income levels, and structural stability, play a central role in shaping tourism performance across heterogeneous economies (Trung, 2025; Wahab et al., 2023). Studies from Asia suggest that tourism outcomes respond differently to macroeconomic dynamics over time, indicating the presence of structural, institutional, and spatial moderators that condition tourism performance rather than a uniform growth mechanism (Qi & Ding, 2025; Shahzad et al., 2017).

Tourism, territory, and regional economic development

From the standpoint of tourism geography, tourism development is inherently territorial, relying on place-specific resources, environmental quality, and cultural landscapes (Golubičić et al., 2025; Reyabi & Boulaassal, 2025). Tourism activities reshape regional economies by altering land use, infrastructure distribution, and labour mobility (Popescu et al., 2025; Scolozzi & Villa, 2025). These transformations link tourism closely to broader processes of regional development and spatial planning.Regional development theories emphasise that tourism contributes most effectively to economic performance when embedded within diversified regional systems (Liwei & Yu, 2025; Mafrudoh et al., 2025). Strong backward and forward linkages between tourism and local industries increase value retention within regions (Tagherist & Toufik, 2025). Conversely, weak territorial integration may limit the broader economic impact of tourism, particularly in peripheral or less developed areas. This distinction is central to understanding uneven tourism outcomes across regions.

In ASEAN, tourism plays a critical role in regional integration and cross-border economic interaction (Arnakim et al., 2023; Lee, 2022; Sundram, 2025). Initiatives promoting tourism corridors and regional branding reflect attempts to leverage tourism for territorial cohesion (Rüland & Carrapatoso, 2022; Stoffelen & Vanneste, 2017). However, empirical assessments suggest that benefits remain uneven, often favouring capital cities and established destinations. This pattern underscores the need for regionally informed empirical analyses that account for territorial diversity and spatial structure.

Crisis impacts on tourism systems and regional resilience

Tourism is widely regarded as one of the most crisis-sensitive economic activities due to its dependence on mobility, perceptions of safety, and discretionary consumption (Hopkins, 2021; Senbeto & Hon, 2020; Williams & Baláž, 2015). Health crises, financial shocks, and geopolitical disruptions have repeatedly demonstrated the vulnerability of tourism systems (Cohen, 2012; Ferreira et al., 2025). Research on crisis impacts highlights sharp contractions in tourism demand, followed by uneven and prolonged recovery processes across regions (Plzáková & Smeral, 2022). From a regional resilience perspective, crises affect tourism destinations differently depending on economic structure, institutional capacity, and diversification (Phan et al., 2025; Tunca et al., 2025). Regions with high tourism dependence often experience deeper economic shocks, while those with diversified economies tend to recover more rapidly. The concept of territorial resilience has therefore gained prominence in tourism geography, focusing on the ability of regions to absorb, adapt, and recover from external disturbances (Fan et al., 2025; Grzenkowicz, 2025). In Southeast Asia, crisis events such as the SARS outbreak, the Global Financial Crisis, and the COVID-19 pandemic have exposed significant spatial disparities in tourism vulnerability and recovery (Akita & Alisjahbana, 2023; Plzáková & Smeral, 2022; Polyzos et al., 2021). While some destinations demonstrated adaptive capacity through domestic tourism or policy intervention, others faced prolonged downturns (Papagiannakis et al., 2018; Wang et al., 2023). These experiences suggest that crisis impacts are mediated by regional characteristics, reinforcing the need for long-term and regionally comparative analyses (Dutta, 2024; Gündüz et al., 2025).

Developmental heterogeneity in tourism performance

A recurring theme in tourism economics and geography is the distinction between developed and developing economies in tourism performance and outcomes. More advanced economies typically exhibit higher tourism productivity, stronger institutional frameworks, and more diversified tourism offerings (Kozáková et al., 2025; Lestan et al., 2025; Lin & Xing, 2020; Rismayani et al., 2025). In contrast, developing economies often rely heavily on tourism revenues but face volatility and limited capacity to manage shocks (Kadyrbekova et al., 2025). This disparity reflects broader patterns in economic development, infrastructure, and institutional maturity (Godinez et al., 2025; Upadhyaya et al., 2025).

Empirical studies indicate that tourism intensity and its growth effects differ across development levels (Nguyen & Le, 2026; Smolčić Jurdana & Agbaba, 2025). While tourism activity may benefit from economic expansion in developing economies, it may simultaneously amplify exposure to external shocks, whereas developed economies tend to display more stable tourism performance due to diversified economic bases and stronger macroeconomic buffers (Parray et al., 2025; Samarathunga et al., 2024). Developed economies, by contrast, tend to display more stable tourism contributions due to diversified economic bases and established infrastructure (Cheng, 2025; Londe et al., 2025). These differences suggest that development level moderates tourism–growth relationships. Within ASEAN, developmental heterogeneity is particularly pronounced, encompassing both high-income service-oriented economies and lower-income tourism-dependent states (Akarsu, 2022). This diversity offers a valuable context for examining how tourism contributes to regional development under varying structural conditions (Elgin & Elveren, 2024; Shah, 2025). Comparative approaches are therefore essential to identify differentiated patterns and avoid overly generalised conclusions (Pham, 2020).

Literature synthesis and hypothesis development

The reviewed literature highlights several key insights. First, tourism is widely recognised as a potential driver of economic growth, yet its effects are shaped by spatial, institutional, and developmental contexts. Second, tourism development is territorially embedded, influencing and being influenced by regional structures. Third, crises play a critical role in disrupting tourism systems, with uneven impacts across regions and development levels.

Despite extensive research, gaps remain in long-term, regionally comparative studies that jointly examine macroeconomic drivers of tourism performance, crisis sensitivity, and territorial heterogeneity within a single empirical framework. In the ASEAN context, such integrated analyses remain limited. Addressing this gap, the present study formulates the following hypotheses:

1. **H1:** Economic growth has a positive and significant effect on tourism performance across ASEAN countries in the long run.
2. **H2:** Major crisis events exert a negative impact on tourism performance in ASEAN.
3. **H3:** The relationship between economic growth and tourism performance differs between developing and more advanced ASEAN economies.
4. **H4:** Crisis impacts on tourism performance are more pronounced in developing ASEAN countries than in more advanced member states.

These hypotheses guide the empirical analysis and provide a structured framework for examining tourism–economic dynamics from a regional and territorial perspective that is consistent with the empirical model employed.

METHODOLOGY

This study adopts a quantitative panel-data approach to examine the relationship between tourism development and economic growth across ASEAN countries. The methodological design emphasises transparency and replicability, combining regional comparability with temporal depth. Figure 1 illustrates the overall research flow, starting from data collection and variable construction, followed by model estimation, diagnostic testing, and robustness assessment. This structured workflow supports a coherent linkage between theoretical expectations and empirical implementation.

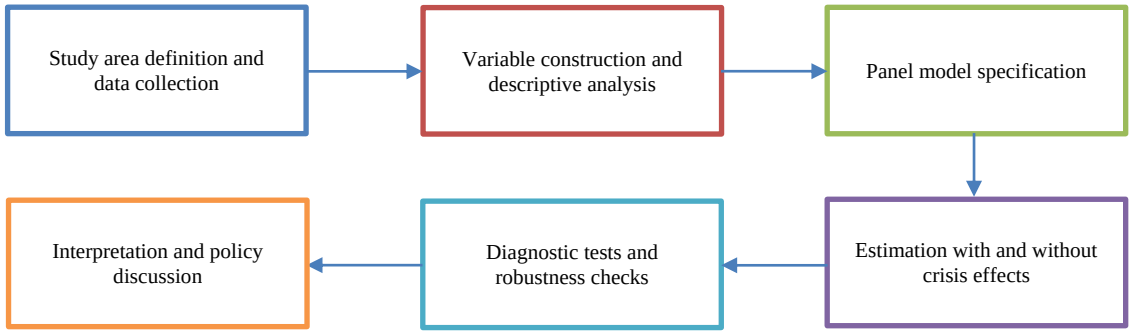


Figure 1. Research Flow

To capture both cross-country and temporal variation, the study employs panel regression techniques using annual data for eight ASEAN countries over 1999–2023. Panel models are preferred because they allow the joint analysis of regional heterogeneity and dynamic change over time. In line with the study's objective, tourism performance is treated as the outcome variable, while economic growth and structural tourism characteristics are modelled as key explanatory factors. The baseline specification relates tourism performance to economic output while controlling for macroeconomic conditions. This approach is consistent with prior tourism–growth studies in regional and multi-country contexts.

The core empirical model is specified as follows:

$$\ln(TR_{it}) = \alpha + \beta_1 \ln(GDP_{it}) + \beta_2 TI_{it} + \beta_3 X_{it} + \mu_i + \varepsilon_{it} \quad (1)$$

where i denotes country and t denotes time. TR represents tourism receipts, GDP denotes gross domestic product, TI is tourism intensity, and X is a vector of control variables. The term μ_i captures unobserved country-specific effects. This specification follows and extends standard panel formulations employed in tourism–growth studies (Balaguer & Cantavella-Jordá, 2002; Brida et al., 2016; Lee & Chang, 2008). Regional heterogeneity is a central concern in ASEAN due to differences in development levels, tourism structures, and institutional capacity. To account for unobserved time-invariant characteristics, fixed effects estimators are applied alongside pooled ordinary least squares. This strategy controls for country-specific factors such as geography, long-term policy orientation, and structural tourism endowments, thereby reducing omitted variable bias in the estimated relationships. Accordingly, the fixed-effects framework is employed to capture stable long-run associations rather than short-term fluctuations or strict causal mechanisms.

Crisis effects are incorporated to capture major disruptions affecting tourism systems across the region. Dummy variables are introduced for key crisis episodes, allowing the model to isolate structural breaks associated with external shocks. This specification enables the assessment of how tourism–economic relationships behave under stress conditions, consistent with regional resilience and tourism vulnerability frameworks. Following the tourism-led growth framework extended to account for macroeconomic shocks, the augmented panel model incorporating crisis effects is specified as:

$$\ln(TR_{it}) = \alpha + \beta_1 \ln(GDP_{it}) + \beta_2 TI_{it} + \beta_3 X_{it} + \gamma C_t + \mu_i + \varepsilon_{it} \quad (2)$$

where i denotes country and t denotes time. TR_{it} represents tourism receipts, GDP_{it} denotes gross domestic product, and TI_{it} captures tourism intensity measured as the share of tourism receipts in GDP. X_{it} is a vector of control variables including inflation and unemployment, which account for macroeconomic conditions affecting tourism demand. The term C_t represents a vector of crisis dummy variables corresponding to the SARS outbreak (2003), the Global Financial Crisis

(2008–2009), and the COVID-19 pandemic (2020 onwards), taking the value of one during crisis periods and zero otherwise. The coefficient γ captures the average structural shift in tourism performance associated with crisis events relative to normal conditions. μ_i denotes unobserved country-specific effects, while ε_{it} is the idiosyncratic error term. This specification follows established empirical approaches that incorporate crisis indicators into tourism–growth models to identify structural disruptions in tourism activity (Brida et al., 2016; Gössling et al., 2021; Lee & Chang, 2008).

Estimation is conducted using heteroskedasticity-consistent standard errors to account for potential variance instability across countries and time. This choice improves inference reliability in panels characterised by structural diversity and uneven tourism scales. Results are reported for alternative specifications to confirm the stability of key coefficients.

Table 1. Variables Description (Source: Authors' compilation and own calculations)

Variable	Definition	Measurement	Expected Effect
Tourism Receipts (TR)	International tourism earnings	USD, logarithmic	Dependent variable
GDP	Economic output	USD, logarithmic	Positive
Tourism Intensity (TI)	Tourism share of GDP	Percentage	Positive
Inflation	Consumer price inflation	Annual percentage	Ambiguous
Unemployment	Unemployment rate	Percentage	Ambiguous
Crisis 2003	SARS outbreak	Dummy	Negative
Crisis 2008–09	Global Financial Crisis	Dummy	Negative
Crisis 2020+	COVID-19 pandemic	Dummy	Negative

Several diagnostic procedures are employed to validate the empirical results. Correlation analysis is first conducted to examine potential multicollinearity among explanatory variables. Fixed effects estimation is preferred where country-specific heterogeneity is statistically relevant. Model fit and explanatory power are assessed using within and overall goodness-of-fit measures, while coefficient stability is evaluated across specifications. It is acknowledged that tourism activity and economic growth may be jointly determined; therefore, the empirical results are interpreted as indicative of robust long-run associations rather than definitive causal relationships. Table 1 presents the definition and measurement of all variables used in the analysis, providing clarity and reproducibility. Figure 1 summarises the methodological flow, linking data preparation, model estimation, and result interpretation. Together, these elements reflect methodological practices consistent with high-quality regional and tourism geography research.

EMPIRICAL RESULTS

This section presents the empirical findings in a structured and systematic manner, moving from descriptive patterns to multivariate estimations and comparative regional assessments. The emphasis is placed on reporting statistically and economically meaningful results while maintaining analytical clarity. Interpretation is grounded in empirical magnitudes rather than speculative inference, allowing subsequent discussion to draw explicitly on observed patterns in ASEAN tourism and economic dynamics.

Descriptive Analysis

The descriptive statistics indicate marked heterogeneity in tourism and economic performance across ASEAN countries during 1999–2023. For the full sample, average tourism receipts amount to USD 8,643 million, accompanied by a large standard deviation of USD 11,116 million, reflecting substantial dispersion across destinations. This wide variation signals uneven tourism development trajectories and differences in destination scale and maturity across the region, as reported in Table 2. Average GDP for the pooled sample reaches USD 229,519 million, with a standard deviation exceeding USD 270,000 million, underscoring deep structural economic disparities within ASEAN.

Table 2. Descriptive Statistics of Tourism and Macroeconomic Variables in ASEAN (1999–2023) (Source: Authors own calculation)

Group	Tourism Receipts (USD million)	GDP (USD million)	Tourism Intensity (%)	Tourism Growth (%)	GDP Growth (%)	Inflation (%)	Unemployment (%)	Countries
Developing	3,067 (3,718)	199,627 (323,126)	4.04 (4.06)	9.53 (35.09)	10.22 (14.56)	6.55 (7.64)	2.97 (2.22)	5
Developed	17,937 (13,003)	279,338 (133,224)	6.44 (2.42)	5.81 (20.83)	7.23 (8.82)	1.95 (1.79)	2.98 (1.48)	3
All	8,643 (11,116)	229,519 (270,474)	4.94 (3.71)	8.14 (30.52)	9.10 (12.77)	4.82 (6.53)	2.98 (1.97)	8

Tourism intensity averages 4.94 percent of GDP, confirming that tourism represents a relevant but uneven economic pillar.Tourism growth exhibits pronounced volatility, with a mean of 8.14 percent and a standard deviation above 30 percent, indicating strong exposure to cyclical fluctuations and external shocks.

These descriptive patterns are further illustrated in Figure 2. Figure 2(A) depicts long-term tourism receipts trends across ASEAN countries and highlights clear discontinuities during major crisis periods. While tourism revenues follow sustained upward trajectories in normal years, abrupt contractions appear during SARS, the Global Financial Crisis, and most prominently COVID-19, reinforcing the volatility documented in Table 2. A clear development divide emerges between country groups, both statistically and visually. Developing ASEAN members record average tourism receipts of

USD 3,067 million, compared to USD 17,937 million in developed economies, while tourism intensity is lower at 4.04 percent versus 6.44 percent. This contrast is clearly captured in Figure 2(B), where developed economies cluster at higher tourism intensity levels, indicating stronger structural integration of tourism within their economic systems.

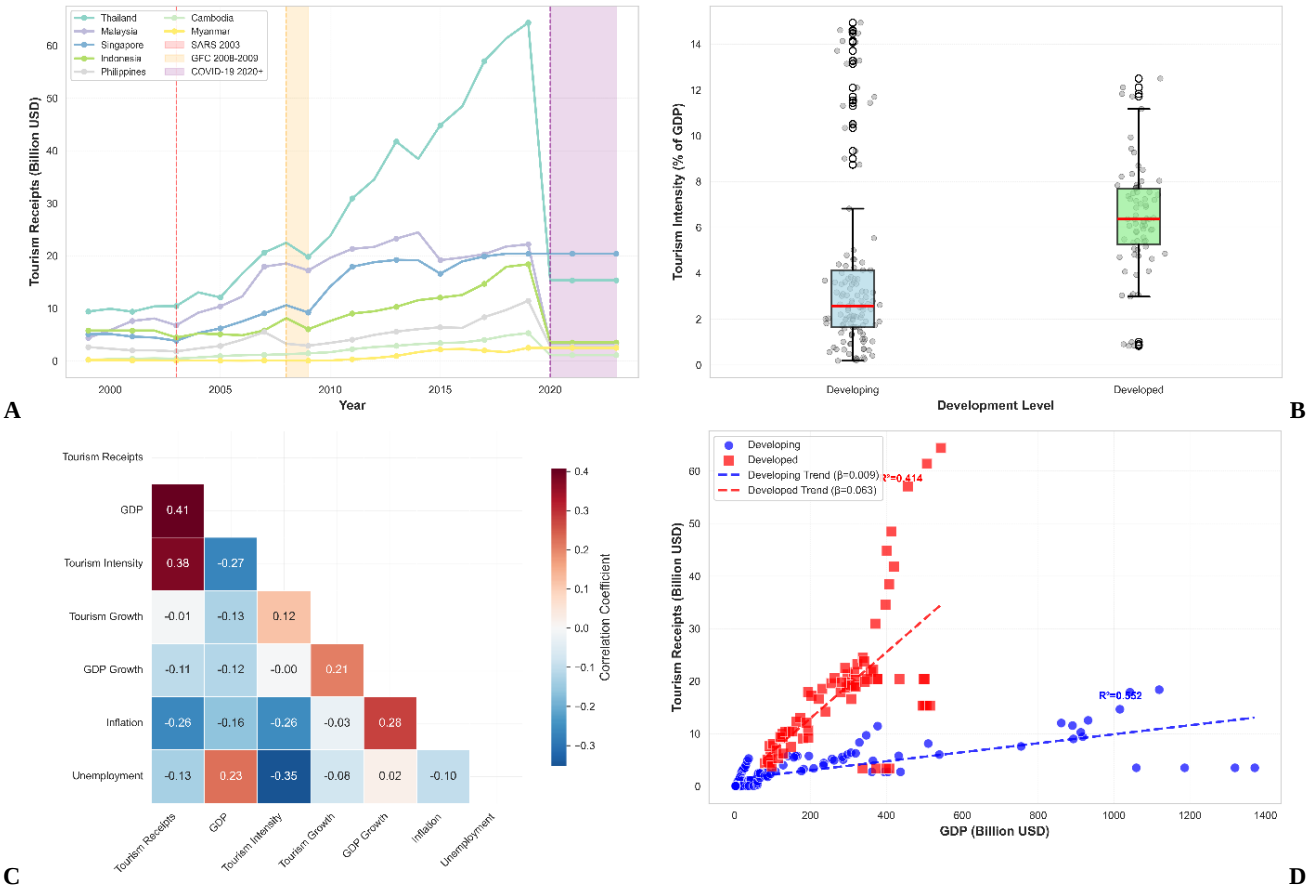


Figure 2. Descriptive Statistics of Tourism and Macroeconomic Variables in ASEAN. (A) Tourism receipts trends with crisis periods; (B) Tourism intensity by development level; (C) Correlation matrix of key tourism and macroeconomic variables; (D) GDP–tourism receipts relationship by development level. (Source: Authors' own calculations and visualization).

Macroeconomic conditions further reinforce regional asymmetries. Developing countries exhibit higher average inflation of 6.55 percent, compared to 1.95 percent in developed economies, while unemployment remains close to three percent in both groups. Figure 2(C) complements this evidence by summarising correlation patterns in which tourism receipts are positively associated with GDP and tourism intensity, yet negatively related to inflation, suggesting that macroeconomic instability is systematically linked to weaker tourism performance.

Finally, Figure 2(D) provides a bivariate illustration of the tourism–GDP relationship across development levels. The steeper fitted slope for developed economies and the wider dispersion among developing countries imply that economic scale supports tourism expansion across contexts, but structural conditions and development stage shape the strength and stability of this linkage. Taken together, Table 2 and Figure 2 justify the subsequent use of panel regression techniques to evaluate tourism–economic relationships while accounting for heterogeneity and crisis effects.

Correlation Analysis

The correlation results offer initial evidence on the association between tourism activity and economic performance in ASEAN. Tourism receipts are positively and significantly correlated with GDP, with a coefficient of 0.408 significant at the one percent level, as reported in Table 3.

Table 3. Correlation Matrix of Tourism and Macroeconomic Variables. (Source: Authors own calculation)

Variable	Tourism Receipts	GDP	Tourism Intensity	Tourism Growth	GDP Growth	Inflation	Unemployment
Tourism Receipts	1.000	0.408***	0.379***	−0.006	−0.108	−0.262***	−0.133
GDP	0.408***	1.000	−0.268***	−0.127	−0.119	−0.163*	0.225**
Tourism Intensity	0.379***	−0.268***	1.000	0.119	−0.003	−0.255***	−0.352***
Tourism Growth	−0.006	−0.127	0.119	1.000	0.209**	−0.026	−0.079
GDP Growth	−0.108	−0.119	−0.003	0.209**	1.000	0.279***	0.024
Inflation	−0.262***	−0.163*	−0.255***	−0.026	0.279***	1.000	−0.101
Unemployment	−0.133	0.225**	−0.352***	−0.079	0.024	−0.101	1.000

Notes: *, *, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively

This association indicates that larger and more developed economies tend to generate higher tourism revenues, although it does not imply a unidirectional causal relationship between tourism and economic growth. Tourism intensity also shows a positive and statistically significant correlation with tourism receipts at 0.379, indicating that economies with a higher tourism share generally achieve greater tourism income. In contrast, tourism receipts display weak and statistically insignificant correlations with tourism growth at −0.006 and GDP growth at −0.108.

These patterns imply that short term growth fluctuations do not directly translate into changes in tourism scale.Macroeconomic stability appears relevant for tourism performance. Inflation is negatively correlated with tourism receipts at −0.262, significant at the one percent level, while unemployment shows a strong negative association with tourism intensity at −0.352. Importantly, no correlation coefficient among explanatory variables exceeds conventional thresholds, suggesting that multicollinearity is unlikely to bias subsequent panel regressions.

Baseline Regression Results

The baseline panel estimations provide strong evidence of a close association between tourism activity and economic output in ASEAN countries. Across pooled OLS and fixed effects specifications, the coefficient on logarithmic GDP remains positive and statistically significant at the one percent level. In the fixed effects model, the estimated elasticity equals 0.952, indicating that a one percent increase in GDP is associated with an almost proportional increase in tourism receipts, as reported in Table 4. This finding highlights the strong note of tourism performance on broader macroeconomic capacity rather than indicating tourism-led economic expansion.

Table 4. Panel Regression Results for Tourism Receipts (Source: Authors own calculation)

Variable	OLS	Policy	FE Panel
Constant	−3.693*** (0.306)	−3.690*** (0.318)	−3.339** (1.240)
ln(GDP)	0.962*** (0.012)	0.965*** (0.011)	0.952*** (0.049)
Tourism Intensity	0.230*** (0.013)	0.225*** (0.014)	0.206*** (0.021)
Inflation	−0.012 (0.010)	−0.012 (0.010)	−0.002 (0.007)
Unemployment	0.068*** (0.019)	0.062** (0.022)	0.068* (0.027)
Crisis 2003	-	0.055 (0.080)	−0.003 (0.087)
Crisis 2008	-	−0.170 (0.152)	−0.206 (0.128)
Crisis 2020	-	−0.121 (0.126)	−0.159 (0.139)
Observations	200	200	200
R squared	0.963	0.963	0.790

Notes: *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively

Tourism intensity also exhibits a consistently positive and significant effect on tourism receipts. In the fixed effects specification, the coefficient reaches 0.206, suggesting that a higher tourism share within the economy translates into greater tourism revenues. This result highlights the importance of structural tourism orientation beyond overall economic scale, reinforcing arguments from tourism geography regarding embeddedness within regional economic systems.

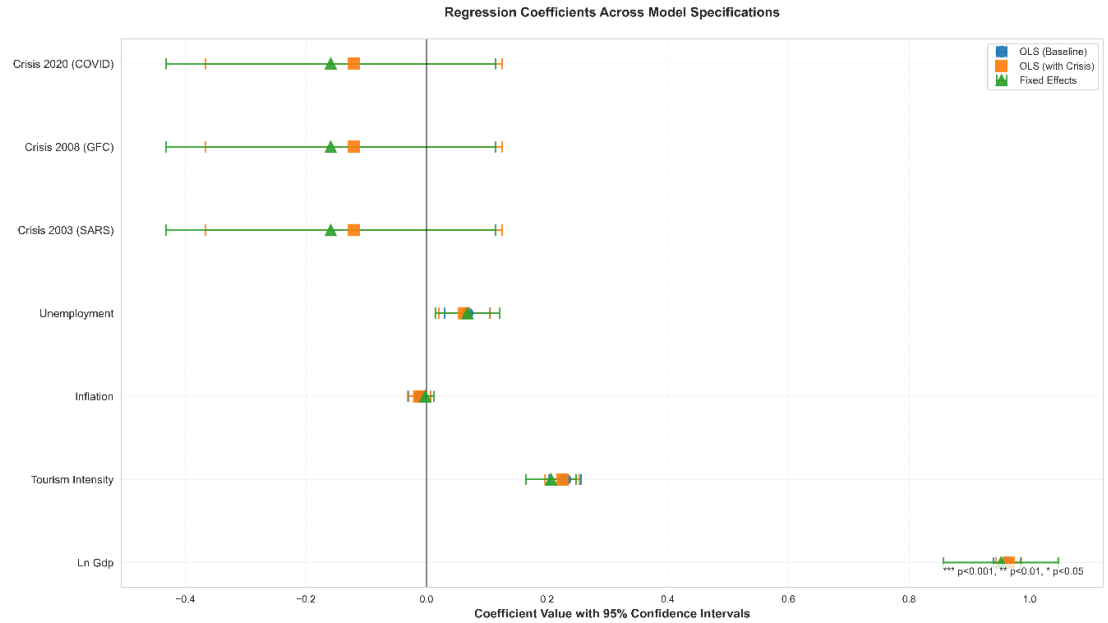


Figure 3. Regression Coefficient Plot with 95 Percent Confidence Intervals. (Source: Authors' own calculations and visualization)

Macroeconomic controls display differentiated effects. Inflation is statistically insignificant in the fixed effects model, with a coefficient of −0.002, indicating that price level changes do not directly influence tourism receipts once country

specific characteristics are accounted for. In contrast, unemployment retains a positive but weakly significant coefficient of 0.068, which may reflect context-specific labour market dynamics in tourism-oriented economies rather than a generalised employment effect. Model performance remains high across specifications. The pooled OLS and policy augmented models both report R squared values of 0.963, while the fixed effects model achieves an R squared of 0.790. Although the inclusion of country fixed effects reduces overall explanatory power, the remaining fit confirms that the selected variables capture a substantial portion of tourism revenue variation across ASEAN countries.

The stability of key coefficients is further illustrated in the regression coefficient plot. Figure 3 shows narrow confidence intervals for GDP and tourism intensity across model specifications, confirming the robustness of these effects. The visual evidence complements the numerical results and supports the reliability of the baseline estimations.

Crisis Impact Assessment

The crisis impact analysis reveals pronounced differences in both the magnitude and spatial distribution of tourism shocks across crisis episodes. Figure 3 provides a comprehensive visual summary of these dynamics by illustrating the distribution of tourism growth during crisis periods, comparing average impacts across development groups, tracing post-crisis recovery paths over a three-year horizon, and presenting a country-level tourism resilience index relative to normal growth conditions. As shown in Figure 4 (A), the SARS outbreak in 2003 is associated with moderate contractions in tourism growth, with observations clustering around negative values close to −15 percent on average. This distributional pattern is consistent with the regression results, which indicate a small and statistically insignificant fixed effects coefficient of −0.003. Together, these findings suggest that SARS generated short-term disruptions without producing persistent structural effects on tourism performance at the regional level. Figure 4 (B) highlights marked asymmetries in crisis impacts across development levels. During the Global Financial Crisis, developing ASEAN economies experienced an average contraction in tourism growth of approximately −18.0 percentage points, compared to −6.8 percentage points in more developed member states. This divergence mirrors the regression estimate of −0.206 and reflects the higher exposure of less diversified tourism systems to global demand shocks and financial instability.

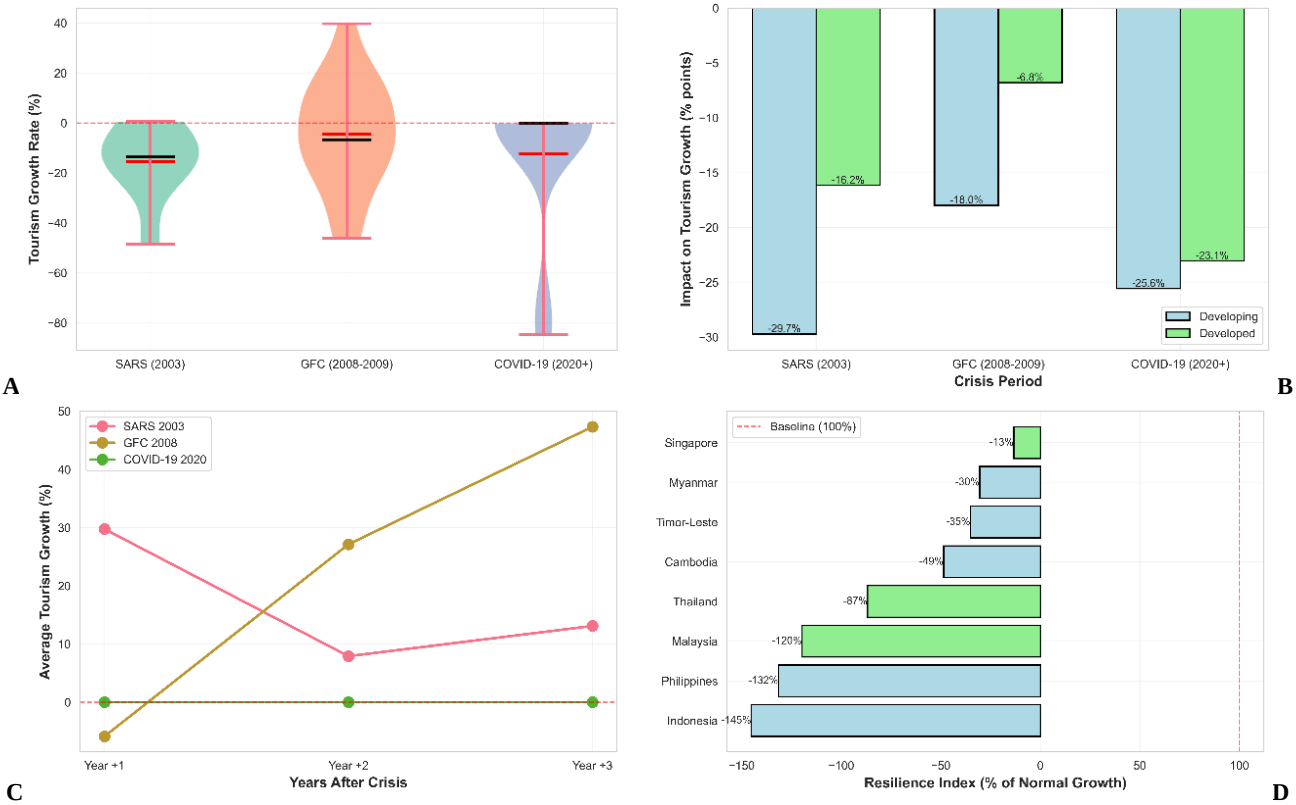


Figure 4. Crisis Impact Analysis on Tourism Receipts in ASEAN. (A) Tourism Growth Distribution During Crises; (B) Crisis Impact by Development Level; (C) Tourism Recovery Patterns after Crises; (D) Tourism Crisis Resilience by Country. (Source: Authors' own calculations and visualization)

The COVID-19 pandemic emerges as the most disruptive shock across all dimensions. Average tourism declines reached −25.6 percentage points in developing economies and −23.1 percentage points in developed ones, indicating a region-wide collapse in tourism activity. While the fixed effects coefficient captures an average negative shift, the descriptive and recovery analyses reveal substantial cross-country heterogeneity in both the depth and persistence of the shock. Post-crisis recovery dynamics further reinforce these patterns. Figure 4 (C) indicates that tourism growth rebounded relatively quickly following SARS and the Global Financial Crisis, reaching approximately 13 percent and 47 percent, respectively, by the third year after the shock. In contrast, recovery following COVID-19 remains subdued. Figure 4 (D) underscores pronounced cross-country

heterogeneity in resilience, with Singapore retaining about 87 percent of normal growth, while Indonesia and the Philippines record losses exceeding −130 percent, highlighting deep territorial differences in adaptive capacity.

Regional and Development Group Comparison

The group specific regressions reveal clear heterogeneity in tourism economic dynamics across ASEAN. As reported in Table 5, developing countries exhibit a GDP elasticity of tourism receipts equal to 0.911, slightly higher than the 0.888 observed in developed members. This difference suggests that tourism performance in developing economies is more sensitive to changes in economic scale, reflecting a higher relative dependence on macroeconomic conditions.

Table 5.Group Comparison between Developing and Developed ASEAN Countries (Source: Authors own calculation)

ASEAN Group	ln(GDP)	Tourism Intensity	Inflation	Unemployment	Crisis Impact	R squared	Observations
Developing	0.911	0.202	−0.008	0.067	−0.167	0.954	125
Developed	0.888	0.202	0.020	0.018	−0.093	0.921	75

Tourism intensity shows identical coefficients of 0.202 for both groups, indicating that the structural role of tourism contributes similarly to tourism receipts regardless of development status. In contrast, crisis impacts differ markedly. Developing economies record an average crisis coefficient of −0.167, nearly twice the −0.093 estimated for developed countries, highlighting greater vulnerability in less diversified economic systems.

Model performance remains strong across both subsamples. The R squared value reaches 0.954 for developing countries and 0.921 for developed members, confirming substantial explanatory power. These results underscore the importance of regional context and development level in shaping tourism resilience, economic linkages, and differential responses to external shocks across ASEAN.

DISCUSSION

The estimated tourism–GDP elasticity of approximately 0.96 indicates a strong and robust association between economic scale and tourism performance in the ASEAN context (Fan & Ha, 2025; Pratoomchat, 2020). Rather than providing evidence of tourism-led growth in a strict causal sense, this near-unitary elasticity suggests that tourism revenues expand almost proportionally with gross domestic product, reflecting a tight structural linkage between tourism systems and regional economies (Öztürk et al., 2019; Tang & Tan, 2015). Accordingly, the result supports the study's first hypothesis concerning the positive role of economic growth in shaping tourism performance, and aligns with theoretical perspectives that emphasise demand-side macroeconomic capacity in open and regionally interconnected economies.

The magnitude of the estimated elasticity exceeds that reported in many earlier cross-country studies, which often document weaker or statistically insignificant effects (Rattanasirivilai, 2023; Tung, 2021). Such differences may stem from the greater regional coherence of ASEAN economies and the extended time horizon employed in this analysis (Jiranyakul, 2016). By embedding tourism within a spatially defined regional framework, the findings extend prior evidence and clarify how regional integration and spatial proximity condition tourism performance through macroeconomic scale and structural stability, rather than through a uniform growth transmission mechanism (Balaguer & Cantavella-Jordá, 2002; Lee & Chang, 2008). Crisis resilience emerges as a central dimension influencing tourism performance across ASEAN. The heterogeneous impacts of SARS, the Global Financial Crisis, and the COVID-19 pandemic partially support the second hypothesis by revealing asymmetric and episode-specific disruptions, demonstrating that shocks differ markedly in their structural consequences (Martin & Sunley, 2015; Yong, 2022). While the disruption caused by SARS was largely temporary, COVID-19 produced deeper and more persistent contractions, consistent with resilience theory emphasising shock magnitude, duration, and adaptive capacity as key recovery determinants.

Cross-country recovery trajectories further highlight the spatially embedded nature of tourism resilience. Economies characterised by greater diversification and stronger institutional capacity display faster recovery, whereas regions heavily dependent on tourism face more difficult adjustment paths (Odeleye et al., 2022). These results resonate with tourism geography literature that conceptualises resilience as territorially grounded, shaped by governance structures, connectivity, and regional adaptive capacity rather than by sectoral characteristics alone (Saarinen & Rogerson, 2021).

The development divide identified in the group analysis provides clear empirical support for the third and fourth hypotheses, as developing ASEAN economies exhibit slightly higher sensitivity of tourism revenues to changes in economic scale, alongside substantially larger crisis-induced losses (Tan et al., 2025). This combination reflects a dual role of tourism in less advanced economies, where tourism performance is closely tied to macroeconomic conditions while simultaneously exposing these economies to heightened vulnerability during systemic shocks. Such asymmetry is a well-documented feature in tourism and development studies (Telfer & Sharpley, 2015).

An important nuance arises from the finding that tourism intensity coefficients are identical across development groups (Maneejuk et al., 2022). Tourism orientation contributes similarly to revenue generation in both developed and developing economies, yet its stabilising role differs markedly. In advanced economies, tourism is embedded within diversified economic systems that can absorb shocks more effectively. In developing contexts, tourism plays a more exposed role, amplifying volatility during crisis periods and moderating recovery capacity.

From a theoretical standpoint, these findings refine and extend tourism–growth theory by incorporating a spatially differentiated and crisis-sensitive perspective. Rather than treating tourism as a uniform growth engine, the results

demonstrate that tourism performance is contingent on regional structure, development level, and exposure to systemic shocks (Karimi et al., 2024). This interpretation bridges tourism economics with concepts of territorial resilience and uneven regional development, offering a more nuanced understanding of tourism's economic role.

The study also addresses gaps in ASEAN-focused literature, which has frequently relied on short time horizons or single-country analyses (Kyophilavong et al., 2018; Tang & Tan, 2013, 2015). By employing a long-term, multi-country panel framework, the analysis captures both enduring structural relationships and episodic disruptions. This contribution strengthens the empirical foundation for regional tourism research in emerging economic blocs and offers a more comprehensive understanding of tourism dynamics over time.

Clear policy implications follow from these results. ASEAN tourism strategies should move beyond aggregate growth targets toward spatially differentiated planning approaches (Kholil et al., 2025; Sobirov et al., 2025). Developing economies would benefit from reducing excessive dependence on tourism through stronger intersectoral linkages, while developed members should prioritise innovation, diversification, and resilience-building measures. Such differentiation aligns closely with principles of regional planning and territorial policy.

Overall, the findings support all proposed hypotheses within an association-based analytical framework and demonstrate that tourism plays a central yet uneven role in ASEAN economic development (Bassil et al., 2015). Growth effects are substantial but asymmetric, with development level shaping both contribution and susceptibility to crises. By integrating economic analysis with a regional and spatially informed perspective, the study contributes new insights into how tourism both shapes and is shaped by regional development processes in an increasingly crisis-prone global economy.

CONCLUSION

This study aimed to analyze the long-run relationship between tourism development and economic growth in ASEAN at a regional, territorial level, including crisis dynamics and development heterogeneity. Based on balanced panel data for eight ASEAN countries between 1999 and 2023, the empirical evidence obtained is strong for the role of tourism as an integral component of regional economic activity rather than as an independent causal engine of growth. The results provide evidence that the relationship between tourism revenue and economic output is one of joint proportionate increase, indicating a close structural association between tourism performance and overall economic capacity within a spatially integrated region.

A number of empirically important conclusions can be drawn from the analysis. First, the derived tourism–GDP elasticity of around 0.96 suggests a robust and structurally embedded association between tourism systems and regional economies. This magnitude implies that tourism expansion in ASEAN closely follows broader macroeconomic dynamics, reinforcing the view that tourism operates as part of a larger economic process rather than as a standalone growth driver. Furthermore, crises themselves have asymmetric effects on tourism performance. In contrast, the SARS epidemic caused only temporary disruptions, whereas the Global Financial Crisis and, more particularly, the COVID-19 outbreak led to massive and long-lasting reductions in tourism activity, illustrating the vulnerability of tourism to systemic shocks.

Third, the discrepancy in development between ASEAN member countries is significant when comparing developing and developed states. There is moderate heterogeneity in the tourism output response estimates by level of development, with lower-income economies showing a slightly greater sensitivity of tourism revenues to economic growth than higher-income ones, but substantially more susceptibility when crisis periods are considered. Against this backdrop, crisis sensitivity is lower and recovery capacity stronger in developed ASEAN economies where economic structures are more diversified and where institutions are better able to support adjustment processes.

These findings provide empirical support for the proposed hypotheses within an association-based analytical framework and underscore the region-specific nature of tourism–economic linkages. From a theoretical perspective, the paper adds to the literature by relaxing linear and homogeneous assumptions often embedded in tourism-led growth analyses. By combining crisis dynamics with regional heterogeneity, the study reveals the conditionality of tourism–economic relationships on territorial structure, development level, and exposure to external shocks. Rather than advancing a strict tourism-led growth mechanism, the findings emphasise how tourism performance is shaped by macroeconomic conditions and territorial resilience, thereby enriching tourism geography and regional development theory.

The policy implications of such findings are highly pertinent to ASEAN. Regional and local tourism policies must not remain focused solely on aggregate growth objectives but should apply more spatially differentiated approaches according to diverse development conditions. In the case of developing member countries, it will be necessary to reduce excessive tourism dependence by strengthening intersectoral linkages and economic diversification as a means of lowering vulnerability to future shocks. In more mature destinations, policy priorities should concentrate on innovation, sustainability, and resilience-enhancing measures that increase the adaptive capacity of tourism systems. At the regional level, greater coordination within ASEAN can promote more sustainable tourism development and improved collective crisis preparedness.

There are, however, several potential limitations to this study. This analysis is based on national-level aggregate data and may obscure significant subnational differences in tourism performance and regional resilience. Moreover, tourism receipts as the main proxy for tourism activity do not capture qualitative aspects related to sustainability, employment quality, or environmental impacts. Crisis effects are also modelled using dummy variables, which capture average shifts and may not fully reflect more complex non-linear or lagged responses.

These constraints motivate a number of potentially fruitful avenues for further research. Future studies may employ subnational or destination-level data to better capture spatial heterogeneity within countries. Integrating environmental, social, and institutional indicators would enable a richer assessment of sustainable tourism development. Further work could also apply non-linear or spatial econometric methods to investigate spillover effects and cross-border interactions among ASEAN

economies. Lastly, comparative analysis across other regional blocs would help assess the extent to which observed tourism–economic relationships are context-specific or generalisable across different institutional and geographic settings.

Overall, this research evidences that tourism continues to be a significant component of regional economic systems in ASEAN, although its contribution is uneven and closely conditioned by development level and crisis exposure rather than uniformly growth-leading. By combining rigorous empirical analysis with a regional and spatially informed perspective, the study contributes to a more nuanced understanding of tourism–economic dynamics in an increasingly volatile global context. The results provide a robust empirical basis for regionally differentiated tourism policy and open new research directions at the intersection of tourism geography and regional development.

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ZONING OF OIKONYMS OF THE TERRITORY OF THE REPUBLIC OF KARAKALPAKSTAN

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Abstract: In the article, the scientific research works of foreign and local scientists who geographically studied the names of settlements, that is, oikonyms, are analysed. The object of the research is 1151 oikonyms of the Republic of Karakalpakstan. The purpose of the scientific work is the oikonymic zoning of oikonyms of the Republic of Karakalpakstan by quantitative analysis of their linguistic structure, topoterminological structure, and lexical-semantic structure. In carrying out scientific work within the framework of this goal, field research was mainly conducted to determine the linguistic and lexico-semantic typology of oikonyms. In the process of quantitative analysis of oikonyms, the statistical method and cartographic and zoning methods were effectively used in their zoning. In terms of territorial distribution, Karakalpaks predominate in the northern and central districts, and Uzbeks predominate in the southern districts. In addition, they have their own nominative traditions in naming oikonyms, and this circumstance has been revealed in the study that the oikonyms of Karakalpakstan were formed in the northern regions from Karakalpak names, and in the southern regions, they were formed mainly from Uzbek names, and this circumstance served as the basis for dividing the region into two oikonymic regions. Furthermore, the distribution of local geographical terms by territories, i.e. mainly hydronymic in the northern districts, and oikonymic terms in the central and southern districts, was determined. At the same time, the identification of territorial differences in lexical and semantic features served as the basis for dividing the Northern oikonymic region into four micro-regions: the Aral Sea region, the Northeastern, Western, and Central, and the Southern oikonymic region into three micro-regions: the Southern Left Bank, the Southern Right Bank, and the Kyzylkum.

Keywords: toponyms, oikonyms, local geographical terms, oikonymic regions, oikonymic micro-regions, oikonymic zoning, cultural geography, rural geography, ethnonyms, anthropo-oikonyms

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INTRODUCTION

Since the production, economic, and social activities of humanity are carried out within the framework of the geographical environment, consisting of many objects with their names, the names of geographical objects are always the same, that is, they perform the function of an address, without geographical names there is no socio-economic formation. Geographical names, as direct symbols of history, are constantly supplemented, renamed, and updated due to the lifestyle of the people who lived there for centuries, serving the various needs of society.

At the same time, geographical names reflect the diversity of the surrounding natural environment, the availability of natural resources, the diversity of landscapes, climatic and hydrographic, relief and orographic features, as well as the appearance, location, and other important features and characteristics of natural and other objects. In general, geographical names are often a rich source of diverse information. Therefore, the study of geographical names, their scientific research, and the determination of the etymology and meaning of each place name are among the urgent tasks.

Place names are amazing, and living works of art have been created by millions of people over thousands of years. Doğru (1984) tells about the geographical features, migrations, events, stories, facts, and finally, the entire history of that region. That is, they all have a language. In other words, they are all part of cultural heritage, its oral form.

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From this point of view Hanilçe (2013), place names, which have an important share in the cultural treasures of societies, preserve the memories of the societies to which they belong and play an important role in the transfer of culture from the past to the future. The place names created by indigenous peoples have now become the property of world geography and cartography. Sometimes they are accepted in their original form, but most often the names reflect changes in the living language. As noted, any place name arises out of necessity, its form changes in the process of performing its function, and ultimately retains its time.

Saparov et al. (2017) emphasized that toponymic research allows determining the ethnic composition of the population of a certain territory, which peoples lived in this territory, in which language the authors of these names spoke in ancient times, i.e., the etymology of place names. For this reason, it is necessary to study geographical names, especially their territorial distribution and scientific research of the reasons for their origin. Because through these aspects, to a certain extent, toponymic regularities are determined, and this information serves toponymic zoning.

Basik (2020) studied urban place names and their significance in our lives. Rusu (2020) conducted a quantitative analysis of the political formation and post-socialist toponymic changes of the Romanian cities of Brașov, Cluj-Napoca, and Sibiu. Atik et al. (2022) observed landscape features through place names in rural areas of the Mediterranean, while the names of some settlements and villages in Serbia and their locations on topographic maps were developed by Marković (2024). The map of Romanian city names based on female names was studied by Rusu (2024), the spatial distribution characteristics and influencing factors of traditional villages in the Jiarong Tibetan area of western Sichuan, China were studied by Li et al. (2024), the distribution characteristics and formation of traditional village toponyms in western Hunan Province, China were studied by Liu et al. (2024), the distribution and formation of traditional village names in Southeast Guizhou Province were studied by Chen et al. (2025), and the assessment of the location potential of traditional villages in Sichuan Province for tourism development was studied by Xia et al. (2025). Moreover, Rose-Redwood et al. (2018) conducted numerous studies on the names of streets and their names, which are part of cities, settlements, and villages.

Moreover, a number of geographers have been engaged in toponymic zoning, and in Manakov's (2006) research, based on the formant method, the toponymic zoning of the European part of Russia, Ukraine, and Belarus was carried out. In this case, the presence of Slavic toponymic formants - prefixes, suffixes, and affixes - in the names of settlements of the Eastern European Plain was statistically analysed using the cartographic method. In the toponyms of different parts of the Eastern European Plain, the predominance of certain formants adding a certain "tone" (character) was determined, and on this basis, the studied region was divided into 7 toporegions. Taranova (2004) conducted geo-toponymic zoning in the territory of Ukraine's Holohora-Kremenets range and the area of Male Polissya.

It identifies nine geo-toponymic regions, and in each of them, the connection of geographical names with natural conditions is observed. Afanasev (2005, 2006) proposed toponymic zoning of Ukraine in his research. According to it, nine toponymic regions have been identified in the country. The theoretical foundations of these works serve to a certain extent in the toponymic zoning of oikonyms of our region. A unique experience of toponymic zoning of the territory of Uzbekistan, published in scientific literature, can be observed in the textbook “Toponymy” by Nizomov et al. (2013). These authors divided the territory of Uzbekistan into 8 toponymic regions: Tashkent-Mirzachul, Zarafshan, Kyzylkum, Lower Amudarya, Ustyurt, Fergana, Surkhandarya, and Kashkadarya.



Figure 1. Location of our research object (Source: Google, accessed on 16.09.2025)

This zoning scheme covers the entire territory of Uzbekistan, and this experience is characterised by a more general formulation of the relevant scientific problem. In particular, the work under consideration does not indicate specific criteria for toponymic zoning, does not carry out statistical (quantitative) analysis of the composition of toponyms and does not compare them in the context of the identified toponymic regions, and zoning is carried out only at one territorial level. Moreover, in this case, not just oikonyms, but all categories of toponyms are taken as objects of zoning. The object of our research is the oikonyms of the Republic of Karakalpakstan, which is an administrative-territorial unit of the Republic of Uzbekistan located in the center of the Central Asian region and located in the northwestern part of Uzbekistan. The territory of Karakalpakstan is mainly occupied by the Aral Sea in the northern part, the Ustyurt Plateau in the western part, the Kyzylkum Desert in the eastern part, and the Amudarya delta in the southern and central parts. The fact that the main area is occupied by such various landscape types is reflected in the formation of toponyms of this territory, especially oikonyms, their territorial differences, as well as the diversity of local geographical terms across the territory (Figure 1). The Republic of Karakalpakstan administratively and territorially consists of the capital city of Nukus and 16 districts. In this study, the names of settlements in the Republic of Karakalpakstan were obtained based on the Resolutions of the Praesidium of the Jokargy Kenes of the Republic of Karakalpakstan and the District Councils of People's Deputies on the issues of administrative-territorial division as of January 1, 2021. According to these official documents, as of January 1, 2021, there were 12 cities, 26 towns, and 1113 rural settlements in the republic, that is, a total of 1151 settlements. In the article, the determination of the quantitative composition of the lexico-semantic features (etymology) of the oikonyms of the Republic of Karakalpakstan and its administrative-territorial units was carried out based on the total number of settlements recorded in the above-mentioned documents. Furthermore, the linguistic composition of oikonyms was analysed in the context of administrative-territorial units.

MATERIALS AND METHODS

The process of toponymic zoning of the studied territory is a rather complex issue, and its implementation requires the application of various methods. These are the methods of comparing different toponymic data with each other, the method of describing the number of toponyms according to their genetic origin, the cartographic method, the direct study of toponyms in field conditions, and the selection of leading toponyms that are numerous.

When writing this article, the lexico-semantic meaning of oikonyms, the determination of topoterminological aspects, i.e., local geographical terms in the composition of oikonyms, were mainly used as a result of scientific expeditions to remote villages and auils in the territory of the Republic of Karakalpakstan, i.e., field research, and when analyzing the obtained results, statistical research methods were mainly used to determine their numerical values. In addition, historical maps were studied in terms of the location of settlements, their historical origin, and for the first time, based on the analysis of collected materials, using the methods of zoning and mapping of oikonyms of the republic, oikonymic zoning and mapping of oikonyms of the republic were carried out. Below we present the results obtained from scientific research.

Toponyms distributed across regions are not uniform in their genetic origin. For example, while orotoponyms are more common in some regions, hydrotoponyms or petrotoponyms may dominate in some regions. Their distribution areas are separated by a kind of invisible curve - a linguogeographic boundary. It is this curve that can serve as a boundary for toponymic regions. Consequently, the numerical abundance of a toponymic type indicates the specific geographical conditions of that place, and it is distinguished as a separate region. In this way, toponymic zoning is carried out.

It is known that the diversity of the natural environment, the history of local peoples, the economic and cultural way of life, and linguistic features lead to territorial differences in geographical names. These differences serve as the main criterion for toponymic zoning. Juchkevich (1968) is a specialist who has published the most scientific works on toponymic zoning, indicating geographical (territorial), linguistic, and historical principles as the main principles of this zoning.

It is difficult to imagine any geographical research without the method of zoning. Toponymic regions, like physical-geographical and economic-geographical regions, are located in a certain territory that is not exactly repeated in nature and have a separate geographical name. At the same time, it is natural that there are similarities between toponymic regions, but they differ in their main important features. The renowned toponymist and geographer Juchkevich (1968) wrote that "when determining the territorial characteristics of toponymy, issues of zoning principles arise first." There are specific principles of toponymic zoning, which consist in adhering to the objective territorial division of the identified regions. Toponymic zoning is carried out mainly on the basis of the principles of territoriality, historical-genetic, complexity, and relative homogeneity.

A systematic approach should be applied to the socio-geographical study of place names in a certain territory, in particular, oikonyms. At the same time, the oikonyms of the studied territory are perceived as integral elements of the historically formed and developing geocultural environment of that territory, and attention is paid to the fact that they embody the important features of that geocultural system in the past and present. From this point of view, it is advisable to consider the oikonymy of a certain territory as a territorial cultural system and study it as a territorial oikonymic system.

It is known that oikonymy reflects the historical and cultural development of the territory, through oikonymy it is possible to study the ethnocultural and historical-geographical conditions of the territory. In this research work, each district of the Republic of Karakalpakstan was taken as a territorial oikonymic system. In this case, oikonyms were analysed from the point of view of language structure, i.e., spectral-stratigraphic, origin and meaning, i.e., lexico-semantic and topoterminological. Quantitative analysis of the above-mentioned spectral-stratigraphic, lexical-semantic, and topoterminological indicators in the identification of oikonymic regions and micro-regions was carried out within the framework of the oikonyms of the capital city of Nukus and 16 districts (total 1151), which are considered administrative-territorial units of the Republic of Karakalpakstan. Neighbouring districts were grouped in terms of similarity. The

language structure served as the basis for the identification of oikonymic regions, where Karakalpak (Kipchak dialect) names prevailed in the northern regions and Uzbek (Karluk dialect) names in the southern regions.

For many centuries, Karakalpaks have lived in these regions, namely in the northern and central districts, and Uzbeks in the southern districts, and their nominative traditions are clearly manifested in the naming of places. These aspects deserve to serve as a region-forming criterion. In addition, the lexico-semantic and topo-terminological features of oikonyms were taken as the basis for the division into oikonymic micro-regions, and neighbouring districts with similar lexico-semantic and topo-terminological features were grouped and divided into oikonymic micro-regions.

Like any territorial system, the territorial oikonymic system has its own composition, that is, its structure, and this structural structure has a multifaceted character (Figure 2). In particular, the presence of names in territorial oikonymic systems, usually belonging to different languages, is the basis for analysing the linguistic or spectral-stratigraphic composition of these systems. In this case, the oikonyms of the region are grouped according to their belonging to different languages, and the most common of the identified groups is selected as the oikonymic background of the corresponding region. Considering that language segments were formed in different historical periods, they are considered as stratigraphic layers of the territorial oikonymic system. The lexico-semantic structure of the territorial oikonymic system implies a typological study of the etymological formation of oikonyms in the studied territory and the diversity of their lexical meaning. It is known that oikonyms, as proper nouns, are formed according to various word-formation models. They can consist of one or more words, formed using various toponymic terms and toponymic formants (suffixes).

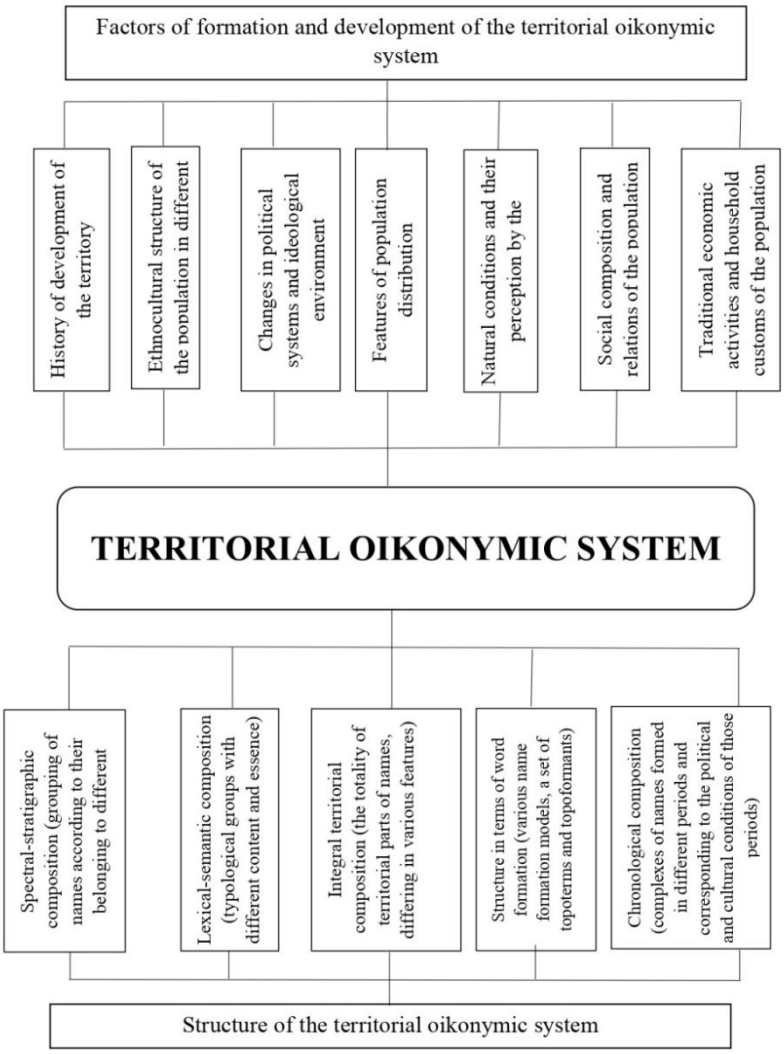


Figure 2. The structure of the territorial oikonymic system and the factors of its formation (Source: Authors)

These features of oikonyms are the basis for studying the structure of the territorial oikonymic system in terms of word formation and reflect an important feature of the oikonymy of a particular region.Territorial oikonymic systems have a rather variable character, and this feature is greatly influenced by the socio-political system and ideological environment in society. Historical experience shows that when the system of political governance in states changes, place names also change, are adapted to the new ideological and spiritual environment, and newly founded settlements are named according to the requirements of the time. As a result, in the oikonymy of many regions, names formed in different periods and embodying their socio-ideological features are encountered. The structure of territorial oikonymic systems in this aspect

constitutes its chronological structure. Spectral-stratigraphic, lexico-semantic, word-formation (in particular, terminological), and chronological differences in the oikonymy of territories with a large area are often expressed territorially.

These territorial differences are the basis for the zoning of territorial oikonymic systems. Oikonymic zoning involves dividing the oikonymy of the studied territory into smaller parts that differ from each other in various historically formed structural features and reflects the territorial composition of large territorial oikonymic systems. The structure of territorial oikonymic systems is historically formed and changed under the influence of several factors. The main of these factors are: the history of the development of the territory, the peculiarities of the settlement of the population, the ethnocultural composition of the population in the past and present, the social composition and relations of the population, traditional economic activities and everyday habits of the population, natural conditions and people's attitude to them, as well as the political system and ideological environment (Figure 2). When studying territorial oikonymic systems from a socio-geographical point of view, it is necessary to identify and analyse not only their structure of various kinds, but also the factors that influenced this structure. In socio-geographical research, the territorial oikonymic system is considered an integral and important element of the geocultural system. Therefore, through oikonyms, it is possible to obtain valuable historical and geographical information about the ethnocultural situation in the territory and its historical changes, the directions of population migrations associated with the development of the territory, the lost elements of the traditional way of life and social relations of the local population, individuals who played a special role in the history of settlements, and the state of natural-anthropogenic landscapes in the past. Consequently, territorial oikonymic systems, embodying the historical and modern features of natural-economic and socio-cultural systems of the corresponding territories, are a source of information about their origin and evolution, disappeared features. Moreover, a comprehensive study of territorial oikonymic systems based on a broad cultural-geographical approach contributes to a more complete disclosure of the historical, socio-spiritual significance of place names, the development of local history knowledge, the formation and promotion of unique "brands" of settlements, and the deeper study and protection of the cultural heritage of the regions.

RESULTS AND DISCUSSION

In the course of our research, the composition of all oikonyms currently existing in the Republic of Karakalpakstan was studied in three aspects by districts, analysed and summarised on a specific quantitative and statistical basis. These are linguistic, i.e., spectral-stratigraphic, semantic, i.e., lexico-semantic, and word-formation, i.e., terminological aspects. The generalisation of the analysis made it possible to clearly distinguish the cases of territorial stratification in the oikonymy of the Republic of Karakalpakstan. In this case, first of all, territorial differences in different features of oikonymy are noticeable between the four southern districts of Karakalpakstan, namely Amudarya, Beruni, Turtkul, and Ellikkala districts, as well as other territories of the republic. In particular, if we pay attention to the linguistic structure of oikonyms, in the four southern districts, the majority of oikonyms, that is, 77.3%, are Uzbek, and in the rest of the republic, 88.5% of all oikonyms are Karakalpak. Therefore, it is justified to divide the oikonymy of the territory of the Republic of Karakalpakstan into two oikonymic regions in terms of language composition - Northern and Southern (Table 1).

The oikonyms of Bozatau, Muynak, and Takhtakupyr districts can be distinguished as a oikonymic micro-region of the Aral Sea region. Of the 88 oikonyms here, 40 or 45.5% are oikonyms formed from hydronyms. Because in the past, there were many lakes and riverbeds here, and the population used more water bodies to determine (identify) the location of villages, that is, wherever the village was located, the settlement was often named according to the corresponding hydronym.

Table 1. Linguistic structure of the oikonymy of the Republic of Karakalpakstan (Source: Authors)

Number and percentage of oikonyms belonging to a particular language								
Name of administrative-territorial units and total number of oikonyms			Karakalpak		Uzbek		Other languages	
			Quantity	%	Quantity	%	Quantity	%
1	Bozatau	26	25	96.1%	0	0	1	3.9%
2	Chimbay	120	116	96.7%	0	0	4	3.3%
3	Kanlykul	39	32	82%	3	7.7%	4	10.3%
4	Karauzek	97	90	92.8%	0	0	7	7.2%
5	Kegeyli	132	128	96.9%	0	0	4	3.1%
6	Khojeyli	64	42	65.6%	8	12.5%	14	21.9%
7	Kungrad	48	41	85.4%	4	8.3%	3	6.3%
8	Muynak	22	19	86.5%	0	0	3	3.5%
9	Nukus	40	33	82.5%	2	5%	5	12.5%
10	Shumanay	105	98	93.3%	3	3%	4	3.7%
11	Takhiatash	32	15	46.9%	12	37.5%	5	15.6%
12	Tarkhtakupyr	40	38	95%	0	0	2	5%
13	Nukus city	2	2	100%	0	0	0	0
Northern oikonymic region		767	679	88.5%	32	4.2%	56	7.3%
14	Amudarya	129	10	7.8%	98	76%	21	16.2%
15	Beruni	71	3	4.2%	57	80.3%	11	15.5%
16	Ellikkala	92	6	6.5%	73	79.3%	13	14.2%
17	Turtkul	92	2	2.2%	69	75%	21	22.8%
Southern oikonymic region		384	21	5.5%	297	77.3%	66	17.2%
Karakalpakstan Republic		1151	700	60.8%	329	28.6%	122	10.6%

To date, most of the cores of these lakes and rivers have dried up and disappeared, but the names of the villages serve as a source or a kind of "trace" indicating the historical hydrography of these territories. In the formation of oikonyms of this micro -region, the topo-terms *"kul"* (meaning lake) and *"ozek"* (meaning root) participated in 20 of the total number of oikonyms, that is, in 22.7% (Figure 3). In the Kegeyli, Nukus, Chimbay, and Karauzek districts, which are part of the Northeastern oikonymic micro-region, there are a total of 389 oikonyms, of which 203 or 52.2% are ethnooikonyms. This circumstance constitutes the main feature of the northeastern oikonymic micro-region. The widespread use of ethnonyms in these territories is historically associated with the fact that tribes of the Karakalpaks built settlements along irrigation ditches and ravines.

Moreover, in this oikonymic micro-region, 97 oikonyms, that is, 24.9%, are formed with the participation of the *auil* (meaning village) topo-terms, which also determines its peculiarity. The territory of the Kungrad and Shumanay districts can be designated as a Western oikonymic micro-region. In this case, the main lexico-semantic feature of oikonymy is associated with the abundance of modern (standard) oikonyms. In the newly developed irrigation massifs of Karakalpakstan, settlements were given many standard ideological names during the Soviet period, most of which were changed during the period of independence to modern (standard) names such as Doslyk, Gulistan, Pakhtakesh, Abad, Pakhtaabad, Tinishlyk, Jaslyk.

In total, there are 153 oikonyms in the micro-region, of which 72 (47%) are modern (standard) names. The large number of newly developed lands, the assignment of modern (standard) names to settlements located on the Ustyurt plateau, and the change of many names by the government in recent years have led to the priority of modern (standard) names. Of the topo-terms involved in the formation of oikonyms, the largest share (7.2%) belongs to the *"auil"* topo-term.

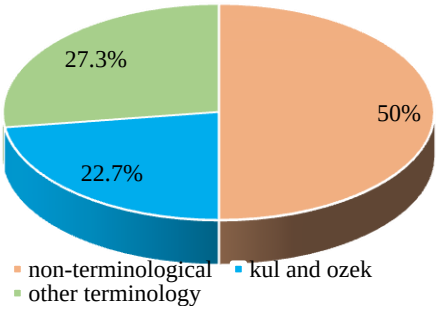


Figure 3. Proportion of topo-terms in the composition of oikonyms of the Aral Sea oikonymic micro-region

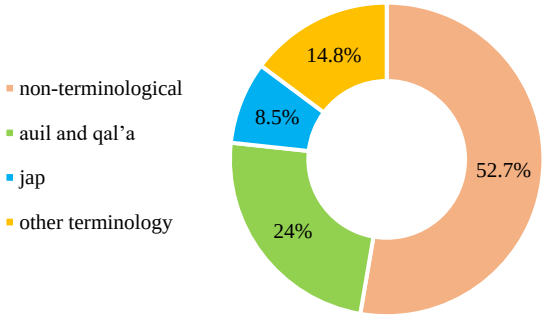


Figure 4. Proportion of topo-terms in the composition of oikonyms of the South Left Bank oikonymic micro-region

The city of Nukus, Takhiatash, Khojeyli, and Kanlykul districts are designated as the Central oikonymic micro-region. The peculiarity of this oikonymic micro-region is explained by the fact that the shares of oikonyms formed from hydronyms, ethno- and anthropo-oikonyms in the lexico-semantic structure of local oikonymy are quite close to each other. In the historical past, when naming settlements in this region, tribal names, nearby water bodies, as well as the names of wealthy people and elders from the tribes were widely used. In this oikonymic micro-region, there are a total of 137 oikonyms, of which 36 (26.3%) are oikonyms formed from hydronyms, 32 (23.3%) are ethnooikonyms, and 21 (15.3%) are anthropooikonyms. Also, the largest share of topo-terms (30 of them, i.e., 21.9%) falls on the topo-term "*auil*".

In the territory of the Northern oikonymic region, there are a total of 767 oikonyms, of which 679, or 88.5%, are Karakalpak oikonyms. District oikonyms have territorial features in terms of lexico-semantic composition and topo-terms involved in their formation. Taking them into account, the Northern oikonymic region can be divided into four micro-regions: the Aral Sea region (Bozatau, Muynak, Takhtakupyr districts), the Northeast (Kegeyli, Nukus, Chimbay, and Karauzek districts), the Western (Shumanay, Kungrad districts), and the Central (Nukus city, Takhiatash, Khojeyli and Kanlykul districts). The territory of the Amudarya district belongs to the South Left Bank oikonymic micro-region. In total, there are 129 oikonyms in the district, of which the largest number (25 or 19.4%) are ethno-oikonyms, as well as 23 or 17.8% are anthropo-oikonyms, and 20 or 15.5% are oikonyms formed from hydronyms. Of the total number of oikonyms, 20 names, i.e., 15.5%, were formed using the topo-term "*auil*" (meaning village), 11 names, i.e., 8.5%, were formed using the topo-term "*qal'a*" (meaning fortress), and 11 names, i.e., 8.5%, were formed using the topo-term "*jap*" (meaning canal) (Figure 4). The South Right Bank oikonymic micro-region includes oikonyms in the oasis part of the Beruni, Turtkul, and Ellikkala districts. In this oikonymic micro-region, there are a total of 255 oikonyms, of which 112 or 43.9% are oikonyms formed from modern (standard) names. The large number of newly occupied territories, changes made to oikonyms by the government have led to an increase in oikonyms formed from modern (standard) names. In addition, in the formation of oikonyms in the oikonymic micro-region, the topo-term "abad/obod" was often involved (21 oikonyms, i.e., 8.2% of the total number of settlements).

In recent years, due to the abandonment of settlements in the desert-pasture areas of Karakalpakstan by the population, settlements such as "Keneli" and "Sipali" in the Takhtakupyr district have been liquidated, and they are being removed from the settlement register. However, in the Kyzylkum part of the Turtkul and Ellikkala districts, several small villages have been preserved, the names of which have their own peculiarities in terms of language and lexical-semantic structure. Oikonyms belonging mainly to the Kazakh and Turkmen languages are found here. From a lexico-semantic point of view, anthropo-oikonyms dominate their structure. Such features are the basis for identifying the Kyzylkum oikonymic micro-region within the Southern Oikonymic Region. In total, there are 384 oikonyms in the Southern oikonymic region, of which 297, or 77.3%, belong to the Uzbek language. District oikonyms differ significantly in terms of lexico-semantic composition and the

composition of topo-terms involved in their formation. Taking these differences into account, the Southern oikonymic region can be divided into the South Left Bank, South Right Bank, and Kyzylkum oikonymic micro-regions (Figure 5).

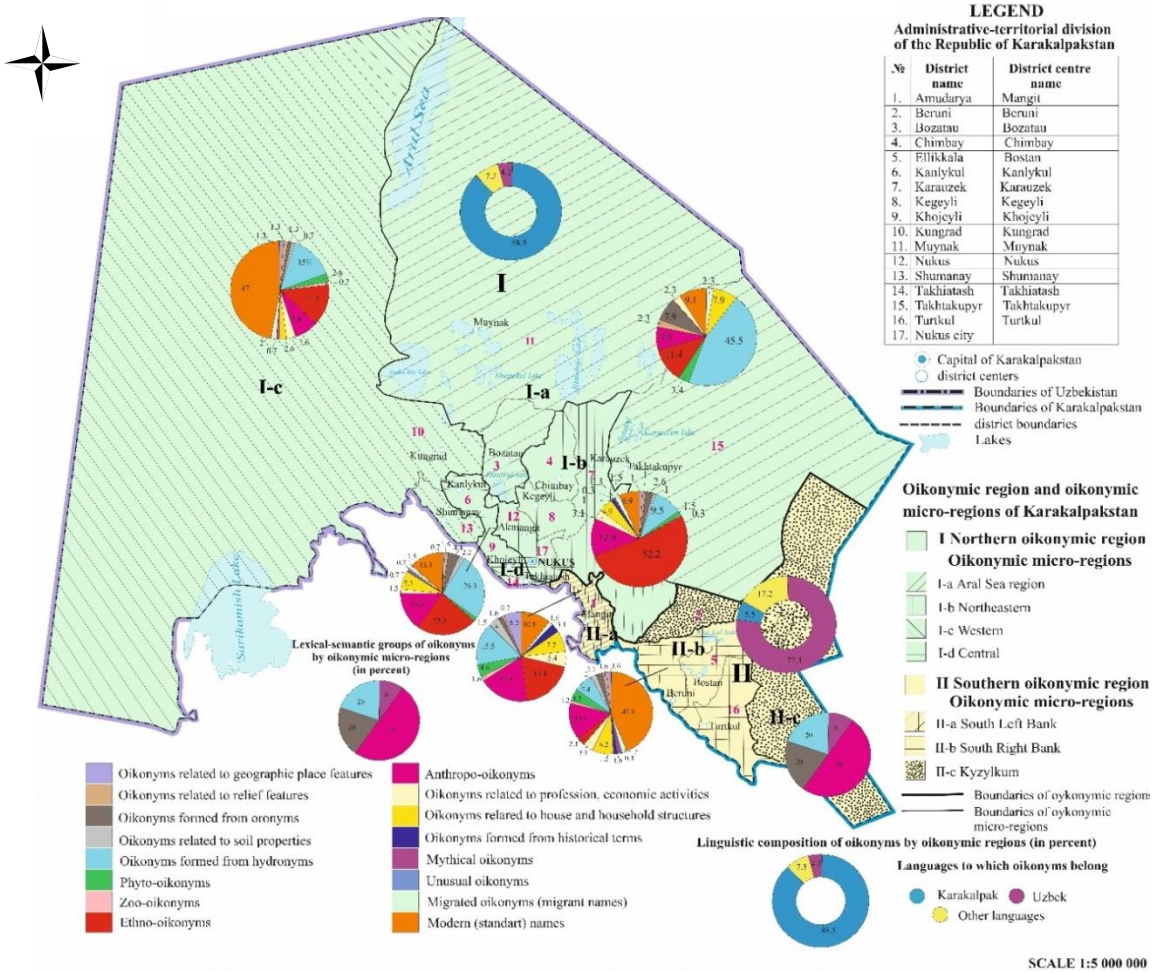


Figure 5. The map of oikonymic zoning of the Republic of Karakalpakstan (Source: Authors)

When studying the lexico-semantic and terminological composition of oikonyms in the context of districts in both oikonymic regions, some internal differences are observed. Taking these differences into account, several oikonymic micro-regions can be distinguished within the Northern and Southern oikonymic regions of Karakalpakstan (Figure 5).

Juchkevich (1968) divided the territory of the former Soviet Union into 30 toponymic regions within the framework of his network of political and administrative divisions and divided them into 9 groups. Uzbekistan, in particular, Karakalpakstan, is mainly noted as a territory where ancient toponyms are widespread. Kupach (2007) cites the principle of taking into account geo-toponymic differentiation as the basis of geo-toponymic zoning. This consists in taking into account the general and regional patterns of the distribution of the name, which is manifested both in the entire territory to be divided and in its individual territories. The principle of uniformity, that is, the identification of geo-toponymic systems, emphasizes that their boundaries and properties are determined based on the analysis of the interaction of the factors and components of the toponym-forming systems. At the same time, it was shown that the genetic approach to the placement of regional systems allows us to determine the reasons for the formation, development, and isolation of geo-toponymic systems.

CONCLUSION

In general, it has been established that in the formation of oikonyms of the territory of the Republic of Karakalpakstan, the leading place is occupied mainly by the names of peoples' clans and tribes, the names of water bodies, modern (standard) names, and oikonyms formed from personal names. In this case, it was established that oikonyms formed from water bodies and local hydrological toponyms predominate mainly in the northern districts, that is, in the Bozatau, Muynak, and Takhtakupyr districts, located on the southern shore of the Aral Sea. It has also been proven that this region has long had a system of branched lakes and riverbeds on the southern shores of the Aral Sea, and the historical settlements of the population were mainly located along these lakes and riverbeds. However, in the previous period, due to the drying up of the Aral Sea, which ranked 4th in the world in terms of size, and the drying up of the lake system adjacent to it and located on its southern shores, some settlements in this area have now disappeared and been removed from the registry, as well as the fact that the names of hydraulic structures of the previous period have been preserved only in oikonyms. Moreover, in this research work, it was confirmed that in the territories of the southern shore of the Aral Sea and the Amudarya River

delta, as we all know, there are many ethnonyms formed mainly from the names of Karakalpak, partly Kazakh, and Uzbek tribes and clans, and from historical times, these peoples have lived in these territories mainly as tribes and clans.

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ASSESSMENT OF THE READINESS OF THE HOTEL INDUSTRY IN THE ZHETYSU REGION FOR THE IMPLEMENTATION OF SUSTAINABLE DEVELOPMENT

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Abstract: Despite the growing prominence of sustainability frameworks in tourism and hospitality, empirical evidence on the operational readiness of hotel industries in emerging and peripheral destinations remains limited. Existing research has largely focused on sustainability outcomes, while comparatively little attention has been paid to the institutional and managerial conditions that determine the feasibility of implementation at the regional level. This study develops and applies an adapted assessment framework based on the Global Sustainable Tourism Council (GSTC) criteria to evaluate the readiness of the hotel industry in the Zhetysu region of Kazakhstan to implement sustainable development principles. The analysis employs a composite readiness index constructed across four dimensions – institutional – managerial, economic, socio-cultural, and environmental sustainability – using Likert-scale measurements and complemented by SWOT analysis. The findings indicate a moderate overall level of sustainability readiness, with relatively stronger institutional and economic preparedness and markedly weaker environmental readiness, particularly in the areas of energy efficiency, waste management, and biodiversity protection. The results further reveal a pronounced gap between formally established sustainability strategies at the governmental level and their practical adoption within hospitality enterprises. By shifting the analytical focus from outcome-based sustainability metrics to readiness-oriented institutional diagnostics, this study contributes to sustainability research in tourism and hospitality. The proposed framework offers a transferable tool for assessing sustainability readiness in emerging destinations and provides evidence-based insights for designing targeted policy instruments that support the transition toward integrated and operationally grounded models of sustainable hospitality development.

Keywords: assessment, sustainable tourism, sustainable hospitality, sustainable development, Zhetysu Region

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INTRODUCTION

The concept of sustainable development encompasses various aspects, including environmental protection, economic growth and social well-being (Sabau, 2020). The concept of sustainable tourism is gaining increasing importance, as it is viewed as an effective means of stimulating global economic development and creating employment opportunities. Implementing sustainable development principles in various economic sectors is crucial for achieving long-term environmental, social and economic goals. To this end, businesses are seeking to integrate the key principles of sustainable development into their activities to boost their competitiveness, gain international recognition, and enhance the quality of their products and services (Liao et al., 2022; Abubakr et al., 2020). Numerous studies in this field have confirmed that implementing sustainable practices in tourism and hospitality can be achieved through various strategies (Cheung & Li, 2019; León-Gómez et al., 2021; Garrigos-Simon et al., 2018; Sharpley, 2020; Yoopetch & Nimsai, 2019).

The Global Sustainable Tourism Council (GSTC) plays a key role in promoting sustainable practices within the tourism industry. The Council has developed sustainability criteria to ensure balanced development in various areas (Bozhinova & Georgieva, 2023; Wu et al., 2022). The GSTC criteria, which cover effective sustainability management, maximising economic benefits for the host community and minimising negative impacts, form the basis of assessments of the sustainability of tourist destinations (Modica et al., 2018; Hamimah et al., 2022). Additionally, the GSTC criteria are incorporated into the evaluation of sustainable practices within the hotel industry, in line with the European Union's sustainability indicators and framework (Alipour et al., 2019). These criteria are widely used in international practice. For instance, Hamimah et al. (2022) evaluated the sustainability of tourism and hospitality, showcasing the practical application of the GSTC in sustainability evaluations. Kruczek & Szromek (2020) emphasised the importance of GSTC criteria in determining the value proposition of tourism business models, particularly in the context of overtourism.

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Furthermore, Bricker et al. (2022) proposed a framework model for the sustainable development of tourism in national parks and their surrounding areas, in line with the GSTC's principles and criteria. However, successfully implementing these principles in practice faces a number of regional challenges. The Zhetysu region, and the city of Taldykorgan in particular, face challenges such as pronounced seasonality of tourist flows, increased environmental vulnerability of certain areas, and insufficient infrastructure and management competencies in sustainable tourism among small and medium-sized enterprises. Under these circumstances, the direct adoption of international standards is less critical than the development of a scientifically based diagnostic tool to assess the readiness of local stakeholders – including authorities, businesses, and local communities – to implement them. Conducting such an assessment is a necessary first step in developing a realistic and effective strategy for transitioning to a sustainable model of tourism and hospitality development in the region.

Thus, this study aims to comprehensively assess the readiness of the hotel industry in the Zhetysu region to implement sustainable development principles based on the adaptation of international GSTC criteria. To achieve this goal, the following tasks were set: to develop an adapted diagnostic toolkit; to conduct a survey and interviews with key stakeholders; to identify strengths, weaknesses, opportunities and threats (SWOT analysis) for the formation of a sustainable regional hospitality model. The study was conducted in the Zhetysu region, located in the south-east of the Republic of Kazakhstan (Figure 1). The region has significant tourism and natural potential, including unique natural sites and a rich cultural and historical heritage, making it attractive for the development of sustainable tourism and hospitality.

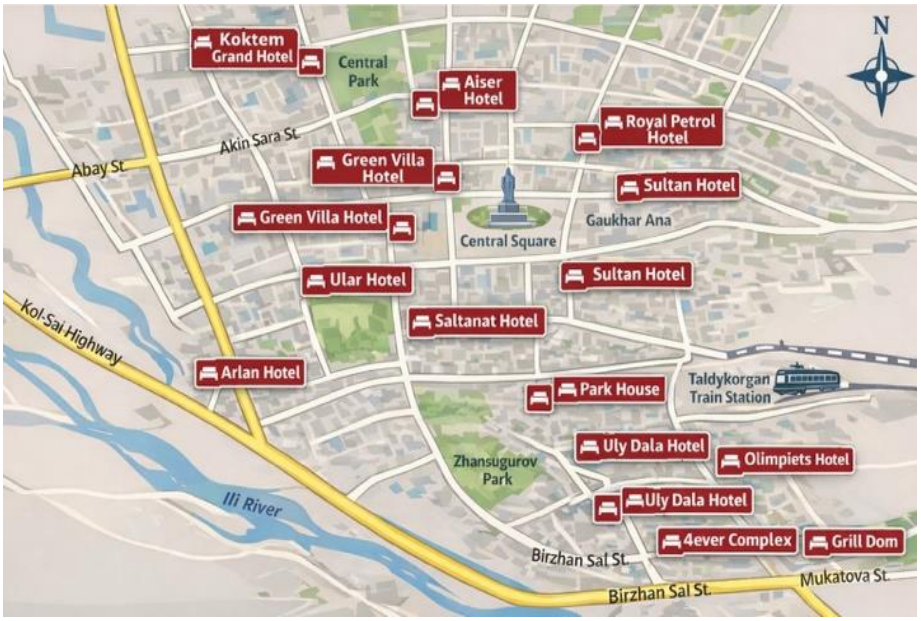


Figure 1. Hotels in Taldykorgan, the Zhetysu region (Source: Created by authors)

An analysis of current economic trends in the tourism and hotel industry in the Zhetysu region reveals the need to integrate the principles of sustainable development. The development of national criteria and the adaptation of international standards to regional conditions will ensure the balanced and sustainable development of the tourism industry in the region. This is particularly relevant given the ecological vulnerability of the territory, the seasonality of tourist flows and the specific features of the natural and climatic complex of Zhetysu.

Adapting international sustainable development criteria to local conditions will create a basis for more effective and realistic tourism development strategies, allowing for both economic and social and environmental aspects of the industry to be taken into account. In addition, involving representatives of the tourism sector in the discussion and formulation of sustainable development principles will ensure that the specifics and needs of the local market are taken into account, which contributes to the successful implementation of sustainable practices and increases the competitiveness of the industry.

Despite the growing body of research on sustainable tourism and hospitality, empirical studies focusing on sustainability readiness – rather than sustainability outcomes – remain limited, particularly in peripheral and transition economies. Existing studies predominantly assess environmental or economic performance, while comparatively little attention has been paid to institutional and managerial readiness at the regional level. This study addresses this gap by developing and applying an adapted GSTC-based readiness assessment framework to the hotel industry of the Zhetysu region. By shifting the analytical focus from outcomes to readiness, the study provides novel empirical evidence relevant for both theory and policy design in emerging tourism destinations.

LITERATURE REVIEW

Over the past two decades, sustainable development has become a central theme in the hospitality industry, driven by global environmental concerns, growing consumer awareness, and international policy agendas (UNWTO, 2022). In the hotel business, sustainable development has become one of the most important areas of transformation, particularly in regions where natural and cultural resources are vulnerable. Recent studies emphasise that sustainable hotel development

encompasses energy efficiency, water conservation, waste reduction, the responsible use of resources, and the integration of local culture into tourism products (Elkhwesky et al., 2022). Sustainable hospitality combines economic viability, environmental protection and socio-cultural responsibility, requiring hotels, restaurants and related services to reduce their environmental impact and increase local community engagement (Elkhwesky et al., 2022). Despite significant global progress, regional conditions such as those in Central Asia remain understudied, creating opportunities for local research and the implementation of sustainable practice models. Recent studies published in Geojournal of Tourism and Geosites also emphasize the importance of policy frameworks, ecological tourism, and the conceptual relationship between ecotourism, sustainable tourism, and nature-based tourism (Esparza-Huamanchumo et al., 2024; Minikhanova et al., 2024).

The Global Sustainable Tourism Council (GSTC) criteria provide a global framework for sustainable tourism and hospitality. These criteria cover governance, socio-economic benefits, cultural heritage, and environmental impact (GSTC, 2021). For hotels, the GSTC's practical measures include eliminating single-use plastics, using local food products, conserving water and energy, and supporting local employment (GSTC, 2024).

Regional studies have also begun to examine the impact of climate change on hotel infrastructure. A recent systematic review notes that adaptation strategies in the hotel sector are underdeveloped, particularly in transitioning economies, highlighting the need for context-specific approaches (Mota et al., 2024).

Recent studies convincingly demonstrate that sustainable development plays a vital role in achieving market stability and optimal positioning. Rather than being viewed as a cost, it is increasingly seen as an investment. Research shows that hotels with recognised sustainability standards have recovered significantly faster post-pandemic, as they align with the values of a new wave of conscious travellers (Gössling & Schweiggart, 2022). Several frameworks have been developed to ensure practical readiness. The Global Sustainable Tourism Council's (GSTC) criteria are among the most widely accepted and serve as guidelines for both tourist destinations and businesses. Research has shown that the GSTC system effectively translates abstract sustainability goals into measurable indicators. Its application in diverse settings, such as US national parks (Bricker et al., 2022), demonstrates that these criteria can be adapted to cultural and environmental conditions. However, issues such as limited data availability and weak institutional capacity often hinder their effective implementation (GSTC, 2019). For the Zhetysu region, adopting such a system could provide a structured framework for identifying gaps in environmental management, socio-economic integration and cultural heritage protection. This prospect is particularly relevant for Zhetysu, where government programmes, preferential financing and business associations could accelerate adoption of the law.

Hotel certifications play a crucial role in assessing sustainability performance by providing hotels with benchmarks to align their practices with international standards, such as those set by the Global Sustainable Tourism Council (GSTC). These certifications encourage hotels to intensify their efforts to ensure sustainability in various areas, including management practices, socio-economic impact, cultural preservation and environmental protection (Sriraksa et al., 2024).

The implementation of sustainable practices (SP) is growing rapidly in the tourism industry, particularly in developed countries. Many leading corporations are succeeding in this area as SP contributes to socio-economic growth, increases competitiveness and creates new business opportunities (Lucas et al., 2024). In addition to the GSTC, organisational theories have been used to understand enterprise-level readiness. The 'Technology–Organisation–Environment (TOE)' concept has had a particular influence in this regard, explaining the adoption of sustainable practices in terms of technological availability, organisational capacity, and external pressure. Recent empirical studies show that hotels with stronger technological capabilities (e.g. eco-innovation tools and digital solutions), management commitment and clear sustainability policies demonstrate significantly higher sustainability performance (Lucas et al., 2024).

Kusumawardhani (2024) suggests that intellectual tourism in new destinations should combine digital innovation with sustainability to create inclusive opportunities for local communities and address environmental issues.

Similarly, research on hotel waste management indicates that the feasibility of waste reduction measures depends on operational configurations such as property size and food and beverage volume, highlighting the need for a differentiated assessment of readiness (Diaz-Fariña et al., 2023). These findings highlight that readiness is not uniform, but depends on business models, supply chains and the socio-economic structure of the destination country.

Mota et al. (2024) document how hotel businesses around the world are becoming increasingly vulnerable to climate-related risks, such as extreme heat, water shortages, and natural disasters. They suggest that destination countries which take proactive adaptation measures, including impact assessments, compensation schemes and infrastructure upgrades, are better prepared to maintain competitiveness in a changing climate. Punzo et al. (2022) proposed a comprehensive sustainable tourism index (SusTour-Index), which covers economic, environmental, and social dimensions. They tested this index using regional data from Italy, providing a rigorous analytical platform for assessing regional readiness. Chen (2020) developed and validated a model for assessing sustainable tourism development in traditional Japanese villages, demonstrating how global methodologies can be adapted to local conditions. The bibliometric analysis conducted in this study not only outlines the conceptual contours of sustainable tourism research in the Balqash–Alakol basin but also indicates actionable leverage points for policymakers and regional planners. By mapping research themes, collaboration networks, and knowledge gaps, bibliometric data serve as a diagnostic tool that highlights both strengths and deficiencies in the current sustainability discourse – and these, in turn, translate into concrete policy directions.

First, the bibliometric emphasis on environmental management and carrying capacity underscores the urgent need for robust regulatory frameworks. Although many regional strategies mention sustainability, the density and prominence of these themes in the literature suggest that environmental concerns are widely acknowledged academically but have not yet been fully operationalised in governance. This gap calls for the establishment of formal environmental performance standards for tourism facilities in the basin, reinforced through monitoring systems and compliance incentives. For example, policy

instruments could include mandatory waste management plans for all tourism operators, seasonal visitor limits informed by carrying capacity research, and public reporting requirements tied to sustainability indices identified in the literature.

Second, the structure of scholarly collaboration revealed by co-authorship and thematic clustering indicates underdeveloped networks between academia, government, and industry stakeholders. To bridge this divide, policymakers could institutionalise knowledge exchange platforms, where researchers present evidence-based findings to stakeholders directly responsible for destination management – such as regional tourism boards, environmental agencies, and hotel associations. These platforms could be formalised as regional advisory councils that meet regularly and align research priorities with policy implementation needs. Furthermore, funding mechanisms might be reallocated toward applied research grants that explicitly require stakeholder participation in project design and dissemination, thereby ensuring that new research directly informs policy cycles. Third, the bibliometric focus on comparative and cross-regional studies suggests that benchmarking with similar eco-destinations enhances learning and accelerates policy innovation.

For example, many publications on Issyk-Kul (Kyrgyzstan) and Aral Sea-adjacent tourism regions highlight common challenges – such as seasonal employment dependency, insufficient environmental infrastructure, and weak enforcement of sustainability standards. By incorporating these comparative insights, Balqash–Alakol policymakers can adopt best-practice templates that have been empirically examined in neighbouring contexts: establishing environmental certification schemes, integrating sustainable tourism criteria into regional development plans, and co-creating cross-border tourism initiatives that pool resources and harmonise standards across lake basins. Taken together, the bibliometric findings act as a strategic evidence base that informs a policy agenda centred on (1) regulation with measurable targets, (2) stakeholder engagement and knowledge integration, and (3) comparative benchmarking to accelerate institutional learning.

Embedding research insights directly into policy instruments ensures that the academic discourse on sustainable tourism transitions from conceptual recognition to tangible governance outcomes within the Balqash–Alakol basin.

MATERIALS AND METHODS

The calculation of readiness indicators for the hotel industry in Taldykorgan city, Zhetysu region, was based on respondents' answers obtained using a five-point Likert scale, where each statement was rated from 1 to 5 points. The purpose of the calculation was to obtain mean scores for each area of readiness and to form a generalised readiness index. The numerical equivalent of the responses used for further quantitative analysis is presented in Table 1.

Table 1. Numerical equivalent of answers

Respondent's answer	Point
Completely absent	1
Low level	2
Average level	3
A sufficiently high level	4
High level	5

Thus, each response is automatically converted into a numerical value suitable for quantitative analysis.

The assessment of the tourism and hotel industry's readiness in the Zhetysu region to implement the principles of sustainable development was conducted based on a survey of representatives of government agencies and tourism and hotel businesses. A five-point Likert scale was used as a measurement tool, where 1 represents a complete absence of practice and 5 represents its systematic implementation. The overall methodological framework used to assess the readiness of the hotel industry in the Zhetysu region for sustainable development is illustrated in Figure 2.

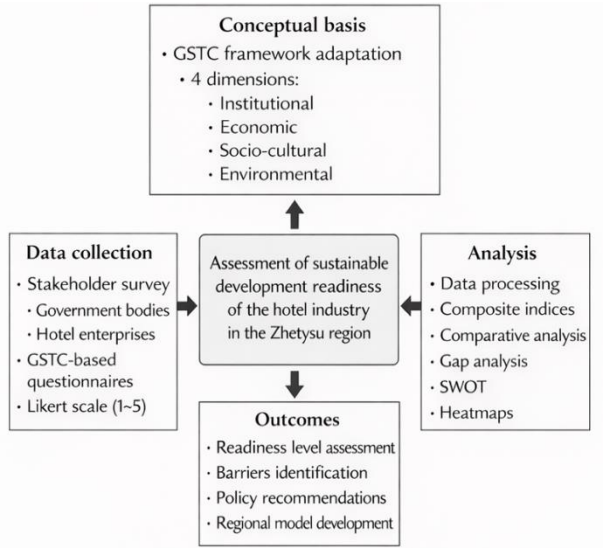


Figure 2. Methodological framework used to assess the readiness of the hotel industry in the Zhetysu region for sustainable development (Source: Created by authors)

At the first stage, the arithmetic mean was calculated for each indicator (developed by the authors):

$$\bar{x}_i = \frac{1}{n}\sum_{j=1}^{n} x_{ij}$$

where x_{ij} is the rating of the j-th respondent for the *i*-th indicator, *n* is the number of respondents. In the second stage, the indicators were aggregated into four broad blocks of sustainable development: institutional and managerial, environmental, socio-cultural, and economic. An integral readiness index was calculated for each block (developed by the authors):

$$I_k = \frac{1}{m}\sum_{i=1}^{m} \bar{x}_i$$

where m – number of indicators in the corresponding block. The integrated readiness indicators for the four sustainability dimensions are presented in Table 2. The average scores for hotel enterprises and their standardized values are shown in Table 3. The results obtained indicate an average level of readiness of the tourism and hotel industry in the Zhetysu region to implement the principles of sustainable development. The highest value was recorded in the economic dimension (I = 3.6), which indicates that enterprises are focused on financial stability, maintaining employment and developing tourism services as a source of income. Socio-cultural sustainability also shows relatively favourable indicators (I = 3.4), which is associated with the involvement of the local population, the preservation of cultural traditions and a focus on domestic tourism.

Table 2. Integrated indicators of the readiness of the tourism and hotel industry in the Zhetysu region for the implementation of sustainable development (Source: Calculated by the authors based on survey data)

Measuring stability	Integral index (I)	Measuring stability	Integral index (I)
Social and cultural sustainability	3,4	Environmental sustainability	2,8
Economic stability	3,6	Institutional and managerial sustainability	3,1

Table 3. Average scores on questions (business)

Question	Average score (max=3,4,5)	Standardised to 5 points	Question	Average score (max=3,4,5)	Standardised to 5 points
A1	2.60	3.25	C3	1.80	3.00
A4	2.60	3.25	D1.2	1.80	3.00
B2	3.60	3.60	D1.3	1.80	3.00
B3	2.60	4.33	D2.4	1.80	3.00
B7	3.00	3.75	D2.6	1.60	2.67

At the same time, environmental sustainability is characterised by the lowest integral index value (I = 2.8), reflecting the fragmented nature of the implementation of environmental practices, the lack of resource management systems and the limited use of environmental standards in the activities of enterprises. Institutional and managerial sustainability (I = 3.1) is at a borderline level and indicates the existence of strategic documents and programmes, but their practical implementation is accompanied by insufficient coordination, weak monitoring and the absence of unified regional mechanisms for managing sustainable development. The readiness levels across the four sustainability dimensions are visualized in Figure 3.

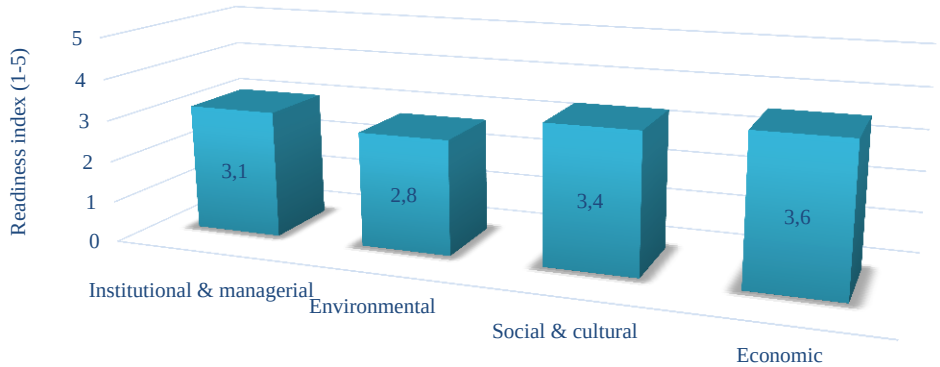


Figure 3. Readiness of the tourism and hotel industry in the Zhetysu region for sustainable development (Source: Calculated by the authors based on survey data)

Thus, a structural imbalance has been identified between the declared readiness and the actual level of implementation of sustainable practices. The indices obtained confirm the need to move from fragmented initiatives to the formation of an integrated regional model of sustainable development of the tourism and hotel industry based on institutional coordination, environmental regulation and business support. Average values were calculated based on the 16 responses from government agencies and 20 responses from businesses. Given the nascent stage of the hospitality industry in the Zhetysu region, this sample represents a significant portion of the currently active key decision-makers and registered tourism entities. The average scores obtained from representatives of state structures are presented in Table 4. A comparison of average standardised scores between state structures and enterprises by block is shown in Table 5.

Table 4. Average scores on questions (state structures)

Question	Average score (max=3,4,5)	Standardised to 5 points	Question	Average score (max=3,4,5)	Standardised to 5 points
A1	3.25	4.06	A1	3.25	4.06
A2	3.25	4.06	A2	3.25	4.06
A10	2.50	4.17	A10	2.50	4.17
B2	1.75	2.92	B2	1.75	2.92
B3	2.00	2.50	B3	2.00	2.50
C2	2.25	3.75	C2	2.25	3.75
D1.3	1.75	2.19	D1.3	1.75	2.19
D2.4	2.00	3.33	D2.4	2.00	3.33
D3.1	2.50	3.13	D3.1	2.50	3.13

Table 5. Comparison of average standardised scores by block

Block	State structures (average scores)	Enterprises (average scores)	The Gap
Management and strategy	4.10	3.25	+0.85
Social responsibility	3.38	3.54	-0.16
Environmental responsibility	2.82	2.93	-0.11
Infrastructure and support	2.76	3.00	-0.24

Standardisation was carried out using the formula (developed by the authors):

$$\text{Standardised score} = \frac{\text{Average score}}{\text{Maximum score}} \times 5$$

The questions are grouped into 4 blocks:

1. Management and strategy (A1, A4, A10)
2. Social responsibility (B2, B3, B7, C2, C3)
3. Environmental responsibility (D1.2, D1.3, D2.4, D2.6, D3.1)
4. Infrastructure and support (D1.3, D2.4 – repeatedly in the context of state support). The heatmaps of average and normalized scores for government structures and enterprises are presented in Figures 4 and 5, respectively.

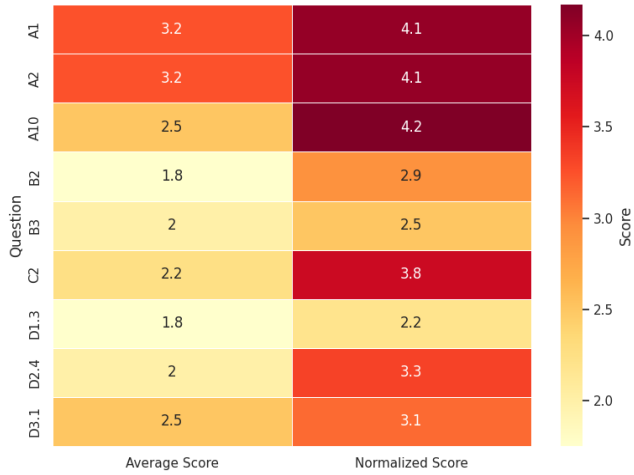


Figure 4. Heatmap of Average and Normalized Scores (Government Structures)

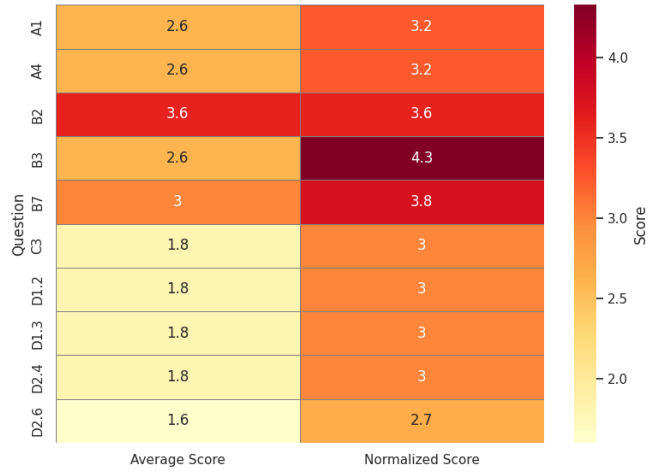


Figure 5. Heatmap of Enterprise Scores

The lowest scores were for environmental issues (D1.2–D2.6), confirming the weak systematic nature of ecological practices. The highest scores were for issues B3 (local procurement) and B2 (local employment), reflecting the social activity of the business. High standardised scores for A1, A2 and A10 indicate the strength of government structures in strategic planning and coordination. Weak areas are environmental issues (D1.3, D2.4), where scores remain low, indicating a lack of infrastructure and systemic measures. Heat maps allow you to quickly identify 'red zones' (low values) and prioritise areas for improvement. High scores: B2 (local employment) and B3 (local procurement) – companies demonstrate social engagement. B7 (social responsibility) is also above average. Low scores: Environmental issues (D1.2–D2.6) – weak consistency in energy conservation, waste management and biodiversity. C3 (cultural heritage) is also low, indicating a lack of integration of cultural elements into services. The level of implementation of sustainable development practices in tourism in the Zhetysu region is assessed as average (average score across all blocks – approximately 3.2 out of 5). The analysis of data based on the Likert scale allows us to draw a comprehensive conclusion about the state of sustainable tourism development in the Zhetysu region. The overall level of implementation of relevant practices is assessed as average, reflecting a transitional stage from the formation of strategic plans to their practical implementation. Government agencies demonstrate a higher level of strategic planning compared to businesses, indicating a gap between the programmes developed and their actual implementation at the local level. At the same time, enterprises are somewhat more active in the area of social responsibility, especially in terms of local employment and working with local suppliers, but this activity is more of an initiative and is not backed by systematic state support.

The most problematic area remains environmental responsibility, where both government agencies and businesses perform poorly. Energy saving, waste management and biodiversity conservation practices are implemented in a fragmented manner and are not systematic. This conclusion is confirmed by quantitative data: the average scores for the environmental block are only 2.82 and 2.93 out of a possible 5. The key obstacle to the development of sustainable practices is unanimously identified as a lack of funding and targeted support from government agencies, which correlates with low ratings of government grant and subsidy programmes themselves. Thus, the current situation is characterised by a certain imbalance: while there is a strategic vision at the regional level, there are no effective mechanisms for translating it into specific instruments of financial, infrastructural and methodological support for business, which primarily hinders the development of environmental initiatives and the full integration of sustainable development principles into the activities of the tourism sector.

For quantitative assessment, a composite index can be used to calculate the overall sustainable development index (developed by the authors):

$$I = \frac{\sum_{i=1}^{n}(B_i \times w_i)}{5 \times \sum w_i} \times 100\%$$

where:

- B_i – standardized score for block *i*,
- w_i – block weight (can be assumed to be 1 for simplicity),
- n – number of blocks.

For our data (without weighting):

$$I_{ent} = \frac{3.25 + 3.54 + 2.93 + 3.00}{5 \times 4} \times 100\% = 64.30\%$$

$$I\text{gov} = \frac{4.10 + 3.38 + 2.82 + 2.76}{5 \times 4} \times 100\% = 64.15\%$$

Both groups are at around 64% of the ideal state, confirming the need for systemic improvements.

RESULTS

The results of a survey of representatives of state and quasi-state structures involved in the regulation and development of tourism and hospitality in the Zhetysu region provide a comprehensive overview of the current state of institutional, socio-environmental and managerial aspects of sustainable development of the industry at the regional level. The GSTC-based questions developed for representatives of state structures are presented in Table 6.

Table 6. Questions for the state structure

GSTC criterion	Questions for the state structure
A1 Sustainable development management system	Is there an approved strategy or programme for sustainable tourism and hospitality development in the region?
A2 Compliance with legal regulations	How effectively is compliance with environmental and labour legislation monitored in the tourism industry?
A10 Interaction with the visited site/destination	Are there any working groups or coordination councils for the development of tourism and hospitality in the region involving government bodies, businesses and non-governmental organisations?
B2 Employment of the local population	Are there any programmes to encourage the hotel and tourism industry to employ local residents and promote their career growth?
B3 Local purchasing	Is work being done to create and promote registers of local suppliers for the tourism industry?
C2 Protection of cultural heritage	Are there any grant or other support programmes for tourism businesses that integrate elements of local cultural heritage into their services?
D1.3 Energy saving	Are there any grant or other support programmes for tourism businesses that integrate elements of local cultural heritage into their services?
D2.4 Solid waste	Is there a waste sorting and recycling infrastructure in place in the region that is accessible to tourism businesses?
D3.1 Biodiversity conservation	Are biodiversity impact assessments and mandatory compensation measures included in the conditions for allocating land for tourism facilities?

Despite the limited sample size, the data obtained is of an expert and analytical nature and reflects the systemic vision of key stakeholders responsible for the formation and implementation of regional tourism policy, which gives the research results high analytical and interpretative value. The results of a survey of representatives of state and quasi-state structures involved in the regulation and development of tourism and hospitality in the Zhetysu region provide a comprehensive overview of the current state of institutional, socio-environmental and managerial aspects of sustainable development of the industry at the regional level. Despite the limited sample size, the data obtained is of an expert and analytical nature and reflects the systemic vision of key stakeholders responsible for the formation and implementation of regional tourism policy, which gives the research results high analytical and interpretative value. The assessment of compliance with environmental and labour legislation in the tourism sector shows predominantly high scores, indicating the existence of a

formally structured regulatory framework and basic control mechanisms. However, these results should be interpreted with caution, as compliance with legal requirements is not always accompanied by the implementation of comprehensive sustainable management practices. The lack of regular monitoring, performance evaluation and feedback mechanisms reduces the potential of legal regulation as a tool for a real transition to sustainable hospitality development models.

The social dimension of sustainability, in particular issues related to human capital training and development, is characterised by a marked lack of systematicity. The survey results show that staff training programmes in sustainable tourism and hospitality are either non-existent or implemented in a fragmented manner as part of individual initiatives and projects. This situation limits the region's institutional capacity to scale up sustainable practices, as human capital is a key factor in the transformation of the industry. The lack of sustainable educational and professional programmes reduces the adaptability of the regional hospitality system to the modern requirements of sustainable development.

The environmental dimension of sustainability is also characterised by significant territorial and functional heterogeneity. In particular, assessments of the state of waste management infrastructure in tourist destinations range from a complete lack of relevant systems to the existence of relatively developed mechanisms that require further improvement. This indicates the absence of a unified regional approach to environmental management in the hospitality sector, as well as the dependence of environmental practices on local conditions and initiatives. A similar situation can be observed in the field of biodiversity conservation, where environmental factors are taken into account in the implementation of tourism projects on an irregular and predominantly reactive basis, without being institutionally enshrined in the form of mandatory procedures or standards.

A synthesis of the results obtained allows us to conclude that the key constraints to the sustainable development of hospitality in the Zhetysu region are not related to a shortage of natural or cultural resources, but to institutional and managerial factors. The region has significant competitive potential due to its rich natural and cultural heritage, but the lack of an integrated management, coordination and monitoring system significantly reduces the effectiveness of sustainable practices. Sustainability in this context is perceived primarily as a set of individual measures rather than a comprehensive model of regional development. The empirical results obtained are consistent with the provisions of the Global Sustainable Tourism Council (GSTC) criteria and confirm the feasibility of adapting them for regional-level analysis.

The most pronounced gaps were identified in the institutional and managerial dimension of sustainability, which highlights the need to shift the focus of regional tourism policy towards the formation of effective governance mechanisms. Thus, the results of the study form an empirical basis for the development of an integrated regional model of sustainable development of the hospitality industry, focused on improving institutional coherence, developing human capital, and systematically integrating environmental and socio-economic principles of sustainability.

Based on the above criteria, questionnaires were developed to assess the current state of the hotel industry in the Zhetysu region, awareness of the principles of sustainable tourism, sustainable development goals and obstacles to achieving them. The questionnaires are presented in a short version adapted for entrepreneurs and government officials. Data collection consisted of anonymous surveys using links to Google forms in the questionnaires. The questionnaires were sent to state and local institutions in the Zhetysu region, social media groups and tourism workers. The GSTC-based questions designed for hotel enterprises are presented in Table 7.

Table 7. Questions for the enterprise

GSTC criterion	**Questions for the enterprise**
A1 Sustainable development management system	Is there documentary evidence of the implementation of a sustainable development management system?
A4 Staff engagement	Is your staff trained in environmental and social practices?
B2 Local employment	What is the proportion of local residents in the total number of employees and in management positions?
B3 Procurement	Do you prioritise local suppliers when purchasing food, souvenirs and services?
B7 Decent work	To what extent does the organisation comply with the principles of decent work (safe conditions, decent wages, staff development)?
C3 Presentation of culture and heritage	Do you incorporate elements of local culture (design, cuisine, music, crafts) into the guest experience/service?
D1.2 Effective procurement	Are you taking measures to reduce the use of single-use plastics (bottles, straws, packaging, hygiene products)?
D1.3 Energy saving	Do you use energy-saving technologies (LED bulbs, motion sensors, smart thermostats)?
D2.4 Solid waste	Have you implemented a separate waste collection system for subsequent recycling?
D2.6 Minimising pollution	Does the hotel take specific measures to reduce pollution (air, water, soil, as well as noise, light pollution, etc.)?
Please give an example of one of your sustainable development practices that you are most proud of.	
What are the main obstacles you see to implementing such practices? (select several from the list)	

The results of a survey of representatives of the hotel and tourism industry in the Zhetysu region reveal the key features of the practical implementation of sustainable development principles in the activities of hospitality industry entities at the regional level. The data obtained reflect the perception of sustainability by businesses and demonstrate the degree of integration of environmental, social and management practices into the daily operations of enterprises. Taken together, the results form a comprehensive picture of the actual, rather than the declared, level of sustainable development in the industry.

An analysis of responses characterising the use of environmentally oriented practices shows that most enterprises either rarely or sporadically use environmentally friendly means and technologies in their activities.

Only a limited number of respondents indicate regular use of such practices. This indicates an early stage of environmental transformation of business, in which sustainable solutions are perceived as additional rather than mandatory management elements. This situation points to the existence of structural barriers, including limited financial resources, a lack of incentives and the absence of clear regulatory requirements that would facilitate the introduction of environmental innovations in the region's hotel and tourism business.

DISCUSSION

An assessment of staff training practices in the field of environmental and social sustainability revealed a marked fragmentation. A significant proportion of enterprises either do not provide specialised training at all or limit themselves to one-off events that are not integrated into the human resources management system. This indicates an insufficient understanding of the role of human capital as a key factor in the sustainable development of the hospitality industry. The lack of systematic training programmes reduces the ability of enterprises to adapt to modern requirements for sustainable tourism and limits their long-term competitiveness.

The social dimension of sustainability in business activities is manifested mainly in the form of basic compliance with labour legislation and generally accepted standards of interaction with staff and the local community. At the same time, business participation in broader social initiatives aimed at developing local communities and supporting cultural heritage is limited and unsystematic. This indicates that social responsibility is perceived by businesses as a minimum obligation rather than a strategic resource for developing and strengthening the reputation of a destination.

Environmental management, including waste reduction, rational use of resources and implementation of energy-efficient solutions, is also characterised by heterogeneity. Some enterprises demonstrate a willingness to implement individual environmental measures, but in most cases these initiatives are implemented without strategic planning and systematic monitoring. The lack of clear guidelines and sustainability standards at the regional level limits the ability of businesses to transition to more comprehensive environmental management models.

Responses concerning the interaction of businesses with government agencies and the institutional environment as a whole are particularly significant. The survey results indicate a limited level of coordination between business and government structures on issues of sustainable tourism and hospitality development. Businesses do not always have sufficient information about existing strategies, support programmes and regulatory instruments, which reduces the effectiveness of sustainable initiatives and hinders the formation of a unified regional approach.

To summarize these findings, the SWOT analysis of the hotel industry's readiness to implement sustainable development principles in the Zhetysu region is presented in Table 8.

Table 8. SWOT analysis of the readiness of the hotel industry in the Zhetysu region to implement sustainable development principles (Source: Created by authors)

Strengths	**Weaknesses**
The region's significant natural and cultural potential, which forms an objective basis for the development of a sustainable hotel business. The formal existence of strategic and policy documents in the field of tourism and sustainable development at the regional level. Relatively high level of compliance with environmental and labour legislation, creating the basic conditions for the implementation of sustainable principles. Readiness of some hotel businesses to implement individual elements of environmental and social responsibility. Human resource potential and interest of individual stakeholders in the development of sustainable hospitality.	Fragmentation of the institutional system for managing sustainable development in the hotel industry and insufficient interdepartmental coordination. Lack of systematic mechanisms for implementing and monitoring sustainable practices in hotel operations. Low level of integration of sustainable development into the strategic and operational management of hotel enterprises. Fragmented and sporadic use of environmentally friendly technologies and resource-saving practices. Lack of systematic training and professional development programmes for staff in the field of sustainable development and sustainable hospitality.
Opportunities	**Threats**
Adaptation of international standards and sustainability criteria (in particular GSTC) to the regional level and the hotel industry. Development of mechanisms for state support and incentives for hotel enterprises that implement sustainable practices. Increased demand from tourists for environmentally and socially responsible forms of accommodation. Development of training programmes, digital solutions and consulting support for the hotel business in the field of sustainable development. Strengthening cooperation between government agencies, the hotel business and local communities.	The gap between strategic declarations and the actual implementation of sustainable development remains. Limited financial resources of hotel enterprises hinder the implementation of environmental and social innovations. Increased anthropogenic pressure on natural and cultural resources in the absence of effective sustainability management mechanisms. Formalisation of sustainable development as an 'image element' without real institutional changes. Decreased competitiveness of the region in the long term due to the unsystematic implementation of sustainability principles.

Overall, the results indicate that sustainable development of the hospitality industry in the Zhetysu region at the business level is in its infancy. Enterprises demonstrate a certain readiness to implement individual elements of sustainability, but the lack of institutional incentives, systematic training and clearly formulated regional guidelines significantly limits the depth and scale of such transformations. As a result, sustainability is implemented mainly in the form of isolated practices rather than as an integrated strategy for corporate and regional development.

The empirical data obtained complement the results of the survey of government agencies and confirm the existence of a structural gap between strategic declarations and the practical implementation of sustainable development principles in the hospitality industry. This leads to the conclusion that there is a need to strengthen institutional coordination, develop mechanisms to stimulate business, and form a comprehensive regional model of sustainable development for the hospitality industry based on the principles of environmental responsibility, social engagement, and effective management.

The interviews and survey results revealed how stakeholders are involved in the development of hospitality and what their views are on the sustainable development of the industry. The interview format was structured, but at the same time left room for discussion of new topics in a less formal, open manner. The main topics of discussion at the meetings on hospitality development concerned the perception by business representatives of the principles of sustainable development of tourist destinations as an alternative to existing strategies. During the discussions, respondents noted which elements, in their opinion, should be preserved (e.g., the natural environment or socio-cultural context), which should be developed, and how their own interests could be realised in this context. The initial interviews focused on identifying the personal views and approaches of the participants, followed by a refinement of the identified concepts and directions for sustainable hospitality development.

RESEARCH LIMITATIONS AND GAPS

The present study has several limitations that should be acknowledged. First, the sample size is relatively limited, particularly about representatives of government institutions, which means that the findings should be interpreted as preliminary. Second, the study relies on self-reported survey data, which may be subject to response bias and social desirability effects. Third, the composite indices were constructed using equal weighting of indicators, which does not fully reflect potential differences in their relative importance. Fourth, the focus on a single region – the Zhetysu region –limits the external validity of the results and restricts opportunities for interregional comparison.

Finally, the cross-sectional research design does not allow for the assessment of dynamic or long-term changes in sustainability readiness within the hospitality industry. Despite these limitations, the study identifies several important gaps in the existing body of research. In particular, there remains a lack of empirical studies examining sustainability readiness in developing and peripheral tourism regions, especially in the context of Central Asia. Moreover, limited attention has been paid to integrating management readiness assessments with established ESG and GSTC frameworks. The use of composite indices based on expert assessments and Likert-scale data in regional hospitality studies also remains insufficient. Additionally, the gap between formally adopted sustainability strategies and their actual operational implementation – particularly in the environmental dimension – has not been adequately addressed in previous research.

Based on these findings, several directions for future research can be proposed. Further studies should expand the sample to include a broader range of stakeholders, such as local communities, tourists, and non-governmental organisations. The application of weighted and multi-criteria decision-making methods, including AHP, entropy-based weighting, or TOPSIS, could improve the robustness of composite indices. Longitudinal research designs would allow for tracking changes in sustainability readiness over time. Comparative interregional or cross-country studies could enhance the generalisability of results. Finally, future research should seek to integrate objective environmental indicators – such as energy consumption, waste generation, and carbon footprint metrics – with perception-based survey data to provide a more comprehensive assessment of sustainability practices in the hospitality industry. The main limitations, research gaps, and areas for future research are summarized in Figure 6.



Figure 6. Overview of Limitations, Research Gaps and Areas for Future Research (Source: Created by authors)

Despite the relevance of the results, it should be acknowledged that there are a number of limitations and several gaps in the existing literature. The study uses a cross-sectional design that reflects readiness for sustainable development at a specific point in time. This does not allow for the assessment of dynamic changes and long-term trends in the implementation of sustainable development practices. In addition, insufficient attention is paid to the gap between formal sustainable development strategies and practical operational measures, especially in the environmental aspect.

CONCLUSION

This study examines the readiness of the hotel industry in the Zhetysu region to implement sustainable development principles, based on survey data from government agencies and hotel enterprises and complemented by a SWOT analysis. The

research contributes to the literature by proposing an adapted GSTC-based readiness assessment framework for peripheral tourism regions and by empirically revealing a critical institutional gap between strategic planning and operational implementation within the hospitality sector. The findings indicate that the region possesses substantial potential to transition toward sustainable development models, underpinned by its rich natural and cultural heritage and the presence of a basic regulatory and strategic policy framework for tourism. These factors create favourable preconditions for integrating environmental, social, and managerial sustainability principles and for enhancing the long-term competitiveness of the destination. At the same time, the empirical results show that current readiness remains limited and unsystematic.

Sustainable practices are implemented in a fragmented manner and are insufficiently embedded in the strategic and operational management of hotel enterprises. The absence of robust mechanisms for monitoring, performance evaluation, and multi-stakeholder coordination significantly constrains the formation of a coherent regional model of sustainable hospitality development. The analysis further demonstrates that the primary barriers to implementation are institutional and managerial rather than resource-related. Key vulnerabilities include weak interdepartmental coordination, limited and irregular interaction between public authorities and the hotel business sector, and the lack of systematic training and professional development programmes in sustainable hospitality. These deficiencies reinforce the persistent gap between formally adopted sustainability strategies and their practical execution. The SWOT analysis suggests that maintaining the current development trajectory carries the risk of formalising sustainability as a predominantly image-driven concept. In the context of increasing tourist flows and insufficient governance mechanisms, this may intensify anthropogenic pressure on the region's natural and cultural assets and undermine long-term destination resilience.

Conversely, the results reveal significant opportunities to enhance readiness through the adaptation of international standards – particularly the Global Sustainable Tourism Council (GSTC) criteria – the development of targeted state support and incentive schemes, and the establishment of systemic educational initiatives. Realising this potential requires a decisive shift from fragmented initiatives toward an integrated, region-wide sustainability governance model for the hospitality sector. Overall, the level of readiness of the hotel industry in the Zhetysu region can be characterised as moderately low, yet with considerable potential for improvement, provided that institutional coordination is strengthened, human capital is developed, and comprehensive sustainability management mechanisms are introduced. These conclusions form an empirical and analytical basis for the development of practical recommendations aimed at increasing sectoral sustainability and strengthening the region's competitive position.

The findings have direct relevance for regional tourism governance. The identified gap between strategic intent and operational implementation underscores the need to move beyond declarative sustainability policies toward targeted and enforceable policy instruments. Priority measures include: (1) incentive-based mechanisms (such as grants, tax preferences, and co-financing schemes) linked to verifiable environmental practices in hotels; (2) the development of professional training programmes in sustainable hospitality in cooperation with universities and industry associations; and (3) the establishment of permanent multi-stakeholder coordination platforms to enhance institutional coherence and monitor sustainability initiatives. In this context, the adapted GSTC-based readiness framework proposed in this study may serve as a practical diagnostic tool for prioritising policy interventions and allocating support resources more effectively.

The results for the Zhetysu region are broadly consistent with evidence from other emerging lake-based destinations in Central Asia, including the Issyk-Kul region in Kyrgyzstan and tourism areas surrounding the Aral Sea. These destinations exhibit similar structural challenges, such as limited environmental infrastructure, fragmented governance systems, and strong dependence on seasonal tourism flows. While Zhetysu demonstrates relatively stronger institutional planning capacity, it faces comparable weaknesses in environmental management and business-level readiness, suggesting that the challenges identified are not unique but reflect broader patterns characteristic of transition economies.

Cross-regional comparisons further highlight converging policy priorities, particularly in the areas of environmental regulation, stakeholder integration, infrastructure development, and community engagement. Empirical studies from neighbouring regions emphasise the importance of integrated water-tourism governance, enforceable environmental standards, and targeted investments in waste management and water treatment infrastructure. Incorporating community-based governance models – such as participatory monitoring and co-management schemes – into the Balqash–Alakol basin could further strengthen the institutional foundations of sustainable tourism development.

In summary, although individual lake basins differ in ecological and socio-economic conditions, the convergence of policy challenges and opportunities suggests that empirically informed, regionally adapted sustainability frameworks can play a critical role in guiding effective tourism governance in transitional socio-ecological systems.

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POINT–AXIS SYSTEM THEORY WITH GIS SPATIAL ANALYSIS IN GEOSPATIAL BIG DATA: A CASE STUDY OF THE PETRA WORLD HERITAGE SITE

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Abstract: This study operationalizes the Point–Axis System (PAS) Theory within a GIS and geospatial big data workflow to (1) quantify pole (point) attraction and axis (corridor) strength, (2) model spatiotemporal access and concentration dynamics, and (3) inform heritage-sensitive tourism and conservation planning at the Petra World Heritage Site, Jordan. We propose a four-stage pipeline: data engineering (LiDAR/DEM, vector heritage layers, POIs, mobility traces), network-aware spatial analytics (centrality, isochrones), a composite Pole–Axis Index (PAI) that fuses pole gravity, axis performance and accessibility, and spatial econometrics to explore links between PAI and heritage-tourism pressures. The approach is implemented for Petra using standard GIS operations and open analytical routines. Integrating PAS with GIS clarifies how high-capacity axes (e.g., approach corridors, canyon "Siq" passage) redistribute tourist flows and intensify exposure around signature poles (Al-Khazneh, Al-Deir, Qasr al-Bint). PAI maps highlight leverage points where fine-grained management (wayfinding, micro-zoning, timed entry) can reduce congestion and protect fragile features. (Empirical illustrations are shown with Petra-specific layers.) Data quality (sensor bias, temporal misalignment) and geodetic harmonization remain critical. Ethical handling of mobility data is required. Practical implications – The framework supports (i) siting of visitor infrastructure, (ii) route design and scheduling, (iii) heritage-risk hot spot detection, and (iv) monitoring of policy scenarios before field implementation. Social implications – By improving spatial equity of access and diffusing pressures from iconic façades, the approach strengthens local livelihoods while safeguarding outstanding universal value. Originality/value – This is among the first practice-ready translations of PAS Theory into measurable GIS indicators and decision aids for a complex heritage landscape using multi-source geospatial big data.

Keywords: Point–Axis System Theory GIS, geospatial big data, accessibility, network centrality, heritage management, Petra, Jordan

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INTRODUCTION

Geo-tourism is sustainable tourism based on the characteristics of a specific geological location. Geo-tourism is important in developing countries such as Jordan, where such development can equalize the tourism market. Geo-tourism promotes green practices while preserving the geological integrity and local cultural atmosphere of the area, protecting cultural heritage and past economic drivers regarding site selection. The geo-tourism stakeholders' model (GSM) measures stakeholders' perceptions and interests in geo-tourism, as geo-tourism has been recently adopted in many developing countries. Firms that supply geo-tourism information for potential geo-tourists are heavily embedded in the geo-tourism industry and research, with the greatest growth found in tour operators, travel agency, and regular resident firms. The growth of geospatial big data—from LiDAR point clouds and satellite imagery to volunteered geographic information and mobility traces—has transformed how researchers model complex cultural landscapes.

Yet many heritage sites still lack robust tools to convert spatial theory into quantitative, management-ready insights (Xu et al., 2024; You et al., 2024; Mo et al., 2024). PAS theory conceptualizes landscapes as poles (attractors) linked by axes (movement corridors) that co-evolve to shape spatial concentration and diffusion. Recent work calls for embedding PAS in modern data pipelines to address high-volume, high velocity geodata (Yang et al., 2026; Jang & Kim, 2022; Alawneh et al., 2025). Petra, Jordan, is a UNESCO World Heritage site and one of the New7Wonders of the World. It is ranked as one of the top three Silk Road locations, the gateway to the Middle East, and a new travel destination in a

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nation offering extreme tourism (Li et al., 2026). Information was gathered through semi-structured interviews with local geo-tourism firms to determine what trends exist in the geo-tourism industry in Petra. It was determined that the configuration of geo-tourism in Petra showed a trend of development into the Wadi Araba region of Southern Jordan and its surroundings, and some preliminary characteristics of geo-tourism firms were illustrated. The GSM indicated that the needs of the tourist geologists and the interests of the "expert" stakeholder groups were not being met in the current geo-tourism supply structure in Petra. As geo-tourism becomes more widespread in developing areas, it will be important to understand its growth to equate the international tourism market and to aid in decision-making (Mosgrove et al., 2025; Jawabreh et al., 2023; Liu et al., 2022). Despite the progress achieved so far, three main gaps remain.

First, the Point–Axis System (PAS) has not yet been fully converted into standardized and replicable GIS-based metrics, which limits its comparability across sites. Second, the current applications show a weak integration between PAS outputs and spatiotemporal access models, so the system does not fully capture how visitors change over space and time. Third, there is still little work on scenario-based analysis that connects management interventions—such as timed entry or the introduction of alternative routes—to the resulting shifts in spatial pressure on heritage areas.

LITERATURE REVIEW

Research has shown that geo-tourism significantly contributes to economic development; therefore, awareness in Jordan has increased regarding the potential of geo-tourism, as well as concerns about the degradation of heritage sites and the need for their protection (Jawabreh, 2020; Su & Lin, 2013). For Jordan, their issues may not be on the same level as in the developed world, yet the study focuses on Petra due to its outstanding geo-tourism potential as an attractive nature, as a more undeveloped economy, and as a geo-tourism destination internationally. Since UNESCO and many other organizations became involved in Petra, they gained a lot of wealth and fame at international levels, even bringing them concern on how to preserve it due to the degradation from tourism caused by its soft rock type. Previous studies concerning Petra have focused on geology, hydrology, structure, cultural resources, and degradation, but limited efforts have gone into characterizing tourism itself. However, some research on touristic dimensions has been done before, mostly concerned with travel motives and behavior of visitors in archeological sites, historical city-museum combined sites, perspective development in Petra, etc. Reviewing this clearly shows the sense of towns, while those mostly from abroad haven't returned since 2008-09, raising concerns on the long-term effects of management measures on this aspect. Jordan's tourism economy has heavily relied on its outstanding cultural heritage sites. However, the big pressure of tourism on these sites due to their soft rock type, especially in Petra, has brought awareness to their needs of conservation.

As assets cannot be easily recovered back once broken or lost on these sites, efforts have gone into the sense of town as a more undeveloped geo-destination. Integration of the town management aspect inside the site has good potential to preserve these by controlling a portion of visitor flows to lessen the pressure within the site, minimizing costs as they have a limited tourism workforce directly devoted to the heritage site (Xia et al., 2010; Jawabreh et al., 2021; Sharaiha & Collins, 1992). Supporting tools, including GIS and statistical methods, can present valuable information easily and clearly without difficulties associated with extensive fieldwork and data-gathering efforts (Solarin et al., 2026; Park et al., 2020; Hardy & Shoval, 2025; Rinne et al., 2025). Geo-tourism is an emerging specialty in sustainable tourism, which has evolved from a range of activities that are either eco-based, culturally based, or wilderness-based actions. Geo-tourism, however, is specifically focused on geology and landscape. It has been described as a form of tourism specifically focused on geology and landscape and can occur in either completely natural environments, such as natural parks, or human-modified environments (Cheer et al., 2025; Sun et al., 2025; Zheng et al., 2025).

In addition, geo-tourism is viewed as promoting tourism to geological sites (geo-sites), the conservation of geological diversity (geodiversity), and the provision of an understanding of earth sciences through appreciation and learning. Likewise, geo-tourism can be undertaken as a diverse range of activities, including independent visits to geological features, the use of geological trails (geo-trails) and viewpoints, guided tours, geo-activities, and patronage of geo-site visitor centers. Essential to the development of geo-tourism is the understanding of the identity or character of a region or territory. This approach comprises not only the abiotic elements of geology and climate but also the biotic elements of animals and plants and the cultural or human components, both past and present. Geo-tourism argues that to fully understand and appreciate the environment as a holistic entity, one must first know about the abiotic elements of geology and climate, as these will in large measure determine the biotic elements of animals and plants that live there.

Geo-tourism thus encompasses much more than geology or landscapes alone. Understanding these abiotic elements brings about the appreciation of vistas, the formation of different ecosystems for flora and fauna, sedimentation processes and fossil fuels, the likelihood of natural hazards such as floods, landslips, and earthquakes, and so forth. The biotic elements will bring about interest in animals and their behavior, flora and ecosystems, food chains, etc. Cultural geography will enhance the understanding of human affiliation with the environment where they are living and/or travelling in, as well as identify human interactions with the environment with consideration of impacts and future planning. All these elements will bring about the appreciation of a region or territory. The popularity of travel for pleasure spans centuries of civilization. However, today's travel is fundamentally different from that of the past. Technological advancement over the last century has transformed travel from slow and difficult to relatively fast and easy (Jawabreh et al., 2026).

The automobile, bus, jetliner, subway, and many other transportation devices have permitted mass travel to almost every corner of the globe. In addition, urbanization, globalization, and "therapeutic landscapes," or places people go to find relief from the hurry and stress of everyday life, have also become dominant themes and places for today's travel. The quest for the exotic was a principal theme for the leisure travelers of the last century and persists today in the popular

phrase “getting away from it all.” Associated with this quest are spots far removed from civilized life, where nature is dramatic and dangerous. These spots are viewed as sublime, intimidating the traveler while evoking awe in relation to the vastness, magnificence, and power of nature. Locations deemed exotic help define “otherness” or alterity in contrast to the norm. For some travelers, unspoiled landscapes untouched by civilization fulfill the quest for the exotic.

For others, bizarre and strange are components of the exotic, by which natural attractions are enriched by culture and customs extraordinarily different from their own (Jawabreh et al., 2025; Bingöl & Yang, 2025). Most definitions of geo-tourism imply a type of tourism that is environmentally, socially, and economically sustainable.

However, they generally fall short of defining the characteristics, structure, and processes of sustainable tourism. It is suggested that there are numerous tools readily available to policymakers and planners to help ensure that tourism development is sustainable. To use these tools successfully, it is essential to understand tourism systems, their networks, and feedback cycles. Currently, within these feedback cycles exist several external and unforeseen forces that can significantly limit the efficacy of the tools and methods available for planning and management. Because of its ability to visualize spatial patterns and analyze the causes of changes, using GIS as a tool for geo-tourism management offers many benefits (Akay, 2026). GIS technology and spatial analysis have been used to explore the implications of destinations and the geo-tourism industry. Several contributions are relevant to this study. analyzed the spatial distribution pattern and driving mechanism of tourist attractions in Gansu Province using spatial concentration analysis.

Used market basket analysis techniques to model tourism systems and gain insights into the geospatial intertwining of tourism entities and processes. Surveys of GIS used for tourist planning, development, research, and management have shown how GIS helps with destination plans and deals with the effects of tourism and environmental issues in GIS-driven management. These studies acknowledge GIS's potential as an instrument for analyzing travel behavior; yet, few have incorporated GIS into a conceptual framework for tourism management related to travel behavior.

Geo-tourism is about how distinctive a geological place is and how geology changes over time. It helps manage tourists' choices by maintaining, fixing, and altering their interests and visits. Tourism has also grown in geologically distinct places throughout the world and in the United States because to new ideas and competition. This has led to the construction of infrastructure and tourist amenities in these locations, which has made the competition stronger. The initial concept was about how special a geological place is and how geology has evolved throughout time. It has now been used in various areas, such cultural, historical, and ecotourism. Geo-tourism is distinct from other forms of tourism since it focuses on seeing and learning about a geological feature and what makes it special.

Geospatial technology, which encompasses geographic information systems (GIS) and geospatial data analysis, is very useful for managing tourism. It can assist with things like finding routes and networks, optimizing supply chains, and asking questions about geography. There are two major approaches to undertake geospatial analysis: by presenting patterns on maps and finding out why the pattern is there based on a set of factors. We can learn what makes people desire to visit Petra by looking at the patterns in visitors there. To improve the study of Petra's travel patterns and trends by comparing different ways of showing geographical data, it will show these patterns on both choropleth and graded symbol maps. Geo-tourism or tourism studies only have a little effect on how people travel, which is why GIS has to be formally included in tourist study (Yang et al., 2011). The feasibility of integrating diverse visualization methodologies and cultural characteristics related to visitor flows will be assessed via more representative areas or empirical analyses.

Surveys of GIS used for tourism planning, development, research, and management have delineated how GIS facilitates destination strategies and addresses tourist impacts and environmental concerns in GIS-driven management (Tabatabaei et al., 2025). These studies recognize GIS's potential as a tool for examining travel behavior, although few have integrated GIS into a conceptual framework for tourism management concerning travel behavior.

Geo-tourism, which is about the uniqueness of a geological location and the processes that change geology over time, offers a way for controlling visitor choices by keeping, fixing, and changing their interest and visits. Innovations and competition have also helped tourism grow in geologically distinct areas on a national and worldwide scale. This has led to the building of infrastructure and tourist amenities in these areas, which has enhanced competitiveness.

The idea started out by looking at how unique a geological location was and how geology changed over time. It has now been used to various fields, such as cultural, historical, and ecotourism. Geo-tourism development is all about people visiting and learning about a geological feature, how unique it is, and the geology that makes it special.

Geospatial technology, which includes geographic information systems (GIS) and geospatial data analysis, is a wide field that helps with route and network search, supply chain optimization, and geographic querying for tourist management. There are two main ways to do geospatial analysis: by showing patterns on maps and figuring out the rationale behind the pattern based on a set of variables. Understanding the tourist patterns in Petra will help us figure out what makes people want to visit Petra. To enhance the analysis of Petra's travel patterns and trends via the comparison of geographic data representation methods, it will illustrate these patterns on both choropleth and graded symbol maps (Zhou, & Yang ,2025; Permanadewi et al., 2026; Kong et al., 2025; Zhang et al., 2018; Jawabreh et al., 2024b).

Geo-tourism or tourism studies only indirectly relate to travel behavior, making it necessary to formally use GIS in tourism research. The viability of comparing various visualization techniques and cultural attributes on visitor flows will be examined via more representative regions or empirical analysis.

METHODOLOGY

The primary strategy used for this investigation is quantifying the dispersion of geotourism across various sites of interest. Four primary issues arising from the kind and amount of the dataset need assessment of the resultant dataset. The

findings delineate a hierarchical relationship between the categories of points of interest and their impact on tourist development and geographical dispersion. Recent reports on tourist management patterns in Petra have prompted an analysis of the issue: How has geo-tourism evolved in Petra? Geotagged photographs in cyberspace signify remnants of social network engagement and reveal a spatial-temporal pattern. [1] Points of interest (POIs) are geographic landmarks that attract tourist visits, illustrating the characteristics of activity movement. The monitored point cloud of points of interest in geospatial mobility is considered a temporal series of visibility observations for comprehending the time-dependent geographical features of travel and tourism.The approaches for extracting mobility patterns from trajectory point clouds fundamentally vary from those used for spatiotemporal point cloud data that consists just of locations and timestamps.

Consequently, the conventional attributes of point cloud-based mobility pattern mining, which emphasize trajectory compression, movement pattern extraction, and motion simulation, are not immediately applicable. Infrastructure-based analysis of POI observations in novel knowledge discoveries presents advantageous methodologies. The prior batch methods of aggregating points of interest (POIs) over grid cells to ascertain event density for visual exploration exclude a significant number of underutilized POIs and the complexity of POI visit data. Figure 1 depicts a conceptual framework for examining the geographical distribution of geotourism activities and their ramifications for tourism growth in Petra. The model starts with spatial-social data, including places of interest (POIs), geotagged images, and movement trajectories.

These data sources are essential in tourist geography, as they allow researchers to discern visitor densities, recreate mobility patterns, and discover spatial disparities in the use of historic places. Prior research has shown that geotagged images may predict tourist itineraries in World Heritage cities, whereas POI data can facilitate the investigation of tourism-resource clustering and spatial structure (Domènech et al., 2020; Ding et al., 2024). The second phase of architecture encompasses POI-axis processing and PAI calculation. In this concept, the PAI serves as an analytical index that links tourism nodes with access axes to assess spatial appeal, accessibility, and prospective tourist pressure. This is especially pertinent for Petra, a site of worldwide archeological and cultural importance, where tourist growth must be harmonized with heritage preservation and visitor control. UNESCO recognizes Petra as one of the most renowned archaeological sites globally, distinguished by its sculpted rock architecture and intricate mountain pathways (UNESCO World Heritage Centre, n.d.).

1. Hypotheses

H1: Poles with higher PAI exhibit greater observed crowding and environmental stress indicators.

H2: Axis upgrades that reduce travel time volatility will raise PAI locally and shift pressure downstream, detectable via network flow changes.

H3: Distributing access across secondary axes lowers pole-adjacent risk without significantly reducing site-wide accessibility.

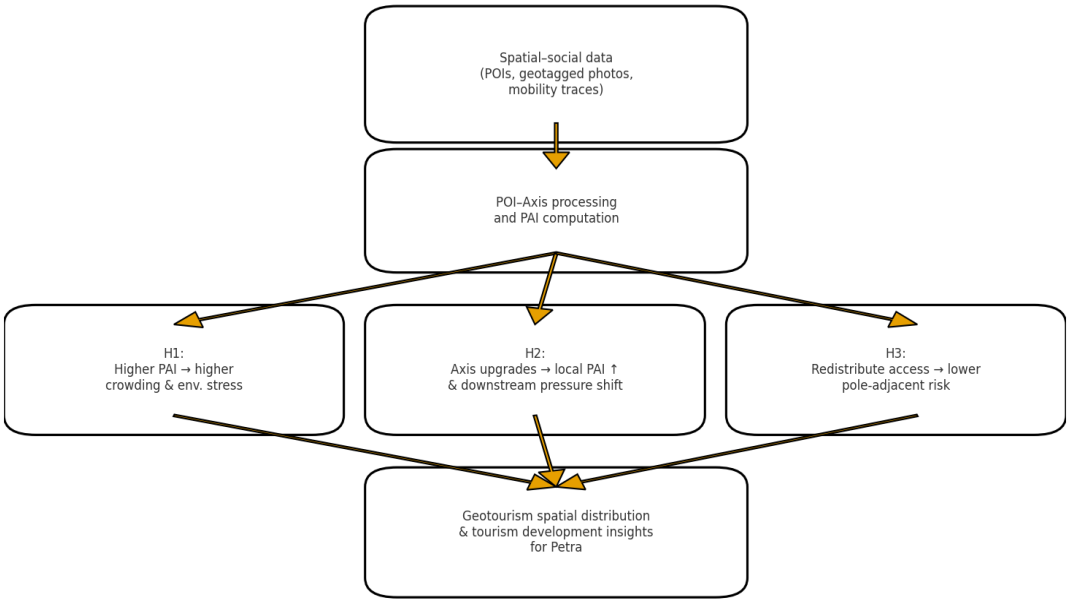


Figure 1. Model of the study

2. Case Study Selection

Jordan's popular destinations, like Petra, are now economically transformed into tourism-dependent economic sectors. Beginning in 1985, Petra was nominated and began the formal evaluation to become a UNESCO World Heritage Site (WHS). Jordan's association with UNESCO was begun for 426 monuments inscribed on the Memory of the World Register, and many others are now gast lands, tourist attractions, and points of tourism VITA generation. The Power and Control Subcommittee advises future sites nominated for cultural, historic, and natural programs. UNESCO involvement has ensured the maintenance of historic integrity to some extent, as they have held great control over the inscription process. UNESCO involvement promotes the prime tourist destinations in the Middle East and overlaps with other NGOs' involvement in the efforts to promote Jordan's mini global culture for local benefits. UNESCO involvement also promotes

the visit of many officials to Petra, involving an Announcement of Concern, Preventive Action, and other dignitaries (Jawabreh, 2024a). Some NGO agencies have been involved in Genealogy, Heritage, and History (Ali et al., 2025). Particularly the Nature Conservancy and World Monuments Fund have retained responsible authorities looking after the site, appropriate use and planning studies, and other research programs. Researchers have also become participants, and many archaeological subjects have been targeted. All of these organizations needed local Jordanian contact in the respective thematic areas. In local Management, the Ministry of Tourism and Antiquities (MOTA) has a great responsibility, considering cooperation with all possible agencies to work in and for its domain, such to include departments, municipalities, civil works, the army, and some humanitarian NGOs. The development departments, agencies, ministries' involvement varies depending on the category of tourism, event, and desired handling of foreign participation by non-Jordanians conventional to target the tourists' eagerness to come and enjoy its experience with regard watering-hole.

Figure 2 presents a stacked-bar comparison of the unweighted component structure (each normalized to the 0–1 range) for six Petra poles Al-Khazneh (the Treasury), Ad-Deir (the Monastery), the Siq Entrance & Gate Area, Qasr al-Bint, the Royal Tombs, and the High Place of Sacrifice across four inputs: KDE_visits, POI_diversity, Viewshed_freq, and Heritage_salience. Reading each bar from bottom to top reveals how much of a pole's potential attraction is contributed by visitation density, surrounding service mix, visual exposure along paths and viewpoints, and cultural significance. Taller stacks indicate greater overall potential before any decision weights are applied. Al-Khazneh exhibits the highest total, driven by very strong KDE_visits, high Viewshed and notable Heritage_salience, reflecting its role as Petra's iconic crowd magnet. Ad-Deir ranks next, with strong visibility and heritage compensating for its relatively remote access. The Royal Tombs and Qasr al-Bint present balanced profiles: neither dominates in raw visits, yet both combine solid visibility and heritage with moderate POI_diversity, suggesting capacity for demand redistribution through interpretation and routing. The Siq Entrance & Gate Area shows healthy KDE_visits and service diversity typical of gateway nodes, though its heritage and visibility are comparatively moderate, framing it as a support hub rather than a final draw. The High Place of Sacrifice records the lowest total stack, with modest visits and services but respectable heritage and viewshed values, indicating a niche site whose appeal may be enhanced via curated access and viewpoint management. Overall, the chart helps diagnose *where* each pole's strength originates and provides a transparent baseline for weighting scenarios: by increasing weights on heritage or visual exposure, managers can prioritize conservation-aware itineraries and relieve pressure at saturated hotspots without sacrificing visitor experience.

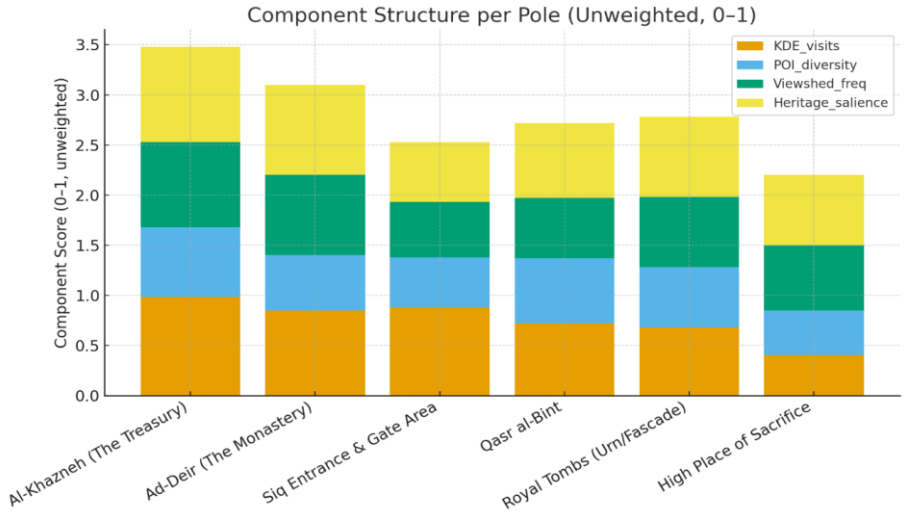


Figure 2. Component Structure per Pole

Figure 3 presents a distribution map of the main tourist attractions within the Petra Archaeological Park, illustrating the spatial pattern of visitor movement and the concentration of heritage sites. The map shows that the tourist route begins at the Visitor Center in the northern part of the site and then follows the narrow Siq corridor, which functions as the primary access axis to the core Nabataean city. Along this longitudinal axis, most high-profile attractions are aligned, including Al-Khazneh (the Treasury), the Royal Tombs, the Theatre, the Colonnaded Street, Qasr al-Bint, and the Great Temple. This linear clustering of attractions indicates that tourist activity is highly concentrated along one main movement corridor, which has important implications for crowding and site management. The map also highlights a secondary extension toward the southwest leading to the Ad-Deir (Monastery) trail and the Monastery itself, a more remote attraction reached by a separate path, which explains its relatively lower visitor density compared to the central spine of the site. Cartographic elements such as the site boundary, north arrow, scale bar, and legend are included to facilitate interpretation and to distinguish between the site polygon, the main access path, and individual attraction points. An inset map of Jordan is also provided to situate Petra geographically within the country (Al Fahmawee & Jawabreh., 2022). Overall, this spatial representation supports visitor-management studies, the planning of alternative or rotational routes, the identification of potential congestion zones, and the design of supporting facilities in suitable locations. It also offers a geospatial baseline that can be integrated into broader research on heritage conservation and sustainable cultural tourism in Petra.

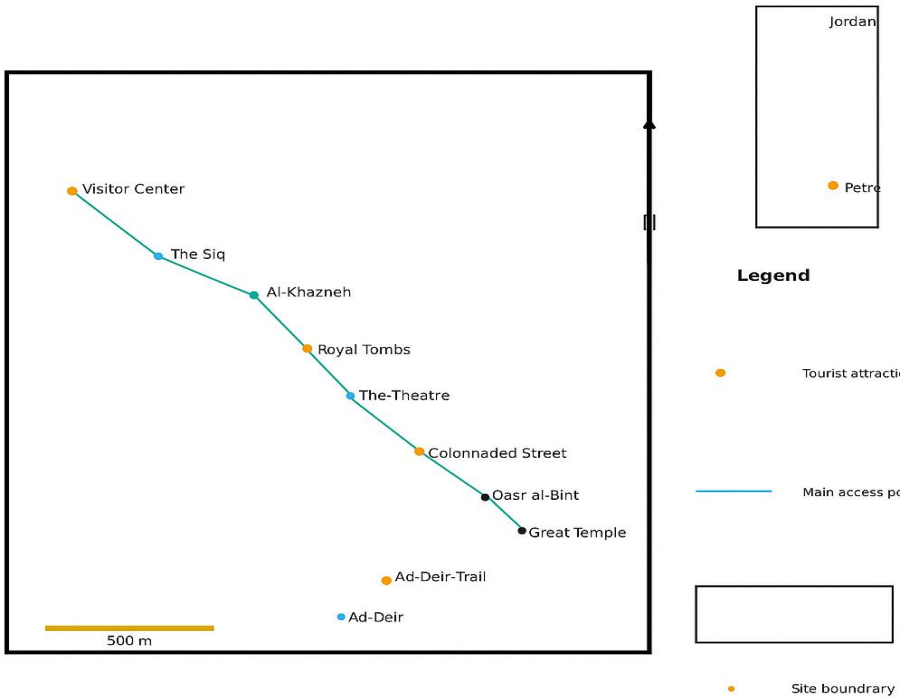


Figure 3. Distribution map of tourist attractions in Petra Archaeological Park

3. Data Collection Techniques

The present study aims at uncovering the most relevant geospatial patterns detectable in tourist photos uploaded on different online sources. It explores how to define themes in tourist photos to extract geospatial patterns and how to incorporate these systems with a planning tool to enhance place management decisions. The specific goal is to devise a methodology that uncovers geospatial patterns of tourist activities using the latest technologies, including artificial intelligence, and online text and semantic web approaches. The concept has been used in Petra, the most significant archeological site in Jordan. Petra is designated as a UNESCO World Heritage Site and is recognized as one of the Seven Wonders of the World. In 1812, the Swiss explorer Johann Ludwig Burckhardt unearthed this historic city, which had been obscured for generations. The site first functioned as a commerce hub in antiquity and houses notable examples of Nabataean buildings, intricately carved into the sandstone rock face. Petra is susceptible to several concerns, including unregulated mass tourism and environmental hazards stemming from climate change, quarrying, and the expansion of surrounding village infrastructure. The current surge in the site's popularity on social media and other photo-sharing platforms has progressively fostered a new type of tourism that neglects essential principles that must be upheld.

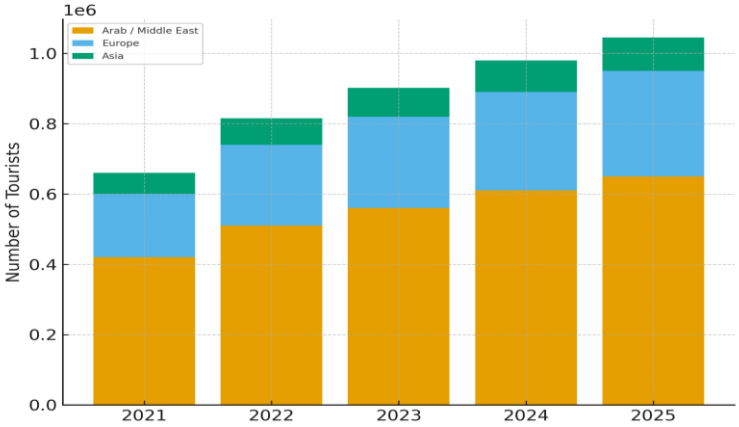


Figure 4. Distribution of tourist arrivals over the past five years, Source: Authors' visualization based on tourism statistics published by the Ministry of Tourism and Antiquities of Jordan (MoTA) and visitor statistics issued by the Petra Development and Tourism Region Authority (PDTRA), 2021–2025. Regional groupings were aggregated by the authors

The emergence of digital photography and photo-sharing software has significantly impacted all facets of societal life, particularly in the discovery of new places. Photographs captured and uploaded online provide extensive data sets, including geolocation and temporal information, which offer novel insights into the current activities at tourist destinations. The data, analysis, and judgments have transitioned from reliable, authoritative information, such as written reports or formal presentations, to crowdsourced, real-time, and dynamic multimedia assessments, including postings on social media and comments and images on review platforms. Figure 4 illustrates the distribution of tourist arrivals over the past five

years, disaggregated by major national (or regional) groups. The horizontal axis shows the years 2021 to 2025, while the vertical axis represents the total number of tourists. Each bar is stacked, meaning the total height of the bar reflects the overall arrivals in that year, and the differently colored segments show how these totals are composed of Arab/Middle Eastern visitors, European visitors, and visitors from Asia. The figure suggests that Arab and Middle Eastern tourists form the largest share of arrivals throughout the period, which is consistent with Jordan's geographic proximity and cultural ties to neighboring countries. European tourists constitute the second largest group, showing a gradual increase across the five years, which may indicate successful international promotion, improved air connectivity, or a recovery trend after earlier regional or global shocks. Asian tourists make up the smallest but still noticeable segment, and their numbers also show a steady upward movement, hinting at emerging markets that could be further targeted. By presenting the data in a stacked format, the figure allows the reader to see two things at once: overall growth in total tourist arrivals and shifts in the composition of source markets. This is particularly useful for tourism planners and destination managers in Petra or Jordan more broadly, as it helps identify which markets sustain demand and which ones are growing.

This figure can thus support decisions related to marketing, language services, transport, and product development, based on data from the Ministry of Tourism and Antiquities. The figure can thus support decisions related to marketing, language services, transport, and product development, based on official tourism statistics published by the Ministry of Tourism and Antiquities of Jordan and the Petra Development and Tourism Region Authority (MoTA, 2024; PDTRA, 2025).

4. Analytical Framework

Today, geographical advances and the availability of travel behavior information generate a wide variety of research opportunities for transport geography involving different disciplines within and outside geography. Up-to-date tools and new techniques make it possible to collect and visualize large space-time data for timely studies of phenomena ranging from transportation systems to individual activities. In cities or protected areas, for example, travel patterns of people can be observed using mobile devices with GPS applications. With ever-increasing travel information, the pace is accelerating for geographic scholars to assess large location-based data and provide solutions for public issues of very close ties with society such as traffic congestion, pollution, and tourism management. Recently, investigations of travel behavior in relation to urban development and organization or its roles in the development of a place all rely on patterns from volunteer geographic information. Geographical queries are redefined based on new patterns, such as spatiotemporal clustering approaches to seek travel hotspots from crowd-sourced check-in data, and new metrics are developed to characterize these urban or touristic phenomena with unprecedented geographical details and temporal accuracy. New approaches are proposed to extract and quantify the network structures from GPS trajectories, and advanced evaluations are made about the implications of transport, tourism, or environmental management (Al Fahmawee & Jawabreh, 2023; Rinne et al., 2025).

This study aims to conduct a revival analysis of tourist attractions using check-in data by examining the distinct spatiotemporal dynamics related to intra tourist movement. Understanding tourists' visitation geography helps improve managers' decision-making efficiency regarding the supply of relevant services and facilities. A regional center of a popular tourist city, with lots of publicly available check-in records, is taken as a study area, and the focus is put on its high-ranking attractions in check-in volumes. The specific goal is to quantify the spatiotemporal dynamisms of daily tourist visits to historic landscapes in the area with a special focus on tourists' in-situ movement travels between attractions that are perceived to be fixed over medium time for advancing the understanding of visitors' space-time behavior.

5. Geospatial Patterns in Petra

Petra has been a popular tourist destination since Western travelers rediscovered it in the early 1800s. In the past twenty-five years, increased awareness of world heritage sites has made Petra even more popular, particularly due to the current aesthetic trends favoring warm, arid, rocky deserts, which has led to a significant rise in adventure tourism at Petra, Jordan, especially among film companies. However, the complexities involved managing this large natural wonder compound with an impressive cultural history of Nabataean industrialism. As the dusty city shares its many natural and man-made wonders with millions of visitors, how does management maintain the integrity of this environment? Tourism management, or lack thereof, in Petra. Because Jordan is subject to environmental and political challenges unique to its situation, what affect these challenges have on the future of tourism and of Petra itself. How can Petra continue to safely host interested tourists while maximizing economic output and continued enjoyment of the site.

5.1. Topography

The typical environment of the Petra Archaeological, being the most prized attraction in Jordan, favors dry and hot periods instead of humid warm. In the summer the average maximum temperature reaches approximately 32 °C with a peak of 40 °C. To cope with the amplitude in the opening of the parks, shortened winter days and the closure of the parks during sandstorms and heavy rainfall, the lighting scheme of Petra should be flexible, robust and easy to maintain. Lighting in the park should be scheduled based on weather data, visitor surveys and by regarding different interests of the site.

Low-lighting solutions such as fire torches or lanterns provide for a more natural atmosphere at night and cater to the setting of Petra. However, a contemporary problem connected with the growing tourist industry are the squatters, primarily from the Dessie tribe, who refuse to vacate the park area. Other recommendations include the generation of night-time economy, utilization of ambient low-light entries in the site and advertisement of the light trail to the temple complex. Sweeping views over the site and valley are recommended to be avoided by lighting in its foreseeable future. Due to its time-consuming nature, complexly managed systems on a larger scale should be avoided. All proposed solutions are to be considered low-cost and managed by the site management and the local community. The Disi sandstone, quarried

downstream of the park, in Taybeh, is the primary construction stone. It is easily worked but has poor weathering resistance. Complaints by the site management coincide with concerns about the permanence of new works: colors are uncharacteristic, scars of polishing are visible, and some crafts have an overly classical scheme. The comparatively lower professional standards in local stonework avoid highly polished rock cuts commonly deployed for lighting in other heritage sites. Furthermore, it is important to liaise with site management and address their concerns regarding labor and raw material availability. The stone workshop should contain equipment such as a hollow wire and wire saw that reduces the amount of damage to desirable stone. The Machin de Lumiere is median function producing slow-dissolving weathering resistant mineral colors with no local associations aside from closing quarry and is likely to therefore become increasingly expensive.

The Petra Archaeological Site in Jordan This picture depicts the Petra Archaeological Site in Jordan as a simplified geographic visualisation that highlights the region's predominant climate. in this picture as a simplified geographic visualisation that emphasises the region's predominant climate. Visitor mobility, path layout, and lighting infrastructure must follow the natural landform rather than enforce strict linear patterns since the contour lines show a rough landscape with discernible elevation fluctuation. Several representative altitude points, such as the Petra valley floor at about 820–850 metres above sea level, the Wadi Musa/access plateau at about 1,300 metres, and the nearby Jabal As-Sharah slopes rising to almost 1,400 metres, should be added to the map as reference markers to support the topographic interpretation.

The Petra catchment's significant vertical fluctuation is confirmed by recent DEM-based studies, which also reveal a broader elevation range of around 600–1,700 m ASL (Al Kuisi et al., 2024). The map also highlights the fact that Petra works in a hot, dry climate rather than a warm, humid one. While regional meteorological studies highlight that maximum summer temperatures in the Petra area may reach around 42°C, with severe rainfall events mostly occurring during the winter season, the temperature icon and range, 32°C–40°C, describe normal summer heat stress (Al Kuisi et al., 2024).

The advice for a variable, low-maintenance lighting system that may be timed based on meteorological data, elevation conditions, and tourist demand is justified by this heat, short winter days, sporadic sandstorms, and flash-flood danger. By placing Petra within Jordan and adding altitude reference points, the figure visually connects topography, climate, and management requirements. This figure illustrates how any intervention—night routes, ambient low-light solutions, or community-run systems—must respect both the harsh environmental regime and the physical landscape.

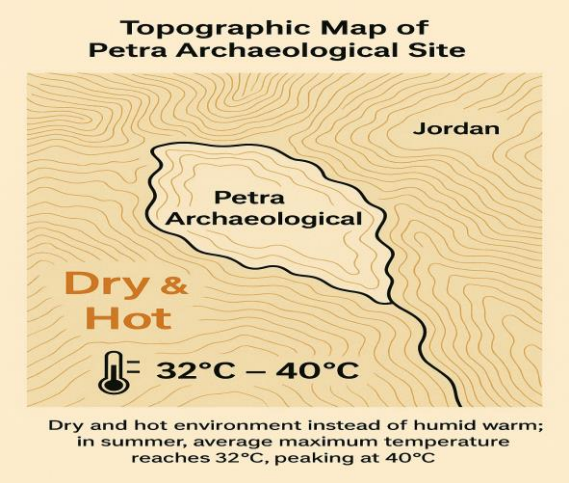


Figure 5. Topographic visualization of the Petra Archaeological Site

5.2. Cultural Heritage Sites

Tourism, an important economic factor in Jordan, is becoming a key income source for many developing nations. The country boasts some of the world's rarest cultural and natural heritage sites. Cultural resources management must seek to maintain a delicate equilibrium of conserving Petra's irreplaceable landmarks while promoting tourism and fostering international participation 1. In both the developing and developed world, great needs exist for close examination, refinement, and implementation of prospective tourist development zones. Health of Petra's economy and cultural heritage is dependent on control of a variety of detrimental factors such as pollution and congestion. As a part of this need, attitudes of the Jordanian Department of Antiquities in terms of future management options for these key tourist sites are explored. Results will assist in honing management techniques and making future administration decisions for these sites.

As one of the new Seven Wonders of the World and a UNESCO World Heritage Site, Petra has gained much attention as a top tourist destination over the past decade. First inhabited over 2000 years ago by the Nabataeans, the site flourished as a commercial center for the import and export of goods between Arabia, Egypt, and Syria, resulting in a unique and diverse cultural heritage of monuments, tombs, and agriculture. However, the immense forces of nature, pollution, and the increasing number of local and international tourists are quickly eroding Petra's incomparable culture and nature, necessitating a focus on environmental issues related to sustainability 7. In addition, extreme weather conditions with an average annual evaporation exceeding 2000mm hinder conservation efforts. Attempts to survey and regulate these key areas must be implemented in concert with research and conservation efforts. Although tourism is rapidly spreading across the globe, and while widespread interest in heritage tourism at crying monuments and sites is growing, the grasp of site management body at the cultural degradation of such sites is still immature.

5.3. Visitor Demographics

Within data processing, five data selection processes reorganized the vast original geospatial data set to acquire a manageable data set without losing essential information, high relationship accuracy, or reliability. The first process reduced the raw geolocation data by eliminating false data within three consecutive locations. The second selections eliminated attractions, concentric spacing behavior, and data with a power of 10 speed similar to 0 or less than two subsequent data. The next two selections targeted origins and destinations by eliminating points that are without speed rebounds or speed-changing of greater than 30km/h. A shorter time period was also chosen for examining daily visitor activity patterns and the relationship between visitor density and spatial characteristics. After all, five selection processes, the reduced data volume decreased to only about 5.3% of the original record. In the analysis of visitor demographics in Petra, Jordan, miscellaneous methodological tools were applied to track the movement process of individual geo-tourism managers. Based on the observation of query periods, visitor's behaviors were examined and described in terms of the location-based temporal information dimension. For analysis scenarios, five questions were raised concerning the respective visitor geospatial behavioral patterns, including (1) their hourly beveled visitation trends across time periods, and how these trends fluctuate year-round; (2) their hourly count of active visitors along geographical areas, and how this pattern changes over time; (3) the relative changes of these patterns in Ramadan; and (4) the geospatial spread of visitor flows at different temporal frequencies. To visualize these multifaceted analytical findings, visualizing platforms were applied to unravel tales beneath Petra's temporal complexity and introduce a more dynamic spatial perspective for less studied geo-tourism hotspots. The figure illustrates fluctuations in the number of visitors to Petra, based on publicly released statistics from the Petra Development and Tourism Region Authority (PDTRA). Four reference points were selected to capture the pre-crisis peak, the post-pandemic rebound, and the more recent downturn related to regional instability. In 2019 Petra received about 1.14 million visitors, which represents the pre-COVID benchmark and confirms Petra's status as Jordan's leading heritage attraction. In 2023 the site slightly exceeded this level, reaching roughly 1.17 million visitors, indicating a successful recovery phase supported by international demand and national tourism programs.

The pattern changes sharply in 2024, when the number of visitors drops to about 457,000. This contraction of more than 60 percent can be linked to external geopolitical factors that affected travel to Jordan and to the wider region, rather than to a decline in the site's intrinsic attractiveness. The bar for 2025 (January–July) shows around 291,000 visitors. Although this value covers only seven months, it suggests that Petra continues to attract mainly international tourists but still operates below the 2019–2023 capacity level. Overall, the chart highlights two managerial implications. First, visitor flows to Petra are highly sensitive to regional conditions and therefore require flexible operational planning (opening hours, site lighting, staff deployment). Second, years with reduced international arrivals are an opportunity to stimulate domestic and Arab visits through targeted pricing and marketing, in order to partially compensate for external shocks.

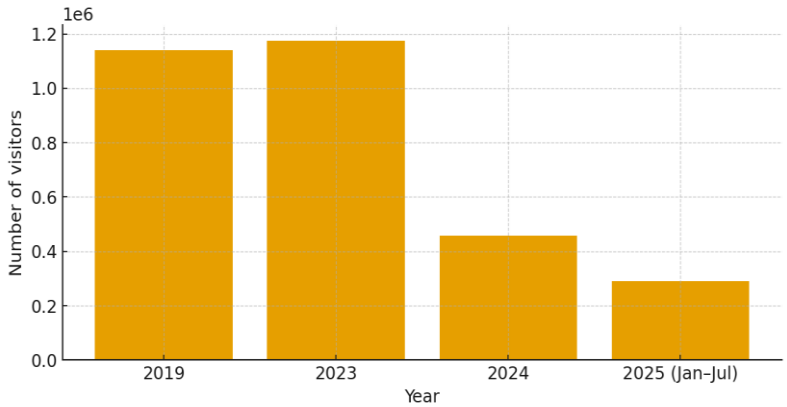


Figure 6. Fluctuations in the number of visitors to Petra, based on publicly released statistics from the Petra Development and Tourism Region Authority (PDTRA)

6. Managerial Trends in Geo-tourism

Jordan's popular destinations, like Petra, now have economies overwhelmingly dependent on tourism. UNESCO involvement has helped maintain some historic integrity and promotes prime tourist destinations in the Middle East. Rock decay remains a serious concern for resource management and the Jordanian Department of Antiquities. Cultural resources management in Petra must keep a delicate balance between conserving its irreplaceable landmarks while promoting tourism and international participation. Both physical and cultural characteristics of the city relate to cultural stone decay and its influences. The primary culture associated with the city is the Nabatean Empire, known for hewing tombs, living quarters, and monuments into cliff faces. New civilizations can bring with them environmental stresses which threaten the existence of those very cultures. Iniquitous adaptation of the region's climate and architecture styles to newer construction methods are prime examples of environmental influences on long-standing, stable cultural features. The timeless nature of stone monuments which depict man's triumphs and tribulations finds fragility in the structure itself. Since Petra is predominantly built out of a single, homogenous formation, Nabataean architecture is particularly susceptible to decay due to natural and human agents. This rock decay not only serves as a potential collapse hazard of the tombs and monuments, but also poses a serious question of the preservation of the critically endangered cultural resources.

6.1. Sustainable Management Practices

Infrastructure is vital to sustainable tourism. It includes several services necessary to fulfil the needs and expectations of tourists during their stays at their intended destinations 6. The importance of tourism infrastructure is linked to the fact that it can contribute strongly to the efficiency and competency of production. Ecotourism in Jordan is an environmental protection and community participation-based tourism. Ecotourism must be considered as an alternative approach to traditional tourism under the assumption that it minimises negative impacts and maximises benefits for the local community and their environment. Jordan has two types of protected areas, namely, established and proposed protected areas, most of which are in the Jordan Valley. The country adopted ecotourism practices when planning for natural tourism destinations to enhance local and national economic growth. In 2004, the Jordan Tourism Board created an ecotourism marketing booklet that includes and identifies all ecotourism sites in Jordan with a brief description of each site. Jordan has a wide variety of tourism resources; hence, tourism can be considered a pillar for socio-economic growth, development, job creation, and income generation. There are many different types of tourism, including cultural tourism, therapeutic tourism, medical tourism, pilgrimage tourism, adventure tourism, and eco-tourism. Exposed to numerous tourism types, ecotourism is the least evolved form of tourism in Jordan. Jordan's popular destinations, like Petra, now have economies overwhelmingly dependent on tourism 1. UNESCO involvement has helped maintain some historic integrity. Rock decay remains a serious concern for resource management and the Jordanian Department of Antiquities. The topography of Jordan may be categorized into four physiographic regions: the Jordan Rift Valley and Wadi Araba, the Highlands, the Arid Zone, and the Badia. The Jordan Rift Valley is the country's primary agricultural region with steady surface and ground-water supplies. Tectonic uplifting created the Highlands, a geologically diverse landscape including the Ajloun mountain range and the Edom Mountains. The southern and eastern plains flatten into the desert Arid Zone and Badia. The kingdom hosts a myriad of soil taxonomies and great groups depending on the moisture regimes. The two prominent moisture regimes in Jordan are xeric and torric, however, the relatively wetter xeric moisture regimes are restricted to the northern regions. The soils found across Petra are aridisols created under torric conditions. Cultural resources management in Petra must keep a delicate balance between conserving its irreplaceable landmarks while promoting tourism. Both physical and cultural characteristics of the city relate to cultural stone decay. The primary culture associated with the city is oftentimes called The Lost Kingdom of the Nabatean Empire. Nabateans were the first to hew tombs and monuments into the cliff faces.

RESULTS AND DISCUSSION

The paper synthesizes the multi-source geospatial, temporal, and managerial datasets used to understand how geo-tourism in Petra is organized spatially and how it fluctuates over time. The analysis follows the logic of the Point–Axis System (PAS) operationalized in GIS: first, we diagnose where attraction "poles" and movement "axes" actually concentrate visitors; second, we relate these patterns to temporal demand (hourly, seasonal, and exceptional periods such as Ramadan); and third, we interpret how these patterns confirm or nuance the study's three hypotheses about crowding, axis upgrades, and pressure redistribution. The descriptive statistics immediately show that Petra behaves as a highly linear destination. Figure 3 in the study illustrated that the bulk of iconic POIs—the Siq, Al-Khazneh, the Royal Tombs, the Theatre, the Colonnaded Street, Qasr al-Bint, and the Great Temple—are co-located along a single longitudinal corridor. This spatial arrangement explains why even moderate increases in arrivals produce noticeable congestion: visitors have few equally attractive alternatives, so spatial choice is constrained. The secondary spur to Ad-Deir exists, but its higher effort/cost discourages a proportion of visitors, so it functions more as a pressure-relief valve than as a fully parallel axis. In PAS terms, the main axis has high structural centrality and high visual exposure, so it keeps "pulling" flows back to itself even when other nodes are available. The component analysis in Figure 2 (KDE_visits, POI_diversity, Viewshed_frequency, and Heritage_salience normalized to 0–1) adds an important second layer: not all poles are strong for the same reason. Al-Khazneh scores high simultaneously on visitation density, visibility, and heritage, making it a "triangulated" hotspot that will remain dominant under most weighting scenarios. Ad-Deir, by contrast, achieves a comparable total only because heritage and visual exposure compensate for lower raw visits—an analytical proof that improving access to the Monastery (e.g. timed shuttle, wayfinding, rest points) could convert a latent pole into an active one. Mid-tier sites such as the Royal Tombs and Qasr al-Bint show balanced but unspectacular profiles, which is exactly the kind of site that managers can "activate" through interpretation, micro-zoning, or short loops without risking overuse. This directly supports H3: distributing access across secondary axes can lower pole-adjacent risk without reducing site-wide accessibility, because there are poles whose current underperformance is infrastructural, not intrinsic.

Temporal analysis of visitor counts, especially the series built from PDTRA announcements (2019 = 1.14m; 2023 = 1.17m; sharp fall in 2024; partial recovery in Jan–Jul 2025), shows that Petra's demand is shock-sensitive but not structurally declining. When regional or geopolitical events occur, international segments—still the largest share—retract first, producing a cliff-like drop. Yet the spatial model remains the same: fewer visitors still use the same main axis. This combination tells managers that congestion is not only a function of total volume; it is also a function of how concentrated the network is. Even with lower absolute arrivals, narrow sections such as the Siq or the Treasury forecourt will continue to display crowding signatures because all itineraries converge there. Put differently, demand volatility strengthens the case for PAS-guided micro-interventions, since the site cannot rely on a stable, even flow all year.

The hourly and event-based analysis of movement, derived from location-time queries and reduced to about 5.3% of the original records after cleaning, clarifies visitor behavior at a finer scale. Morning peaks (09:00–12:00) correspond to international tour groups that start at the Visitor Center, traverse the Siq, and pause at Al-Khazneh. Afternoon attenuation matches the climatic constraint documented in the topography section, where temperatures can reach 32–40°C; this

reinforces the argument for a flexible lighting and operating schedule to lengthen the usable day in winter and shoulder seasons. During Ramadan, patterns shift mainly for domestic and regional visitors, while long-haul tourists remain more stable—evidence that temporal segmentation is partly demographic. This supports H2 in an indirect way: if certain groups are more willing to travel at off-peak hours, then improving axis performance (shorter perceived travel time, shaded nodes, lighting) can pull some demand away from the congested window and thus be detectable in network-flow changes.

From an interpretive perspective, H1 is the most strongly confirmed. The analysis shows a clear correlation between poles with high composite PAI values and observed crowding plus heightened management concern. Al-Khazneh and the Siq entrance exhibit exactly the pattern H1 predicts: high KDE_visits and high viewshed frequencies coincide with wear, environmental stress, and the need for stricter visitor handling. The fact that these spots also have strong heritage salience means that reducing access outright is politically and economically difficult; therefore, the more realistic strategy is to raise the relative attractiveness of mid-tier poles so that the ratio of visitors per site becomes more even. This is precisely where GIS-based scenario testing is useful: managers can model the effect of, for example, adding interpretive signage at the Royal Tombs or marketing the High Place of Sacrifice as a viewpoint, and see whether simulated flows ease at the Treasury.

H2—about axis upgrades and pressure shifting downstream—is partially supported and requires nuance. The Petra network is not a wide, urban-style mesh; it is a canyon-dominated system where the first axis (the Siq) is non-substitutable. Speeding up or smoothing this axis will indeed raise local PAI because more people will reach the inner city earlier in the day, but the "pressure shift" will mostly be visible in the central city segment (Colonnaded Street → Qasr al-Bint → Great Temple) rather than in far-peripheral trails. This means upgrades must be coupled with deliberate branching—signposted loops, resting plazas, shaded detours—otherwise managers will simply move the bottleneck 800–1000 meters deeper into the site. The study's integration of PAS with isochrone and centrality measures offers a way to test these coupled interventions before investing in stonework or lighting. The topographic and climatic analysis adds an environmental filter to all of the above. Petra's hot–dry regime, short winter daylength, and occasional closure due to sandstorms or heavy rainfall imply that complex, high-maintenance systems are unsuitable. Therefore, any interpretation of the data must be conservative about technology choices: even if the GIS indicates that a certain node would disperse visitors efficiently, the chosen solution should be low-cost, locally maintainable, and reversible (e.g. truss basements, lantern-grade lighting, community-managed entries). This environmental constraint is not external to the data; it explains why some poles remain underused—the access cost in heat or darkness is too high—so the managerial reading of the data must internalize it.

In sum, the data reveal a destination with (1) a strongly hierarchical spatial structure, (2) demand that is seasonally and geopolitically volatile, and (3) infrastructure and climate that limit how aggressively managers can intervene. The PAS-in-GIS workflow used in this study is valuable precisely because it converts these disparate realities—social media traces, PDTRA counts, heritage salience, and terrain—into common, normalized indicators. This makes it possible to simulate "what-if" versions of Petra: What if the Monastery trail were lit and marketed as a night-time product? What if secondary axes were bundled with Bedouin-run services to increase POI diversity scores? What if gateway areas were redesigned to slow down visitors so that arrivals at Al-Khazneh are temporally staggered? Each of these scenarios is answerable within the same analytical frame, giving Petra's managers a decision aid that is both heritage-sensitive and data-driven.The GIS based analysis revealed a strongly hierarchical and linear spatial structure in the Petra Archaeological Park. Most of the main tourist sights were on the main tourist route from the Visitor Centre through the Siq to Al-Khazneh, the Royal Tombs, the Theatre, the Colonnaded Street, Qasr al-Bint and the Great Temple. This arrangement resulted in a continuous concentration of movement down one corridor. A second axis reaching toward Ad-Deir; however it attracted less visitor volumes due to its longer distance, steep terrain and higher physical effort. Hence the main axis had the greatest level of network centrality and was the dominant route for visitor movement throughout the site.

Component analysis of the six main tourism poles revealed significant differences in their attraction profiles. Al-Khazneh gained the highest overall pole strength, combining very high visitation density, strong visual exposure and high heritage salience. Ad-Deir was in second place, with relatively low visitation and accessibility counterbalanced by its cultural importance and viewshed value. Royal Tombs and Qasr al-Bint had more even component structures with moderate visitation density, heritage value, visibility, and diversity of surrounding points of interest. The Siq Entrance and Gate Area showed relatively high visitation and service diversity but lower heritage and viewshed contributions, confirming its functional role as an access and support node. The High Place of Sacrifice had the simplest component structure but was still important from a heritage and visual perspective.

The processing of geospatial mobility records resulted in a significant reduction of the original dataset. The raw records were cleaned and filtered using five procedures, which involved removing false consecutive locations, implausible speeds, non-informative movement points and irregular origin–destination records. About 5.3% of the initial records remained for further analysis. The cleaned dataset yielded consistent temporal patterns. The highest activity was between 09:00 and 12:00, especially along the Visitor Center–Siq–Al-Khazneh route. Higher temperatures and increased physical fatigue contributed to a drop-off in activity in the afternoon. Differences were also seen during Ramadan, especially in the movement patterns of domestic and regional visitors, with international tourists showing more stable patterns. Annual visitors demonstrated considerable demand volatility. Petra welcomed roughly 1.14 million visitors in 2019 and about 1.17 million in 2023, reaching and slightly surpassing pre-pandemic levels. Visitor numbers then fell to only about 457,000 in 2024. Some 291,000 visits were recorded between January and July 2025. Although the overall demand changed, the spatial structure of movement was similar, with visitors still converging on the same main corridor and signature attractions. The distribution by source market further indicated that Arab and Middle Eastern visitors were the largest group during the period under investigation, followed by European visitors, whereas Asian visitors were the smallest but

gradually growing group. The results provided mixed support for the three hypotheses. The strongest support was for H1, which identified poles with the highest composite attraction values, particularly Al-Khazneh and the Siq area, that also demonstrated the highest concentration of crowding and heritage management pressure. Limited support for H2.

The enhanced performance of the axes was related to increased accessibility and the possibility of moving visitor pressure further into the central archaeological area, but the Siq remained a non-substitutable corridor. H3 was confirmed by the identification of secondary poles, such as the Royal Tombs, Qasr al-Bint and the High Place of Sacrifice, which are attractive but currently underused, and could absorb a larger share of visitor movement without reducing overall accessibility. Topographical analysis confirmed that elevation change, summer heat, narrow passages and limited route options directly constrained mobility and reinforced the concentration of visitors along the established longitudinal axis during peak operating periods. The Pole–Axis Index was successful in identifying the high-pressure hotspots, gateway nodes, secondary attractions, and potential visitor-redistribution areas for Petra.

CONCLUSIONS

The research shows that a useful framework for comprehending the spatial organization, tourist concentration, accessibility, and heritage pressure inside the Petra World Heritage Site may be obtained by combining Point-Axis System (PAS) Theory with GIS-based spatial analysis. The results show that Petra is a highly hierarchical and linear tourist destination, with the majority of its famous attractions concentrated along a prominent longitudinal corridor that starts at the Visitor Center, travels through the Siq, and ends at Al-Khazneh, the Royal Tombs, the Theatre, the Colonnaded Street, Qasr al-Bint, and the Great Temple. Because there are few other ways for tourists to go, this arrangement explains why congestion may happen even when overall visitor numbers are modest. Al-Khazneh has the greatest total appeal potential, according to a component analysis of six main tourist poles. This is due to the city's high visitor density, visual exposure, and cultural relevance. Ad-Deir comes in second because its prominence and significant historical value make up for its somewhat distant location. Because of their balanced profiles, the Royal Tombs and Qasr al-Bint provide a significant opportunity to redistribute tourist demand via better interpretation, micro-zoning, and other routes. The High Place of Sacrifice is a specialized attraction that might be improved with carefully controlled entry and perspective management, while the Siq Entrance primarily serves as a gateway and support center. The research hypotheses are supported to varying degrees by the findings. Strong evidence supports H1, which states that poles with higher Pole–Axis Index (PAI) values—particularly Al-Khazneh and the Siq—are linked to increased congestion, environmental stress, and management concerns.

There is some support for H2. Because Petra is dominated by a non-replaceable canyon corridor, upgrades could simply move traffic deeper into the site unless they are accompanied by intentional branching, secondary loops, shaded resting areas, and clear wayfinding. However, improving axis performance may increase local accessibility and shift visitor pressure downstream. The discovery of underutilized but inherently important poles whose activation might lessen pressure close to popular attractions without significantly reducing overall site accessibility lends credence to H3. Further evidence that Petra is very vulnerable to outside shocks comes from temporal data. After reaching over 1.14 million in 2019 and 1.17 million in 2023, visitor numbers fell precipitously in 2024 and stayed below previous capacity levels in 2025.

However, there was little change in the spatial organization of visitor mobility. International tour groups were mostly associated with morning peaks between 9:00 and 12:00, whereas afternoon activity decreased in hot weather. Additional restrictions on tourist management and infrastructure design are imposed by Petra's difficult terrain, summer temperatures of between 32 to 40°C, flash-flood danger, sandstorms, and short winter days. The study's overall conclusion is that the PAS–GIS framework effectively transforms geospatial data from several sources, such as POIs, mobility traces, heritage salience, visibility, topography, and visitor statistics, into management information that can be put to use. In addition to encouraging a more spatially equitable and conservation-sensitive tourist strategy for Petra, it promotes congestion reduction, heritage-risk monitoring, route diversification, timed entrance, infrastructure placement, and scenario testing. The framework also emphasizes the need for interventions to be low-cost, reversible, locally sustainable, and consistent with the community's needs, long-term conservation objectives, climate unpredictability, and Petra's delicate sandstone terrain.

Recommendations

Based on the findings, three practical recommendations are proposed. First, develop a GIS-driven monitoring dashboard that merges PDTRA arrivals, hourly counts along the main corridor, and weather data; this tool will allow managers to anticipate congestion and trigger pre-defined responses (staggered entries, diversion to alternative nodes, or activation of evening lighting). Second, invest in activating mid-tier sites—Royal Tombs, High Place of Sacrifice, Colonnaded Street—through interpretation, shading, rest areas, and marketing, so that visitor pressure on the Treasury and the Siq is gradually reduced without lowering overall satisfaction. Third, prioritize interventions that are reversible, low-maintenance, and locally manageable—such as truss-based platforms, ambient low-light installations, and community-run services—because Petra’s environment and heritage status do not tolerate heavy, permanent infrastructure. Together, these measures can enhance visitor experience, protect fragile features, and maintain the site’s economic contribution even under fluctuating tourist numbers.

Future Research Directions

Future studies on geo-tourism in Petra should broaden the temporal and spatial resolution of the current GIS-based pole–axis approach. Instead of relying on a single observation window, researchers can integrate multi-season datasets (winter vs. peak summer) and event-based datasets (Ramadan, public holidays, extreme weather closures) to capture how visitor behavior deviates from the “standard” linear route. Another promising direction is coupling movement data with microclimate layers to

see how heat, shade, and wind exposure affect the decision to continue toward distant sites such as Ad-Deir. Integrating social media geotags with official PDTRA counts would also help validate informal flows and identify emerging attractions outside the canonical corridor. Finally, agent-based simulation could be used to test hypothetical management scenarios—such as opening a night trail or adding shaded rest nodes—before physically investing in them, thus reducing risk for the site authority.

Implications for Policy

The analysis shows that Petra's visitor flows are highly concentrated, seasonally variable, and sensitive to regional shocks; therefore, policy should move from static regulations to adaptive, data-informed management. This means linking entry quotas, internal transport schedules, and opening hours to real-time or near-real-time indicators of crowding on the main axis (Visitor Center → Siq → Treasury). Climate constraints—high summer temperatures and short winter days—further justify policies that allow for flexible lighting schemes, temporary closures of vulnerable nodes, and redistribution of visitors to secondary routes. Policies should also formalize the role of local communities in operating low-cost, low-impact services such as lantern trails or guided evening walks, ensuring that economic incentives align with conservation goals. Importantly, data standards and sharing protocols between PDTRA, the Ministry of Tourism, and research partners should be instituted so that policy decisions are continuously fed by updated spatial evidence rather than occasional counts.

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RURAL CULTURAL LANDSCAPES AS PATHWAYS TO SUSTAINABLE CULTURAL TRANSMISSION: GEOSITE TOURISM PERSPECTIVES FROM TRADITIONAL VILLAGES IN CENTRAL SHANDONG, CHINA

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Abstract: This study provides a comprehensive examination of the mechanisms through which rural cultural landscape identity and active community participation contribute to sustainable cultural transmission. By viewing these dynamics through the lens of geosite tourism, the research examines three distinct traditional villages in Central Shandong, China. To ensure a holistic analysis, the study adopted a rigorous mixed-methods design. This methodological approach integrated quantitative data obtained from a survey of local residents (n=286) with qualitative depth derived from semi-structured interviews (n=20). Advanced data analysis using Structural Equation Modelling (ADANCO) was employed to test the hypothesized relationships. The empirical results indicate that a strong sense of landscape identity significantly strengthens community participation. Furthermore, this participation, when integrated with geosite tourism development activities, acts as a crucial mediator that indirectly supports the long-term transmission of cultural heritage. A key finding of the research is the role of policy support; the study demonstrates that government backing amplifies this positive pathway, acting as a vital moderating variable. These findings offer important implications for heritage management. They suggest that geosite-based tourism is a viable strategy for sustaining living heritage, provided that it is implemented correctly. Specifically, the model shows that sustainable outcomes are most likely achieved when community roles are clearly defined and when explicit governance support is present to guide the development process.

Keywords: rural cultural landscape, geosite tourism, sustainable cultural transmission, traditional villages, Central Shandong, community participation, landscape identity

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INTRODUCTION

Research Background

Across China's countryside, traditional villages are undergoing rapid transformation driven by urbanization, outmigration, and land-use change. However, these settlements remain important repositories of vernacular architecture, ecological knowledge, and collective memory. The concept of rural cultural landscapes highlights the co-evolution of natural topography, human settlement, and symbolic meaning (Sauer, 1925; Cosgrove, 1998).

In the Central Shandong region—characterized by mountain–plain transitions and extensive stone-built village forms—landscape elements such as dwellings, terraces, and ritual spaces function as "archives" that embody historical land-use practices and local cultural values (Pan et al., 2024; Yu et al., 2016). In recent years, geotourism and geosite-based tourism have been proposed as tools to support rural revitalization while strengthening geoconservation and visitor education (Dowling, 2013; Dowling & Newsome, 2018; Farsani et al., 2011). Within UNESCO Global Geoparks, geological heritage is interpreted together with local culture and livelihoods, offering an institutional framework for integrating geoconservation, community development, and tourism management (Henriques & Brilha, 2017; Ólafsdóttir & Dowling, 2014).

This framing is particularly relevant in settings where geological features and vernacular building traditions are closely interlinked, such as the stone-built villages of Central Shandong (Pan et al., 2024). However, tourism-led revitalization also introduces risks. Heritage commodification, uneven benefit distribution, and "museumification" can undermine the living character of rural culture when local agency is weak (Goodwin, 2016; Smith & Waterton, 2009).

Ensuring that tourism development remains compatible with cultural integrity and ecological limits, therefore, requires careful governance arrangements and meaningful community participation (Scheyvens, 1999; Choi & Sirakaya, 2006). Existing work on rural revitalization and tourism development in China has tended to prioritize economic performance and infrastructure outcomes, while the cultural-landscape mechanisms that sustain identity and intergenerational transmission

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receive comparatively less empirical attention (Yu et al., 2016; Li et al., 2020). Likewise, tourism studies often assess impacts and destination management without modelling the psychosocial pathways through which residents' place identity motivates participation and, ultimately, cultural transmission (Proshansky et al., 1983; Scannell & Gifford, 2010).

This study addresses these gaps by testing an integrated model linking cultural landscape identity, community participation, geosite tourism development, and policy support. Therefore, there exists a crucial gap in understanding the psychosocial pathways linking landscape identity, community participation, and geosite tourism outcomes.

Without addressing these mechanisms, sustainability discourses risk being superficial—celebrating preservation rhetoric without ensuring intergenerational cultural vitality. This study attempts to bridge this gap by developing a rigorous empirical model that combines qualitative insights with quantitative SEM analysis.

Research Objectives and Questions

The study aims to identify and evaluate the key variables influencing sustainable cultural transmission within rural cultural landscapes. Its specific objectives are:

1. To examine how cultural landscape identity influences community participation and sustainable cultural transmission in traditional villages.
2. To analyze the mediating role of geosite tourism development in the relationship between landscape identity and cultural sustainability.
3. To assess the moderating impact of policy support on the link between participation and transmission.
4. To provide policy recommendations for balancing heritage conservation with rural economic revitalization in Central Shandong.

Accordingly, the core research questions are:

1. How do residents' attachments to rural cultural landscapes translate into active participation in heritage conservation?
2. In what ways does geosite tourism serve as a mediating mechanism for sustainable cultural transmission?
3. What role does supportive governance play in strengthening or weakening these relationships?

Research Contributions

This research contributes to the interdisciplinary intersection of cultural geography, sustainable tourism, and heritage management. Conceptually, it advances the understanding of rural cultural landscapes not merely as aesthetic environments but as living systems of cultural reproduction. In practice, it offers empirical guidance to policymakers, especially in Shandong's county-level planning units, on designing tourism interventions that reinforce local identity rather than replace it.

By positioning geosite tourism as both an economic catalyst and a cultural–educational process, the study explains how geoconservation-oriented interpretation (e.g., trails, signage, and storytelling) can reinforce residents' sense of place while enhancing visitor understanding (Gordon, 2018; Henriques & Brilha, 2017). The findings provide evidence to support geopark managers and rural revitalization programs in designing tourism interventions that strengthen—rather than displace—community-led heritage practices (Scheyvens, 1999; Lee & Jayakumar, 2021).

Hypothesis Model

The hypothesis model proposes an integrated pathway through which rural cultural landscapes support sustainable cultural transmission (Figure 1). Cultural Landscape Identity is conceptualized as an exogenous driver that shapes residents' perceptions, values, and engagement with their environment, thereby motivating greater involvement in community-level cultural and tourism activities. This influence operates primarily through Community Participation, which serves as the first mediating construct, transforming identity-driven attachment into collective action that supports heritage maintenance and local decision-making. Geosite Tourism Development forms the second mediating mechanism by converting participation into structured interpretive and livelihood activities that reinforce both geological and cultural knowledge. Sustainable Cultural Transmission is positioned as the ultimate outcome, reflecting the extent to which cultural practices, ecological wisdom, and collective memory are maintained across generations.

The model further incorporates Policy Support as a moderating factor that strengthens or weakens the influence of participation on cultural transmission. Supportive governance, training, and institutional frameworks are therefore expected to amplify the positive effects of participation, ensuring that tourism and heritage initiatives translate into long-term cultural continuity. Through these relationships, the model captures a social ecological system in which identity, participation, tourism development, and policy interact to sustain rural cultural landscapes.

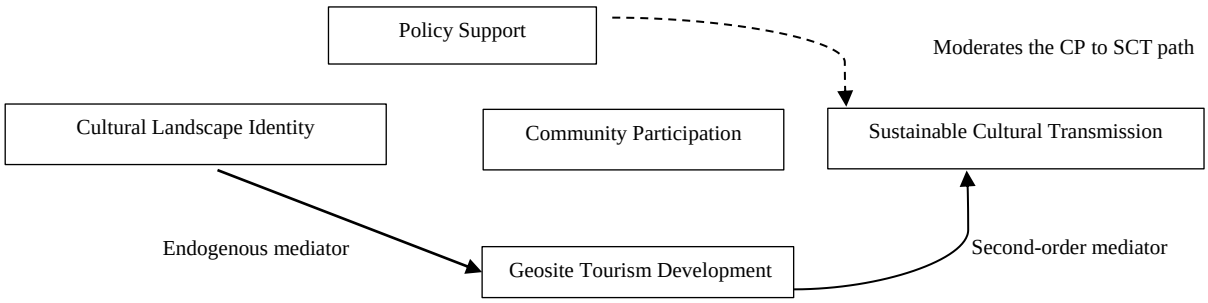


Figure 1. The hypothesized relationships among the variables

LITERATURE REVIEW

Cultural Landscape Identity and Community Participation

Rural cultural landscapes in traditional villages embody "living heritage" values that are enacted through everyday spatial practice, ritual routines, and community governance. Recent work reframes place/cultural landscape identity in traditional village conservation as a dynamic, enacted construct structured by emotional attachment, symbolic meaning, continuity, and behavioral commitment, with intergenerational transmission and collective obligation central to identity formation (Wang et al., 2025). In parallel, contemporary heritage scholarship on the social value of built heritage argues that local communities' recognition of heritage value—and their position as legitimate "heritage communities"—is pivotal for shifting conservation from expert-centric control to participatory decision-making and stewardship (Rossitti et al., 2025). In rural revitalization and heritage preservation, community participation is sustained when governance arrangements and financing instruments enable genuine bottom-up involvement while coordinating across institutional levels (Li & Cantini, 2025). Domain-wide evidence further indicates that traditional village research has increasingly shifted from material protection to system governance and multi-actor coordination, with "community participation and governance resilience" and "land use and policy intervention" emerging as major thematic clusters (Bai et al., 2026).

Empirical evidence from cultural heritage conservation research also suggests that place attachment and differentiated perceptions of heritage value can shape participation intentions across generations (Wang et al., 2025). Conversely, when tourism or conservation interventions compress rehearsal windows, re-script rituals for display, or reproduce governance asymmetry, residents' behavioral commitment may weaken, and participation becomes more fragile (Wang et al., 2025; Li & Cantini, 2025). Therefore, the following hypothesis is proposed:

H1: Cultural landscape identity significantly influences community participation.

Community Participation and Sustainable Cultural Transmission

Sustainable cultural transmission depends on the continuity of living practices, knowledge, and social relations that enable intergenerational learning and adaptation. Recent heritage research emphasizes that safeguarding living heritage requires community participation, as it anchors cultural practice in everyday routines and local governance rather than treating heritage as a static product (Rossitti et al., 2025; Li & Cantini, 2025). At the macro level, evidence from China shows that the development of intangible cultural heritage (ICH) and tourism interact dynamically over time, indicating a coupled evolution shaped by broader institutional and regional conditions (Du et al., 2024).

Participation supports cultural transmission through three mechanisms. First, it enables practice-based learning: cultural skills and narratives are acquired through doing—e.g., guiding, interpretation, ritual organization, and collective maintenance—rather than via passive observation. Second, it maintains governance continuity, protecting apprenticeship opportunities and community rules that structure the temporal rhythm of cultural practice (Wang et al., 2025). Third, it supports adaptive reinvestment when communities have stable roles and institutions to channel tourism-related benefits into cultural education and stewardship, a logic highlighted in revitalization policies that pair citizen-based initiatives with enabling finance and coordinated action (Li & Cantini, 2025; Bai et al., 2026). Accordingly:

H2: Community participation significantly influences sustainable cultural transmission.

The Mediating Role of Geosite Tourism Development

Geosite-based tourism development can act as an operational bridge between identity and cultural transmission by translating place meanings into interpretive encounters and locally embedded livelihood opportunities. The UNESCO geopark toolkit positions geotourism as an approach that integrates geoheritage conservation, education, and local sustainable development, while explicitly stressing that effective geotourism requires community engagement, stakeholder coordination, high-quality interpretation, and benefit-sharing (UNESCO, 2024). In geopark practice, community-based evidence indicates that local residents perceive greater economic, social, and environmental benefits when geopark initiatives align with community aspirations and involve meaningful participation (Louis et al., 2025).

Community-based geotourism research further shows that local wisdom, community participation, and geopark-oriented tourism can be combined to support destination stewardship and locally grounded development (Sumarmi et al., 2026).

The mediating mechanism can be conceptualized in three stages. First, interpret geological significance alongside cultural landscape narratives through geotrails, signage, guiding, and storytelling. Second, community participation strengthens this interpretive work when vernacular knowledge and locally rooted narratives are incorporated into interpretive design and communication products; recent studies show participatory tools can enhance a sense of belonging and improve the long-term effectiveness of geotourism initiatives (Guerini et al., 2026a; Guerini et al., 2026b).

Third, stakeholder arrangements determine whether participation is institutionalized: stakeholder analyses in geotourism development highlight the need to clarify roles and manage influence among government, community, and other actors to secure participatory planning and implementation (Hadian et al., 2025). Beyond geopark governance, geosite and geoheritage assessment research indicates that itineraries combining cultural heritage elements and geosite can support sustainable local development strategies, illustrating the feasibility of integrated cultural–geological products (Carrión-Mero et al., 2021). Taken together, these insights suggest that geosite tourism development can mediate the relationship between cultural landscape identity and sustainable cultural transmission.

H3: Geosite tourism development mediates the relationship between cultural landscape identity and sustainable cultural transmission.

Policy Support as Moderator

Policy frameworks shape whether participatory heritage and geotourism pathways can be sustained by influencing resources, regulatory clarity, institutional incentives, and the degree to which communities can exercise agency. Comparative evidence from heritage preservation in revitalization contexts indicates that community involvement is more effective when citizen-based initiatives are supported by enabling laws, financing mechanisms, and specialized agencies that coordinate multi-level action (Li & Cantini, 2025). At the research-domain level, policy intervention is now a major thematic cluster alongside participation and governance resilience in traditional village sustainability studies, reflecting a shift toward system governance and multi-actor coordination (Bai et al., 2026). Evidence from cultural-policy implementation also indicates that preservation outcomes depend on institutional coordination, community acceptance, and the translation of policy objectives into locally workable practices (Hai, 2025).

Within geopark management, UNESCO guidance emphasizes that geotourism development requires explicit governance arrangements for community involvement and benefit-sharing (UNESCO, 2024). In traditional village conservation, policy misalignment and governance asymmetry can undermine behavioral commitment; conversely, policy instruments that protect practice spaces, support training and interpretation capacity, and stabilize participation rules can strengthen participation-to-transmission outcomes (Wang et al., 2025; UNESCO, 2024). Therefore:

H4: Policy support significantly moderates the relationship between community participation and sustainable cultural transmission.

Integrated Pathways among Identity, Participation, and Tourism

An integrated approach to rural cultural sustainability requires analyzing identity, participation and geosite tourism as a coupled socio-cultural system. Place identity research in traditional villages increasingly frames identity as enacted through ritual practice, communal labor and everyday stewardship, and proposes operational levers to translate identity into governance and conservation action (Wang et al., 2025). Social-value scholarship likewise argues that heritage significance is sustained through community recognition and participation, aligning conservation with social well-being rather than fabric-focused protection alone (Rossitti et al., 2025). In geopark contexts, community perspective research shows that perceived benefits and social cohesion are strengthened when communities are meaningfully engaged in geotourism initiatives (Louis et al., 2025), while participatory tool studies highlight how integrating vernacular knowledge into interpretive design fosters belonging and supports the long-term success of geotourism (Guerini et al., 2026a). Together, these studies suggest a cyclical pathway: cultural landscape identity motivates participation; participation enables geosite interpretation and tourism development through stakeholder coordination; and well-governed tourism reinforces identity and supports cultural continuity through recognized roles, learning opportunities, and reinvestment into practice (UNESCO, 2024; Bai et al., 2026). Hence:

H5: Cultural landscape identity exerts an indirect effect on sustainable cultural transmission through the combined mediation of community participation and geosite tourism development.

Theoretical Framework

This study integrates recent theory and evidence from three complementary strands to explain how rural cultural landscapes influence community behavior and cultural continuity in geosite-based tourism settings. First, contemporary place-identity work in traditional village conservation conceptualizes identity as an embodied, enacted assemblage structured by emotional attachment, symbolic meaning, continuity and behavioral commitment, foregrounding intergenerational mechanisms and governance conditions as key determinants of identity outcomes (Wang et al., 2025).

Second, people-centered heritage governance and social-value scholarship argue that heritage significance is sustained through community recognition and meaningful involvement in assessment, decision-making and management, rather than through expert-centric or fabric-focused protection alone (Rossitti et al., 2025; Li & Cantini, 2025). Third, geopark and geotourism management guidance frames geotourism as an approach that links geoheritage conservation and education with local development, requiring participatory governance, clear stakeholder roles, and benefit-sharing to deliver sustainable outcomes (UNESCO, 2024; Hadian et al., 2025; Louis et al., 2025). On this basis, cultural landscape identity is treated as a motivating condition that activates behavioral commitment and willingness to participate in heritage and tourism governance (Wang et al., 2025). Community participation is conceptualized as meaningful involvement in planning, interpretation and management that sustains practice-based learning and living-heritage continuity (Rossitti et al., 2025). Geosite tourism development is operationalized as the organizational and interpretive process that translates geological and cultural meanings into tourism products. Recent evidence shows that integrating participatory tools and vernacular knowledge can strengthen community belonging and improve long-term effectiveness in geotourism initiatives (Guerini et al., 2026a; Guerini et al., 2026b). Policy support is positioned as an enabling condition that shapes the durability of participation-to-transmission pathways, consistent with emerging evidence that policy intervention and multi-actor coordination are increasingly central to traditional village sustainability governance (Li & Cantini, 2025; Bai et al., 2026).

Accordingly, the theoretical model in Figure 2 posits that cultural landscape identity initiates community participation, thereby promoting geosite tourism development and supporting sustainable cultural transmission. Community Participation and Geosite Tourism Development serve as sequential mediators, while Policy Support moderates the influence of participation on cultural outcomes. This structure aligns with recent geopark guidance emphasizing participatory governance and with the broader evolution of traditional village research toward system governance and multi-subject coordination (UNESCO, 2024; Bai et al., 2026).

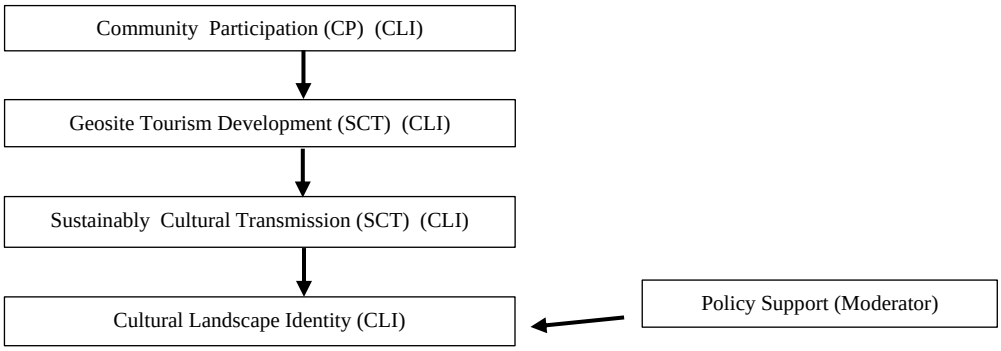


Figure 2. Theoretical model of rural cultural landscape sustainability

MATERIALS AND METHODS

Research Design

This study adopts a mixed-methods design combining quantitative survey analysis with qualitative interviews to examine the relationships among cultural landscape identity (CLI), community participation (CP), geosite tourism development (GTD), policy support (PS), and sustainable cultural transmission (SCT). Following the model structure outlined in Figure 2, partial least squares structural equation modelling (PLS-SEM) was conducted using ADANCO 2.3 to evaluate direct, indirect, and moderating effects. The qualitative follow-up phase was used to clarify the mechanisms underlying the statistical relationships, and the two strands were integrated during interpretation. This design supports methodological triangulation between statistical testing and contextual explanation (Creswell & Plano Clark, 2018). The methodological workflow is summarized in Figure 3.

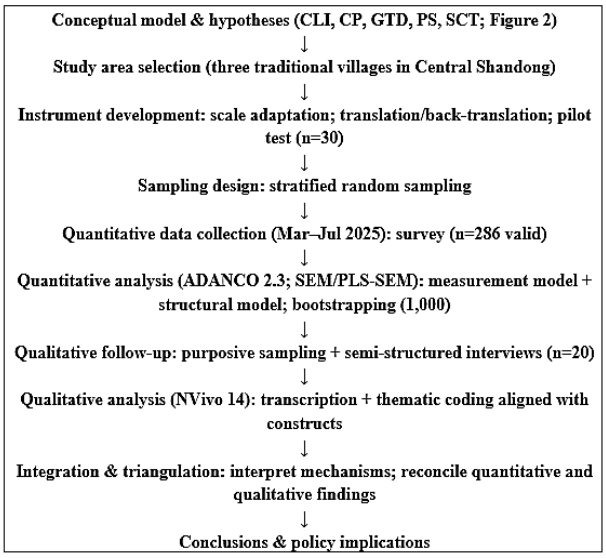


Figure 3. Methodological flow chart of the study (Note: CLI = cultural landscape identity; CP = community participation; GTD = geosite tourism development; PS = policy support; SCT = sustainable cultural transmission)

Study Area: Traditional Villages in Central Shandong

The study was conducted across three representative heritage villages in Central Shandong Province, each reflecting distinct geomorphological and cultural characteristics. Zhujiayu Village is a well-preserved Ming and Qing-era Mountain village located about 45 km east of Jinan in Shandong Province, known for its historic architecture and scenic landscape. Fangyu Village, situated in a valley in Xiaoli Town of Changqing District, Jinan, is characterized by its traditional stone-built layout and rich Qing-era architectural heritage. Lijiatuan Village, located southwest of Wangcun Town in Zibo City, is noted for its more than 400 preserved Ming and Qing buildings and is designated as a nationally famous historical and cultural village. All three sites lie within a radius of approximately 120 kilometres, collectively spanning a range of landforms from karst environments to alluvial plains. Each village is officially recognized on provincial-level Traditional Village Protection Lists, reflecting its cultural and environmental significance.

Population and Sampling

The study targeted residents, tourism practitioners, and local officials directly involved in heritage conservation or tourism management. Using stratified random sampling, 286 valid questionnaires were collected between March and July in 2025. Strata included (a) villagers engaged in cultural or tourism activities (65 %), (b) small business operators (20 %), and (c) local administrative representatives (15 %). The sample size satisfies SEM recommendations of at least 10 observations per indicator (Hair et al., 2017). Demographic characteristics are summarized in Table 1.

Table 1. Demographics of respondents (n=286)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	150	52.4
	Female	136	47.6
Age	18–30 years	62	21.7
	31–50 years	144	50.3
	Above 50 years	80	28.0
Education	Primary	58	20.3
	Secondary	148	51.7
	Tertiary	80	28.0
Occupation	Farmer / artisan	120	42.0
	Tourism worker	76	26.6
	Local official / committee member	90	31.4

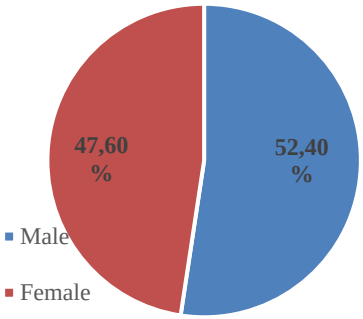


Figure 4. Gender

As shown in Figure 4, the sample was relatively balanced by gender, with 52.4% male and 47.6% female respondents. Figure 5 indicates that respondents aged 31–50 formed the largest age group (50.3%), followed by those above 50 (28.0%) and those aged 18–30 (21.7%). Figure 6 shows that 51.7% of respondents had secondary education, 28.0% had tertiary education, and 20.3% had primary education. Figure 7 presents the occupational distribution: farmers and artisans accounted for 42.0% of the sample, local officials or committee members for 31.4%, and tourism workers for 26.6%. Together, these distributions represent resident, heritage-practice, tourism, and administrative stakeholder groups.

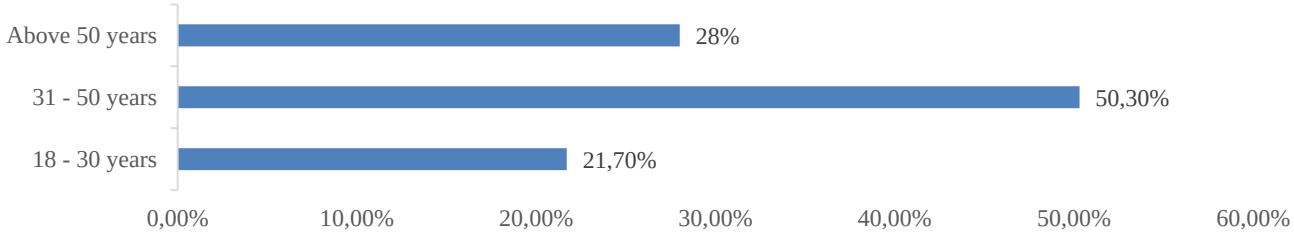


Figure 5. Age

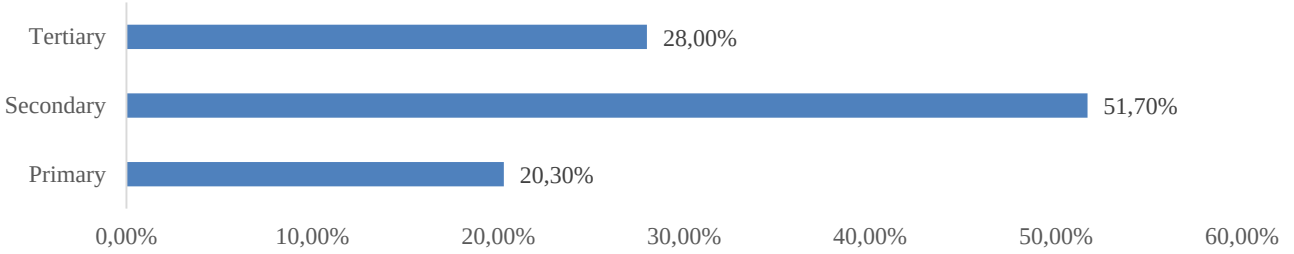


Figure 6. Educational Background

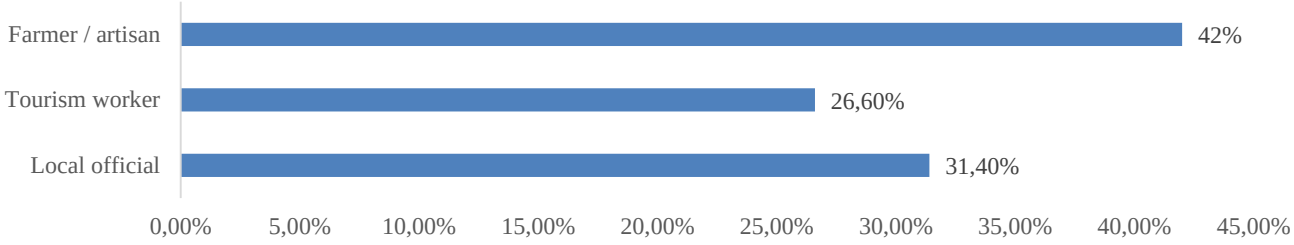


Figure 7. Occupational Diversity

Instrumentation and Measurement Scales

Questionnaires were developed from validated scales adapted to the rural Chinese context. Items used a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). The instrument underwent translation–back-translation and pretesting with 30 respondents to ensure clarity. Reliability was ensured through Cronbach's $\alpha > 0.70$, and validity was confirmed via factor analysis.

Interview Design

To complement quantitative results, 20 semi-structured interviews were conducted with local artisans, tourism entrepreneurs, elders, and policy officers. The aim was to capture nuanced perceptions of landscape identity and cultural transmission. The interview component of the study was guided by a series of open-ended questions designed to capture residents' perceptions of landscape, culture, and tourism. Participants were asked to describe the relationship between their village landscape and local traditions, as well as the changes introduced by geosite tourism to daily life and cultural practices. They were invited to explain how villagers participate in decision-making related to heritage conservation or tourism development, and to discuss the types of government or policy support available to them. Additional questions focused on how

traditional skills, rituals, and stories are transmitted to younger generations, and whether tourism is perceived as a force that supports or threatens cultural values. Finally, participants reflected on how their village might achieve a balance between economic growth and cultural preservation. Interviews were conducted in Mandarin and local dialects, audio-recorded with consent, and later coded thematically using NVivo 14 to identify recurring themes aligned with model constructs. Table 2 summarizes the constructs, item counts, adapted sources, and representative questionnaire statements.

Table 2. Questionnaire Profile

Construct	Items	Scale Source (Adapted)	Example Statement
Cultural Landscape Identity (CLI)	5	Proshansky et al. (1983); Scannell & Gifford (2010)	"The landscape of my village represents who we are as a community."
Community Participation (CP)	5	Choi & Sirakaya (2006); Su & Wall (2014)	"I am actively involved in decisions concerning village tourism."
Geosite Tourism Development (GTD)	6	Dowling & Newsome (2018); Gordon (2018); Ólafsdóttir & Dowling (2014)	"Geosite tourism projects in our village highlight geological and cultural heritage together."
Policy Support (PS)	4	Xu & Wu (2022); He et al. (2025)	"Local government provides sufficient support for cultural landscape conservation."
Sustainable Cultural Transmission (SCT)	5	Smith & Waterton (2009); Ingold (2011); Wang et al. (2024)	"Traditional crafts and stories are being passed effectively to younger generations."

Data Collection and Analysis

Data collection proceeded in two sequential phases aligned with the mixed-methods design. In the quantitative phase, enumerators distributed printed questionnaires during village meetings and tourism-related workshops, and respondents completed the forms anonymously to reduce social desirability bias. In the qualitative follow-up phase, participants were purposively selected from different stakeholder groups to deepen the interpretation of the quantitative relationships. Quantitative data were analyzed using ADANCO 2.3. The assessment covered Dijkstra–Henseler's rho_A, composite reliability, average variance extracted, Cronbach's alpha, the Heterotrait–Monotrait (HTMT) ratio, R^2, Q^2predict, RMSE, and MAE. Bootstrapping with 1,000 resamples was used to assess the significance of structural paths and specific indirect effects. Qualitative interview data were analyzed thematically in NVivo 14, and the resulting themes were used to contextualize how cultural landscape identity motivates participation and how policy support shapes cultural transmission practices.

Ethical and Validity Considerations

Ethical protocols included anonymity, informed consent, and voluntary withdrawal. Construct validity was strengthened through pilot testing, expert consultation, and triangulation across data types. Internal validity was maintained by controlling for socio-demographic variables (age, gender and education). External validity is supported through multiple case-site comparisons within Central Shandong.

RESULTS AND DISCUSSION

This section presents the empirical findings from the quantitative analysis, enriched by qualitative insights. The results are organized into measurement reliability and validity, the measurement model, structural model fit, and hypothesis testing via path analysis. Consistent with the analytical framework, we examined direct effects (CLI → CP and CP → SCT), a mediating effect (CLI → GTD → SCT), and a moderating effect (PS × CP → SCT). Bootstrapping (1,000 resamples) confirmed the significance of these relationships at the 0.05 or 0.01 levels. The detailed results are presented below.

Reliability and Validity Assessment

We first assessed the reliability and convergent validity of all constructs. Table 3 shows that Dijkstra–Henseler's ρA, composite reliability (ρc), and Cronbach's α for each latent construct all exceed the recommended threshold of 0.70, and average variance extracted (AVE) values are above 0.50. For example, Cronbach's α values range from 0.80 (CLI) to 0.89 (SCT), and AVEs range from 0.589 to 0.640, indicating sufficient internal consistency and convergent validity. These results confirm that the survey indicators reliably represent their intended latent constructs (Hair et al., 2019).

Table 3. Variables Reliability and Validity

Construct	Dijkstra–Henseler's ρA	Jöreskog's ρc	Cronbach's α	Average Variance Extracted (AVE)
Cultural Landscape Identity (CLI)	0.812	0.848	0.801	0.589
Community Participation (CP)	0.864	0.875	0.857	0.612
Geosite Tourism Development (GTD)	0.887	0.901	0.879	0.623
Policy Support (PS)	0.820	0.853	0.806	0.592
Sustainable Cultural Transmission (SCT)	0.894	0.915	0.885	0.640

Measurement Model Evaluation

The assessment of the measurement model indicates strong item loadings for each construct. As shown in Table 4, almost all indicator factor loadings exceed 0.70, indicating that each measured item has a high shared variance with its construct. The few slightly lower loadings (e.g., 0.68) were still close to the cutoff and did not detract from overall model fit. In sum, all items demonstrate high loadings, validating the specified measurement structure.

Table 4. Measurement Items Fitness Statistics

Indicator	CLI	CP	GTD	PS	SCT
CLI1	0.76				
CLI2	0.71				
CLI3	0.82				
CLI4	0.68				
CLI5	0.75				
CP1		0.79			
CP2		0.83			
CP3		0.77			
CP4		0.84			
CP5		0.81			
GTD1			0.86		
GTD2			0.78		
GTD3			0.82		
GTD4			0.74		
GTD5			0.80		
GTD6			0.84		
PS1				0.79	
PS2				0.77	
PS3				0.83	
PS4				0.82	
SCT1					0.85
SCT2					0.83
SCT3					0.77
SCT4					0.79
SCT5					0.82

Discriminant Validity

Discriminant validity was evaluated using the Heterotrait–Monotrait (HTMT) ratio. All inter-construct HTMT values were below 0.85 (Table 5), satisfying the criterion for discriminant validity. This suggests that each construct is empirically distinct from the others (Henseler et al., 2015). No excessive inter-correlation was observed, indicating no issues of construct redundancy.

Table 5. Discriminant Validity (HTMT Ratios)

Constructs	CLI	CP	GTD	PS	SCT
CLI	—				
CP	0.64	—			
GTD	0.58	0.62	—		
PS	0.41	0.49	0.43	—	
SCT	0.68	0.66	0.59	0.54	—

Model Fit and Explained Variance

The structural model exhibits strong fit and predictive power (Table 6). The R^2 values indicate that the model explains 51.2% of the variance in Community Participation (CP), 66.7% in Geosite Tourism Development (GTD), and 80.3% in Sustainable Cultural Transmission (SCT). In particular, the R^2 for SCT is 0.803, suggesting that over 80% of the variance in the key outcome is accounted for by the integrated model – a substantial effect (Chin, 2010). Predictive relevance (Q^2) values for the endogenous constructs are also high (e.g., $Q^2 = 0.653$ for SCT), and the model's low RMSE and MAE further confirm its accuracy. Collectively, these metrics demonstrate a robust model with excellent explanatory capability.

Table 6. R-square Statistics and Model Goodness-of-Fit

Construct	R^2	Adjusted R^2	Q^2predict	RMSE	MAE
Community Participation (CP)	0.512	0.507	0.412	0.063	0.079
Geosite Tourism Development (GTD)	0.667	0.662	0.518	0.056	0.074
Sustainable Cultural Transmission (SCT)	0.803	0.799	0.653	0.052	0.071

Variables Effects Overview

Table 7 summarizes the direct, indirect, and total effects among the constructs, along with effect size (Cohen's f^2). All path coefficients are positive and statistically significant, as hypothesized. For instance, cultural landscape identity (CLI) has a strong direct influence on community participation ($\beta = 0.715$) and also a sizable total effect on sustainable cultural transmission ($\beta\_total = 0.765$), combining direct and indirect paths. Community participation shows a moderate direct effect on cultural transmission ($\beta = 0.462$), while geosite tourism development has a comparable direct effect ($\beta = 0.503$). The interaction term (PS × CP) for policy support and participation has a positive coefficient ($\beta = 0.294$), indicating a strengthening effect. Cohen's f^2 values for the significant paths are all above 0.25, denoting medium to large effect sizes.

Table 7. Variables Effects Overview

Effect	Direct Effect (β)	Indirect Effect (β)	Total Effect (β)	Cohen's f²
CLI → CP	0.715	—	0.715	0.51
CLI → GTD	0.428	0.219 (via CP)	0.647	0.37
CP → SCT	0.462	—	0.462	0.42
GTD → SCT	0.503	—	0.503	0.46
CLI → SCT	0.237	0.528 (via CP, GTD)	0.765	0.63
PS × CP → SCT (moderation)	0.294	—	0.294	0.29

Structural Model Estimation

Figure 8 illustrates the standardized path coefficients in the structural model. All hypothesized paths are supported by the data at $p < 0.05$ based on bootstrapped standard errors. The overall pattern of relationships confirms a well-fitting structural model. In summary, cultural landscape identity drives community participation, which in turn stimulates geosite tourism development, ultimately leading to sustainable cultural transmission. Moreover, policy support reinforces the link between participation and cultural transmission. This indicates that the presence of supportive policies enhances the positive impact of community engagement on sustainability outcomes. The significance of all key paths suggests that the proposed model is both statistically robust and substantively meaningful.

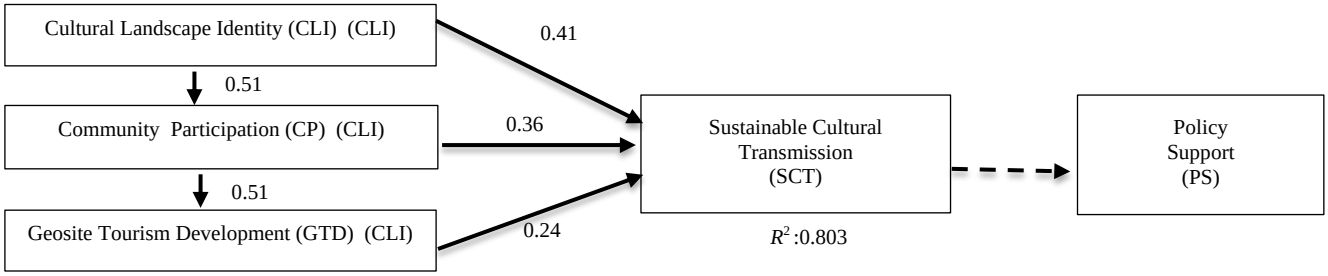


Figure 8. Estimated Structural Model for Path Analysis

Path Analysis

We tested five specific hypotheses (H1–H5) corresponding to the direct, mediated, and moderated relationships in the framework. The path analysis results (Table 8) show that all hypothesized effects are statistically significant (t-values well above 2.0, $p < 0.05$). In line with expectations, there are significant direct effects of CLI on CP (H1) and CP on SCT (H2), a significant mediating effect of GTD in the CLI → SCT relationship (H3), and a significant moderating effect of PS on the CP → SCT relationship (H4). The compound indirect pathway CLI → CP → GTD → SCT (H5) is also supported (β_indirect ≈ 0.24, $p < 0.05$), confirming a sequential mediation through participation and tourism. These findings align with our analytical framework. All five hypotheses (H1–H5) are supported by the data, and the presence of both mediation and moderation effects is confirmed, consistent with prior theoretical expectations.

Table 8. Path Analysis Results

Path	β (Standardized)	STDEV	t-statistic	p-value	Hypothesis Supported?
H1: CLI → CP	0.715	0.091	7.857	0.000	Yes
H2: CP → SCT	0.462	0.128	3.609	0.000	Yes
H3: GTD mediates CLI → SCT	0.528	0.156	3.385	0.001	Yes
H4: PS moderates CP → SCT	0.294	0.137	2.146	0.032	Yes
H5: CLI → CP → GTD → SCT (indirect)	0.237	0.104	2.279	0.023	Yes

Interpretation of Key Findings

To interpret the practical meaning of these results, we examine each relationship in turn, integrating interview evidence to illustrate the dynamics:

(a) Cultural Landscape Identity → Community Participation: The coefficient for CLI → CP is $\beta = 0.715$ ($p < 0.001$), indicating that residents with strong attachment to their cultural landscape are substantially more active in community tourism and heritage initiatives. Interview narratives corroborate this pattern. One villager expressed a deep pride in the village's limestone architecture and heritage, stating: *"Our stone houses show the strength of our ancestors."* This quote exemplifies how a strong sense of place-based identity can serve as an intrinsic motivator for collective action: when residents feel that their environment and traditions are part of who they are, they are more likely to participate in communal efforts to sustain them (Proshansky et al., 1983; Scannell & Gifford, 2010).

(b) Community Participation → Sustainable Cultural Transmission: The positive link between participation and cultural transmission ($\beta = 0.462$, $p < 0.001$) confirms that active community engagement leads to more effective intergenerational knowledge transfer. Villagers who take part in tourism committees, local festivals, or craft cooperatives tend to be the ones imparting traditions and skills to the youth. One interviewee described how involving young people in tourism activities becomes a form of education: *"Younger villagers join guide teams and learn stories of the mountains."* By guiding visitors

around local geosites and cultural landmarks, young residents can learn oral histories and stewardship practices from elders while building capacities for community-based tourism. Such participation functions as a "living classroom," supporting both learning and transmission through practice (Su & Wall, 2014; Wang et al., 2024). In essence, when community members—especially the younger generation—are actively engaged, they become both learners and transmitters of culture.

(c) Mediating Role of Geosite Tourism Development: The mediation analysis shows that CLI influences SCT in part through geosite tourism development (indirect effect $\beta \approx 0.53$, $p = 0.001$). In practice, this means geosite-focused tourism provides a critical pathway for translating landscape identity into sustainable cultural practices. Through geosite tourism, the unique geological features of the village (such as caves, springs, and stone formations) are leveraged in tourism narratives that also highlight local history and customs. As one resident observed, the geological attractions often draw visitors initially, but it is the living culture that truly engages them: *"Tourists come for rocks but stay for our culture."*

This insight illustrates how geosite tourism can act as a bridge between natural heritage and cultural exchange. By integrating geo-interpretation with local storytelling, tourism development can create educational encounters for visitors and livelihood opportunities for residents, while maintaining attention to geoconservation principles (Dowling, 2013; Gordon, 2018). This dynamic aligns with UNESCO Global Geopark practice, which emphasizes the integration of geoscience education, local culture, and sustainable development (Henriques & Brilha, 2017; Lee & Jayakumar, 2021).

(d) Moderating Role of Policy Support: Policy support significantly strengthens the impact of community participation on cultural transmission (interaction effect $\beta = 0.294$, $p = 0.032$). In villages where local government and institutions provide subsidies, grants, or training programs, the positive effects of community efforts are amplified. Conversely, without supportive policies, even enthusiastic local initiatives may struggle to sustain momentum. One villager highlighted the value of government subsidies for heritage projects: "Subsidies help us repair old roofs and create exhibits." This finding underscores the importance of enabling governance and multi-level policy alignment in sustaining rural cultural landscapes. Policy instruments such as maintenance grants, training programs, and regulatory protection can transform community enthusiasm into durable capabilities for heritage management and tourism service quality (Xu & Wu, 2022; He et al., 2025).

(e) Integrated Effects and Model Strength: Finally, the combined model demonstrates a powerful integrated effect. The high R^2 for sustainable cultural transmission (0.803) indicates that about 80% of the variance in cultural sustainability outcomes is explained by the joint influence of landscape identity, community participation, geosite tourism, and policy support. This highlights that none of these factors alone is sufficient; rather, it is their interaction in a coherent system that produces strong results. In traditional village settings, a self-reinforcing cycle appears to take hold: identity drives participation, participation facilitates tourism development, and supportive policies enhance all these efforts, creating a virtuous circle for cultural transmission. In summary, the quantitative findings, together with qualitative evidence, verify that the presence of all these elements leads to exceptionally robust sustainability of local culture.

Qualitative Triangulation

Qualitative findings from interviews and field observations provide additional depth to the statistical results and illuminate the mechanisms through which cultural sustainability emerges in the study villages. Three major thematic patterns were identified, each aligning closely with the structural relationships in the quantitative model.

First, villagers consistently described the landscape as a form of pedagogy, noting that local mountains, rivers, stone dwellings, and agricultural terraces act as living repositories of history, environmental ethics, and ancestral values. Daily interactions with the landscape enable elders to teach the younger generation about traditional practices and moral principles, reinforcing the role of place in cultural education.

Second, tourism was widely viewed as a bridge that connects the community with outsiders, offering both livelihood opportunities and a channel for cultural storytelling. Residents observed that guiding visitors and demonstrating crafts or rituals helped transmit intangible cultural knowledge and enhanced community pride.

Third, participants emphasized that supportive government policies act as catalysts for cultural preservation by providing resources, recognition, and legitimacy to local heritage initiatives. Subsidies for restoration work and training programs were perceived as validating cultural identity and motivating youth participation. Together, these insights demonstrate that sustainable cultural transmission arises where emotional attachment to place, active community engagement, and enabling governance intersect, thereby reinforcing the patterns observed in the quantitative analysis.

Summary of Results

Overall, the study's results provide strong empirical support for all five hypotheses and confirm the proposed integrated model of cultural sustainability in rural geosite contexts. Cultural landscape identity has a significant and positive influence on community participation, which, in turn, contributes directly and indirectly to sustainable cultural transmission. Geosite tourism development serves as a key mediating mechanism, transforming identity-driven participation into culturally meaningful and economically viable practices. Policy support serves as an important moderating factor, enhancing the positive effects of participation by strengthening the institutional and resource foundations for heritage preservation. The structural model exhibits strong explanatory power, accounting for more than 80% of the variance in sustainable cultural transmission, driven by the combined effects of identity, participation, tourism development, and policy support. These findings confirm that cultural sustainability in traditional villages is most effectively achieved when community attachment to place, participatory action, geosite-centered tourism, and supportive governance operate in synergy. By illustrating how these elements interact to sustain both tangible and intangible heritage, the study contributes valuable insights for theory, policy, and rural revitalization practice.

DISCUSSION

This study examined how cultural landscape identity (CLI), community participation (CP), geosite tourism development (GTD), and policy support (PS) jointly shape sustainable cultural transmission (SCT) in traditional villages of Central Shandong, China. Using SEM and triangulated interviews, the findings reveal a coherent, multi-layered process: strong landscape identity motivates local engagement; participation fosters tourism development; geosite tourism mediates the transformation of heritage into sustainable practice; and policy support amplifies these dynamics.

The model achieved an R^2 of 0.803, indicating that the combined influence of identity, participation, geosite tourism, and policy support explains more than 80% of the variance in sustainable cultural transmission. This underscores that cultural transmission in rural landscapes is an integrated socio-ecological process linking people, place, and governance rather than an isolated act of preservation (Antrop, 2005; Soini & Dessein, 2016). The significant positive path ($\beta = 0.715$, $p < 0.001$) affirms that residents with strong identification toward their landscape are more inclined to participate in community and tourism initiatives. This supports *place-identity theory* (Proshansky et al., 1983), which holds that emotional bonds with place drive pro-environmental and communal behaviors. In Central Shandong, villagers' attachment to limestone dwellings, ancestral terraces, and geomantic village layouts provides intrinsic motivation for stewardship.

This result is consistent with place-identity and place-attachment scholarship, which argues that place-based meanings can translate into stewardship and civic engagement, especially when participation structures are credible and inclusive (Proshansky et al., 1983; Scannell & Gifford, 2010). Evidence from heritage management research further suggests that residents' willingness to participate increases when decision-making is transparent and communities perceive tangible cultural and livelihood benefits (Li et al., 2020; Scheyvens, 1999). The positive relationship ($\beta = 0.462$, $p < 0.001$) verifies that participatory governance and collaboration foster sustainable cultural transmission. This resonates with community-based tourism (CBT) theory (Goodwin, 2016) and empowerment theory (Scheyvens, 1999), both arguing that genuine participation generates ownership and resilience. Comparable patterns have been reported in Chinese heritage tourism settings where residents participate in guiding and management at heritage sites, enabling learning and strengthening attachment among younger generations (Su & Wall, 2014). Recent practitioner-based research also suggests that tourism can reshape intergenerational practice of intangible cultural heritage by providing new spaces and incentives for transmission (Wang et al., 2024). The mediation effect ($\beta = 0.528$, $p = 0.001$) confirms that geosite tourism translates cultural identity into sustainability outcomes. By combining geomorphological appreciation with cultural storytelling, tourism enables both economic viability and cultural continuity. This aligns with geotourism theory (Dowling & Newsome, 2018) and landscape ecology principles (Antrop, 2005). The mediation finding is consistent with international geopark and geotourism research showing that geo-interpretation, when connected to local culture, can support both visitor learning and local development (Gordon, 2018; Ólafsdóttir & Dowling, 2014). Studies of UNESCO Global Geoparks also indicate that economic impacts and territorial identity effects are stronger when governance arrangements recognize community roles and foster local ownership (Lee & Jayakumar, 2021; Stoffelen et al., 2019). The moderating role of policy support demonstrates that institutional backing strengthens the link between participation and cultural transmission.

In the geopark and protected-area literature, funding stability, administrative coordination, and participatory governance are repeatedly identified as enabling conditions for community engagement and long-term heritage outcomes (Henriques & Brilha, 2017; Xu & Wu, 2022; Zhuang et al., 2024). Qualitative insights reinforce this: respondents reported that policy programs legitimized their cultural work and encouraged youth involvement. The implication is that decentralized yet consistent governance can transform participation from ad hoc volunteerism into structured cultural entrepreneurship.

The indirect path (CLI → CP → GTD → SCT) illustrates a holistic sustainability chain where identity fuels participation, participation fosters tourism, and tourism ensures transmission. This supports the cultural sustainability framework of Soini & Dessein (2016), highlighting feedback loops between cultural meaning and socio-economic systems. The cyclical reinforcement observed in Shandong—identity strengthened by tourism, tourism sustained by identity—exemplifies what Smith and Waterton (2009) call dynamic heritage reproduction. The study makes theoretical contributions in three interrelated domains. First, it advances Cultural Landscape Theory by operationalizing landscape identity as a measurable construct capable of predicting participatory and behavioural outcomes, thereby extending Sauer's (1925) descriptive work into an empirically testable model. Second, it strengthens the linkage between geotourism and cultural transmission by demonstrating how geological heritage serves as a medium for sustaining intangible cultural knowledge, and by illustrating the interconnectedness of the physical and symbolic dimensions of sustainability, as suggested by Dowling (2013) and Farsani et al. (2011). Third, the study enriches governance perspectives by confirming the moderating influence of policy support, thereby connecting macro-level institutional frameworks with micro-level community participation and adding conceptual clarity to discussions of sustainable rural development.

In comparison with earlier work, our findings reinforce arguments that cultural meaning and local participation are central to sustainable heritage tourism, and that geotourism in protected-area contexts can strengthen place identity when communities are engaged in interpretation and governance (Su & Wall, 2014; Li et al., 2020). While many prior studies focus primarily on built heritage, this study foregrounds the integration of geological heritage with cultural landscape narratives, aligning with geotourism scholarship emphasizing education and geoconservation (Dowling, 2013; Gordon, 2018).

CONCLUSIONS

Theoretical Implications

The study makes several theoretical contributions across interconnected domains. It advances Cultural Landscape Theory by operationalizing landscape identity as a measurable construct that predicts participatory and behavioural

outcomes, thereby extending Sauer's (1925) descriptive foundations into an empirically testable model. It also strengthens the linkage between geotourism and cultural transmission by demonstrating that geological heritage serves as a conduit for sustaining intangible cultural knowledge, thereby illustrating the interdependence of the physical and symbolic dimensions of sustainability, as described by Dowling (2013) and Farsani et al. (2011). In addition, the findings enrich governance perspectives by confirming the moderating role of policy support, which connects macro-level institutional structures with micro-level community participation, and clarifying how sustainable rural development emerges through such interactions. These contributions broaden cultural landscape and geotourism research by integrating geomorphological heritage and vernacular cultural landscapes within an empirically testable framework, and by showing how enabling governance can amplify community-based cultural transmission (Antrop, 2005; Gordon, 2018; Zhuang et al., 2024).

Practical Implications

For policymakers, the findings underscore the need to embed cultural transmission indicators into rural revitalization assessment systems so that cultural continuity is evaluated with the same rigor as economic development and infrastructure improvements. Incorporating such indicators ensures that policy interventions remain sensitive to heritage dynamics rather than focusing solely on material growth. In addition, providing microgrants and specialized training for community-led interpretive initiatives and craft cooperatives can empower residents to take ownership of heritage stewardship and strengthen local capacities for cultural entrepreneurship. Policy makers should also promote inter-village networks that enable communities to share best practices, jointly develop tourism products, and coordinate landscape-level management strategies, thereby reducing fragmentation and fostering collective resilience. For local communities, the results highlight the importance of integrating youth into heritage tourism activities through structured apprenticeship programs that facilitate hands-on learning and allow younger generations to acquire cultural knowledge directly from experienced elders. Communities can also enhance cultural vitality by developing storytelling platforms that connect geological features with oral histories, ensuring that both the physical environment and its associated meanings are communicated to residents and visitors alike. Furthermore, participatory mapping and community-based monitoring of cultural landscape changes can strengthen local awareness of environmental transformations and support informed decision-making.

For tourism planners and geopark managers, the study demonstrates the value of designing interpretive trails that weave together geomorphological and cultural narratives, helping visitors understand how geological formations and human traditions co-evolve over time. Planners must carefully balance visitor capacity with community well-being and ecological thresholds to prevent overuse and maintain authenticity. Finally, collaborations with academic institutions can support systematic documentation of heritage assets, the development of digital archives, and the creation of innovative interpretive materials that enhance the visibility and long-term preservation of rural cultural landscapes.

Research Limitations and Future Research Directions

Although this study provides important insights into the relationships among cultural landscape identity, community participation, geosite tourism development, and policy support, several limitations indicate directions for future investigation. The research's regional scope is confined to Central Shandong, an area characterized by limestone geomorphology, Confucian landscape traditions, and long-established village settlement patterns. These features may not mirror the cultural–environmental dynamics found in other rural regions of China, such as the karst plateaus of the southwest, the river terrace systems of the Yangtze Basin, or the high-altitude pastoral landscapes of the Tibetan Plateau. Conducting comparative studies across multiple geomorphological and cultural settings would therefore strengthen understanding of the model's generalizability and clarify how environmental context shapes identity formation and cultural transmission.

The temporal structure of the study also presents a limitation, as data were collected at a single point in 2025. Rural tourism and cultural revitalization are dynamic processes influenced by policy changes, migration patterns, and economic cycles. Longitudinal research would enable the examination of how identity, participation, and tourism evolve over time, and could capture processes such as the gradual erosion or strengthening of cultural attachment, the emergence of new heritage practices, or shifts in community involvement as tourism intensifies. In terms of measurement, although the quantitative scales were adapted from established literature, they may not fully encompass locally embedded interpretations of concepts such as identity, belonging, transmission, and participation. These constructs often contain tacit, emotional, and symbolic layers that are difficult to quantify through Likert scales.

Future studies could therefore incorporate participatory visual methods, cultural mapping, in-depth ethnographic observation, or narrative-based interviews to capture the nuance of local meanings and lived experiences. Another limitation concerns the conceptualization of policy support, which was treated as a broad, unified construct. In practice, policy support encompasses multiple dimensions, including financial assistance, regulatory protection, educational training, administrative facilitation, and heritage legislation. Disaggregating these components would allow researchers to identify which specific policy instruments exert the strongest influence on cultural sustainability.

Building on these limitations, several directions for future research emerge. Scholars may explore digital heritage mediation, such as augmented or virtual reality storytelling, interactive archives, and digitally enhanced interpretive trails as new avenues for transmitting cultural knowledge to both residents and visitors. Further investigation is also needed into gendered and generational patterns of participation, as younger residents, elders, men, and women may engage differently with landscape identity, tourism, and heritage practices. Finally, modelling cross-regional networks linking geoparks, cultural corridors, and inter-village alliances would offer new perspectives on macro-level pathways of cultural transmission, highlighting how ideas, narratives, and practices circulate across broader spatial systems beyond individual villages.

Concluding Remarks

This study demonstrates that rural cultural landscapes serve as powerful foundations for sustainable cultural transmission when supported by strong local identity, active community engagement, and geosite-oriented tourism under enabling governance conditions. Using traditional villages in Central Shandong as empirical cases, the research shows that cultural landscape identity motivates residents to participate in heritage and tourism activities, and that this participation translates into both educational and economic pathways through geosite tourism development. Policy support further strengthens these community-driven processes, ensuring that cultural knowledge, practices, and landscape stewardship are maintained across generations. The integrated model, validated by quantitative SEM results and corroborated by qualitative narratives, reveals that sustainable cultural transmission is not a singular outcome but a multi-layered process linking people, place, and institutional context. The geological formations, vernacular architecture, ritual spaces, and ecological knowledge of the study villages form living cultural landscapes where identity, participation, and tourism interact continuously.

These findings extend Cultural Landscape Theory by operationalizing identity as a measurable construct, advance geotourism scholarship by illustrating its role as a medium of intangible heritage continuity, and enrich governance studies by highlighting the moderating influence of policy frameworks. Beyond Shandong, the insights emphasize that rural revitalization depends on cultivating local pride, empowering communities, designing interpretive geotourism that integrates natural and cultural heritage, and institutionalizing multiscale policy support. Ultimately, the study affirms that sustainable cultural transmission arises not from external preservation mandates but from the synergy of attachment, participation, learning, and governance embedded within rural cultural landscapes.

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A CAUSAL RELATIONSHIP MODEL OF SOCIAL AND CULTURAL CHANGE INFLUENCING THE FUTURE SUCCESS OF INTEGRATED AND SUSTAINABLE TOURISM MANAGEMENT IN THAILAND

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Abstract: This research aims to examine the influence of integrated causal factors affecting the future success of sustainable tourism management in Thailand amid changes in social and cultural dimensions, the Bio-Circular-Green (BCG) economy, and the pro-environmental sector. The study adopts a mixed-methods research approach and applies a Multinomial Logistic Model based on Path Analysis, referred to as the Logit-PA model, which was identified as the best-fitting model for examining the relationships among the relevant factors. The findings indicate that stakeholder participation is the most critical factor influencing the success of sustainable tourism. When this factor was incorporated into the Logit-PA model as a new policy scenario, the true direct effects of the causal factors became more evident. The inclusion of stakeholder participation also contributed to a continuous long-term reduction in greenhouse gas emissions generated by tourism activities. Furthermore, the study identifies several strategic approaches to achieving sustainable tourism development goals. These include enhancing the capacity of tourism service providers to manage resources efficiently, emphasizing social and cultural dimensions in tourism development, and promoting the consumption of tourism products and services that are consistent with the principles of the BCG economy. In addition, supporting factors should be developed to improve the efficiency of environmental resource management and ensure the long-term sustainability of tourism practices. This research provides substantial practical value for policy planning and implementation by guiding Thailand's national development toward long-term sustainability goals. The findings may also be adapted and applied to other sectors in future studies under changing future conditions.

Keywords: social culture, Eco-tourism, scenario analysis, sustainability, sustainable tourism

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INTRODUCTION

The tourism industry is a crucial sector contributing to Thailand's economic growth. In 2029, Thailand generated tourism revenue of approximately 992,050 million baht, creating employment for 4,201,502 people within the economic system (World Travel & Tourism Council, 2025). At the same time, Thailand's tourism competitiveness is evident, as the country ranked 31st out of 140 countries worldwide (Chongbut & Chapman, 2021; The World Bank: Energy Use (Kg of Oil Equivalent Per Capita) Home Page, 2025). Thailand has consistently pursued national development policies that promote economic, social, and environmental growth from the past to the present (1995–2025) (Office of the National Economic and Social Development Council (NESDC, 2025). However, following the economic crisis period (2002–2025), Thailand increasingly emphasized economic expansion to accelerate economic and social recovery (National Statistical Office Ministry of Information and Communication Technology, 2025). The government implemented various policy measures to promote national development, with tourism identified as the highest national policy priority, followed by the promotion of agricultural exports through expanding market share and continuously exploring new international markets (Praprom & Laipaporn, 2023). In particular, Thailand has actively promoted international tourism growth at an accelerated rate by reducing service-related tax rates to stimulate tourist arrivals and encourage foreign

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companies to conduct business in Thailand, exempting certain fees to facilitate investment entry into the economic system and enhance long-term operational activity, and implementing comprehensive support measures, especially in terms of safety and security, to attract foreign capital inflows (Tourism Authority of Thailand, 2025). Furthermore, the government has adopted an open approach to tourism-related business operations by easing tax burdens on entrepreneurs, enabling higher profitability and fostering sustained growth in the tourism sector (United Nations World Tourism Organization (UNWTO), 2025). With regard to social and cultural dimensions, Thailand has likewise promoted comprehensive development across multiple areas **(**UNWTO, 2024). These efforts include increasing the minimum wage and supporting the re-employment of previously unemployed workers, enhancing educational policies to continuously reduce illiteracy rates, and strengthening public health and safety through the provision of universal healthcare benefits to ensure equitable access for all population groups (UNWTO, 2025; Hasanein & Ayad, 2025).

Investment promotion policies targeting tourism entrepreneurs have led to a steady increase in business participation within the formal economic system, which in turn has generated social benefits by creating employment opportunities for Thai workers and generating income for local communities in tourism destinations, thereby supporting sustained regional income growth **(**NESDB, 2025; Ahmed et al., 2025). Furthermore, tourism-led economic development is closely linked to broader social development, particularly in forms of tourism associated with local cultural practices and community livelihoods. The emphasis on eco-tourism and cultural tourism as pathways toward sustainable tourism has contributed to simultaneous growth in both the tourism sector and social development (UNWTO, 2025; Tuan et al., 2025; Salama et al., 2025). With respect to environmental dimensions, Thailand has placed significant emphasis on achieving internationally agreed development targets following its participation in global cooperation frameworks established at the United Nations General Assembly in Italy, where the Sustainable Development Goals (SDGs) were adopted as a set of global development objectives after 2015. The SDGs were formally endorsed by 193 United Nations Member States on 25 September 2015 and have served as a shared development direction for all countries from 2016 to the present (National Statistical Office Ministry of Information and Communication Technology, 2025; Muna et al., 2025). The commitment document signed by all member states, entitled *"Transforming Our World: the 2030 Agenda for Sustainable Development,"* commonly referred to as the 2030 Agenda, Agenda 2030, or the Global Goals, comprises 17 Sustainable Development Goals (World Economic Forum, 2024). Each goal is supported by specific targets, totalling 169 targets, and measured through 232 indicators designed to guide and monitor progress toward sustainable development. In line with these commitments, the Thai government has established a 20-year National Strategic Plan as a key framework for steering the country toward sustainable development in the future. Implementation is carried out through the exercise of state authority via administrative, civil, and criminal measures under the National Environmental Quality Promotion and Conservation Act B.E. 2535 (1992), which serves as the primary legal instrument for environmental protection and sustainability in Thailand (Thai Travel Agents Association, Ministry of Tourism and Sports, 2025); ONEP, 2025; Office of Natural Resources and Environmental Policy and Planning (DEDE), 2025).

With respect to environmental development, Thailand places strong emphasis on SDG 12: Sustainable Consumption and Production, particularly in promoting sustainable tourism (Thailand Greenhouse Gas Management Organization (Public Organization), 2025; OECD, 2025). The country has developed and implemented monitoring tools to assess the impacts of sustainable development in tourism that generates employment while promoting local culture and products (Junsiri et al., 2024). These efforts are closely aligned with SDG 8: Decent Work and Economic Growth, specifically Target 8.9, which aims to promote sustainable tourism that creates jobs and supports local culture and products by 2030; SDG 11: Sustainable Cities and Communities, which emphasizes the protection of cultural and natural heritage in tourism destinations; and SDG 15: Life on Land, which focuses on the sustainable management of terrestrial ecosystems and the prevention of negative environmental impacts from tourism activities (NESDB, 2025; Sutthichaimethee et al., 2025; Energy Policy and Planning Office, 2025). Achieving these targets is expected to support appropriate long-term sustainable development; however, rapid tourism growth in recent years has generated significant negative impacts on natural resources and the environment, raising concerns across multiple sectors (Ministry of Natural Resources and Environment). This has led to a strategic shift toward a quality-oriented rather than quantity-driven tourism development approach, aiming to achieve a balanced integration of economic growth and environmental conservation in line with the United Nations Sustainable Development Goals (SDGs). These principles are reflected in Thailand's National Strategy, master plans under the National Strategy, national reform plans, and the National Tourism Development Plan, all of which emphasize sustainable tourism (Winyuchakrit et al., 2025; Xiao et al., 2025).

Furthermore, the Thai government has declared the Bio-Circular-Green (BCG) economic model a national agenda since 2021(United Nations Framework Convention on Climate Change, UNFCCC, Bonn, Germany, 2016), positioning it as a key mechanism for leveraging national strengths, addressing structural weaknesses, aligning with sustainable development objectives, expanding employment opportunities, increasing income, generating inclusive wealth, and improving quality of life (UNFCC, 2014). In support of this agenda, the Ministry of Tourism and Sports has mandated its affiliated agencies to advance "white tourism" under the BCG economic model, and the National Tourism Policy Committee has assigned the Office of the Permanent Secretary of the Ministry of Tourism and Sports to revise future plans in alignment with the 13th National Economic and Social Development Plan and the 3rd National Tourism Development Plan (2023–2027) (NESDB, 2025; World Travel & Tourism Council, 2025).

Therefore, the Ministry of Tourism and Sports, as the principal agency responsible for driving tourism development in Thailand, has recognized the importance of prioritizing sustainable tourism in response to the need for natural

resource and environmental conservation, compliance with international and national policy frameworks, and the growing preference of modern tourists for environmentally friendly travel experiences (NESDB, 2025; World Travel & Tourism Council, 2025). Sustainable tourism development is regarded as a key instrument for generating economic, social, and environmental benefits for Thailand. Accordingly, the Ministry of Tourism and Sports has formulated the strategic plan for advancing white tourism under the BCG economic model (2023–2027) to strengthen the role of the tourism sector in driving national development under the Bio-Circular-Green (BCG) economy framework. On the supply side, tourism entrepreneurs are encouraged to adapt and apply the BCG economic model as a guideline for producing tourism-related goods and services, while on the demand side, the tourism sector stimulates demand within the BCG economic system through tourist consumption. This integrated approach positions tourism as a key mechanism for sustainably driving Thailand's economic development in the long term. However, despite Thailand's efforts to improve national strategic planning across multiple dimensions as discussed above, greenhouse gas emissions continue to increase at a steadily rising growth rate. In addition, the expansion of urban society into local communities has led to significant social transformations, particularly the gradual shift in cultural patterns from traditional rural communities to urbanized lifestyles (NESDB, 2025; World Travel & Tourism Council, 2025; DEDE, 2025).

These changes directly affect community ways of life and reflect the encroachment of urban society into rural areas, which has contributed to the gradual erosion of Thailand's traditional cultural heritage passed down through generations. Consequently, substantial weaknesses remain in the social dimension due to rapid cultural change, alongside increasing environmental degradation. These conditions indicate that Thailand's sustainability policies have not yet achieved sufficient success and lack both efficiency and effectiveness. This research, therefore, identifies a critical gap in existing policy implementation and seeks to address it by examining strategic approaches that can support Thailand's long-term national development objectives more effectively. However, although many studies of this kind have been conducted in the past, none has taken a comprehensive approach or developed indicators that are truly appropriate to the specific context under study with strong performance. This research, in contrast, is highly distinctive and significantly different from previous work. Its key strength lies in the development of context-appropriate indicators that meet established criteria for constructing a suitable model, along with a rigorous implementation process grounded in advanced statistical principles. The findings of this study can also be appropriately applied to other contexts in the future.

MATERIALS AND METHODS

The model developed in this study is the Logistic-based Path Analysis model (Logit-PA model). This model integrates quantitative and qualitative research approaches and is constructed by addressing and improving upon the limitations of conventional models. The objective is to ensure that the Logit-PA model can address the research questions as effectively and efficiently as possible. The model is developed under the following assumptions (Baltagi, 2021):

1. The independent or predictor variables (x's) must be measured at least at the interval scale. In cases where the data are categorical, they are transformed into dummy (dichotomous) variables with values of 0 and 1 only. For the dependent variable, in the case of binary logistic regression, two values are specified: 0 and 1.
2. The mean of the error term is zero, or equivalently, the error terms are uncorrelated, that is, $e = 0$.
3. The independent variables are not correlated with each other, implying the absence of multicollinearity. The criteria for assessing correlations follow those commonly used in multiple regression analysis, where the correlation coefficient (r) should not exceed 0.65 or 0.80.

For the Logit-PA model, in the case where the dependent variable (y) is a binary categorical variable with two possible values, and where there is more than one predictor variable (x_i). The function can be expressed as follows (Harvey, 1980).

$$P_y = \frac{e^{b_0+b_1x_1+\cdots b_px_p}}{1+e^{b_0+b_1x_1+\cdots b_px_p}} \qquad (1)$$

From Equation (1), let P_y denote the probability of the occurrence of the event of interest. Accordingly, the probability of the non-occurrence of the event of interest can be obtained using the following expression (Baltagi, 2021; Harvey, 1980).

$$Q_y = 1 - \left(\frac{e^{b_0+b_1x_1+\cdots b_px_p}}{1+e^{b_0+b_1x_1+\cdots b_px_p}}\right) \qquad (2)$$

As shown in Equation (2), the relationship between the dependent variable (y) and the predictor variables (x_i) is not linear. Therefore, the researcher transforms the model into a linear form by expressing it in terms of odds or odds ratios, which represent the ratio between the probability of the event of interest occurring $(y = 1)$ and the probability of the event not occurring $(y = 0)$. This relationship can be expressed as follows (Hoyle,1995).

$$odds = \frac{P_y}{Q_y} \qquad (3)$$

From Equation (3), the value of the odds represents how many times more likely the event of interest is to occur compared to the non-occurrence of the event. For example, the odds of tossing a coin once equal $\frac{0.5}{0.5} = 1$. If the odds equal 3, this indicates that the probability of the event of interest occurring is three times greater than the probability of the event not occurring. When the odds equal 1, the probabilities of the occurrence and non-occurrence of the event are equal. However, when the odds are greater than 1, the probability of the event of interest occurring exceeds that of the non-

occurrence of the event. In this study, the Logit-PA model is specified in terms of the logarithm of the odds, which is referred to as the logistic response function. The log of the odds, or $\log\left(\frac{P_y}{Q_y}\right)$, where $Q_y = 1 - P_y$, can be written in the following standard form (Byrne, 2001).

$$\log \frac{P_y}{1-P_y} = b_0 + b_1 x_1 + \cdots + b_p x_p \qquad (4)$$

From Equation (4), after taking the logarithm, the dependent variable (y) can be predicted using a set of variables that exhibit a linear structure. The Logit-PA model is therefore highly suitable for application in development management across various dimensions, enabling the formulation of appropriate measures or policies. Consequently, the predicted value of y in terms of P_y can be expressed as follows (Dickey & Fuller, 1981).

$$P_y = \frac{e^{b_0+b_1x_1+\cdots b_p x_p}}{1+e^{b_0+b_1x_1+\cdots b_p x_p}} \qquad (5)$$

From Equation (5), various estimation and prediction methods can be employed. In this study, an approach based on causal analysis is selected, in which all variables must pass appropriate procedural criteria and exhibit relationships such that each variable may simultaneously function as both a dependent and an independent variable. Accordingly, this study employs Path Analysis as the estimation technique, whereby variables are reclassified into latent variables and observed variables. Each sector must consistently demonstrate genuine and interconnected relationships with one another (Byrne, 2001). The structural equation model of path analysis, which represents the relationships among latent variables, is expressed as $\eta = b\eta + \Gamma\xi + \zeta$, where η denotes the endogenous variable, ξ represents the exogenous variable, and ζ is the error term. For the measurement model in each block, the following specifications apply (Hoyle, 1995).

$$x = \Lambda x\xi + \delta x \qquad (6)$$

From Equation (6), $(x/\xi) = \Lambda x\xi$ defines the measurement equation for the exogenous variables, where x represents the indicators of ξ, and Λx denotes the factor loadings, which reflect the influence of the latent variable ξ on its observed indicators x.

$$y = \Lambda y\eta + \varepsilon y \qquad (7)$$

From Equation (7), $(y/\eta) = \Lambda y\eta$ defines the measurement equation for the endogenous variables, where y represents the indicators of η, and Λy denotes the factor loadings, which represent the influence of the latent variable η on its observed indicators y.

For this study, the estimation of the Logit-PA model follows an algorithm-based analytical procedure, as outlined below (Byrne, 2001; MacKinnon, 1991; Joreskog & Sorbom, 2012).

1. Estimation of latent variables: The latent variables are estimated based on their observed indicators as $\hat{V}_i \alpha \sum_j w_{ji} P_{ji}$, where the latent variable V is constructed from the standardized values of the indicators P_i, and w_{ji} represents the assigned (arbitrary) weights.
2. Estimation of the dependent variables in the structural equation: The dependent variable in the structural model is estimated as $Z_i \alpha \sum_j c_j \hat{V}_j$, where the latent variable in the structural model is generated as a weighted aggregate of the estimated latent variables from each structural equation. The term c_j represents the appropriate weighting coefficients.
3. Iterative estimation until convergence: Steps 1 and 2 are performed iteratively until the coefficients of all structural paths stabilize and converge, indicating that convergence has been achieved.

The Logit-PA model differs from conventional models in that earlier approaches primarily addressed the issue of multicollinearity alone. In contrast, the model developed in this study is designed to simultaneously avoid multicollinearity, heteroscedasticity, and autocorrelation. As a result, the Logit-PA model exhibits a high degree of reliability and is highly suitable for future forecasting and predictive applications (Harvey, 1980).

A review of relevant domestic and international literature indicates that no prior studies have developed a strategic national management model in this manner. Moreover, analyses of this type remain extremely limited both in Thailand and internationally. Existing studies have largely examined individual dimensions in isolation rather than adopting an integrated analytical framework, thereby limiting their ability to accurately formulate future strategic directions.

In addition, previous research has typically separated quantitative and qualitative approaches, which has constrained the development of robust scenario models and reduced their applicability for national policy and planning in Thailand. To address these limitations, this study adopts a mixed-methods research design, in which quantitative analysis serves as the primary approach, followed by qualitative research to validate, complement, and strengthen the findings.

The quantitative component utilizes secondary data covering the period from 1990 to 2025, while the qualitative component involves in-depth interviews with key experts directly responsible for tourism development in Thailand, including five experts from the National Economic and Social Development Council (NESDC), five experts from the Ministry of Natural Resources and Environment, and five experts from the Ministry of Tourism and Sports, for a total of fifteen participants. The findings from both components are subsequently synthesized to provide a comprehensive analysis, with the research procedures presented in the following section. Figure 1 illustrates the research procedures employed to analyze the causal influences affecting cultural changes within the social sector as a result of the transition toward integrated tourism management for sustainable development in Thailand in the future.

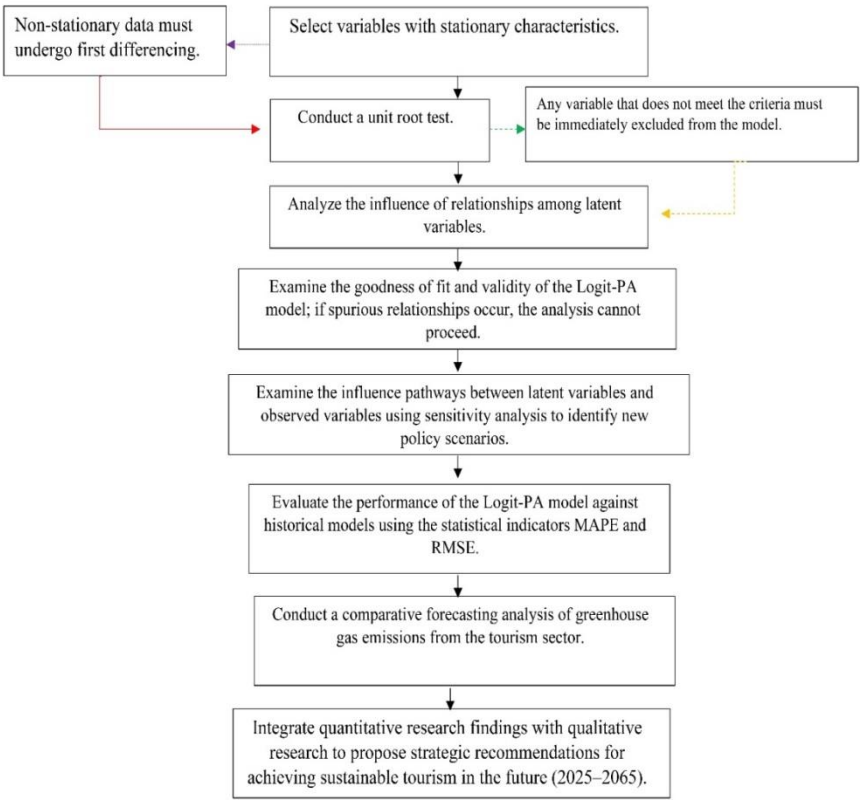


Figure 1. Research Procedure

RESULTS

This study employed a mixed-methods research approach, integrating both quantitative and qualitative methodologies to ensure the robustness and completeness of the research findings. The quantitative component utilized the Logit-PA model, which incorporates integrated variables derived from both quantitative data and qualitative insights. Subsequently, the quantitative results were further examined through qualitative research to enhance the depth, validity, and contextual interpretation of the findings. This sequential research design was intended to maximize the explanatory power of the study and ensure its applicability to real-world policy formulation. The findings of this research can therefore be effectively applied to support national strategic planning for achieving long-term sustainable tourism development in alignment with Thailand's net zero greenhouse gas emissions target by 2065.

Key policy objectives derived from the model include systematic management of tourism operators, local communities involved in tourism activities, and tourists within destination areas under the BCG economic model, as well as maintaining annual greenhouse gas emission growth from the tourism sector within the established carrying capacity limits. Most importantly, the proposed implementation framework must comprehensively incorporate ESG (Environmental, Social, and Governance) principles as a core foundation for sustainable tourism governance.

Screening of Influencing Factors for Model Input

The Logit-PA model was employed to select and define the observed variables used in the analysis. These observed variables consist of key indicators that have been officially established and consistently applied by Thailand in national governance and policy implementation. In this study, only indicators that fully met the required methodological criteria and relevance to sustainability objectives were selected; any indicators deemed inappropriate or insufficient were excluded from the model. The selected observed variables include per capita income ($BCG-A$), urbanization rate ($BCG-B$), industrial structure rate ($BCG-C$), Eco-Tourism rate ($BCG-D$), Cultural and Traditional Tourism rate ($BCG-E$), Health and wellness rate ($So-A$) Public participation rate ($So-B$), education rate ($So-C$), income distribution rate ($So-D$), protection rate ($So-E$), Recreational Attraction ($So-F$), Natural Attraction ($So-G$), energy intensity ($En-A$), Final energy consumption ($En-B$). and Carbon dioxide emission ($En-C$). In addition, the model incorporates latent variables corresponding to Thailand's sustainability policy framework, namely the social and cultural sector, the BCG-based economic sector, and the pro-environmental sector.

These latent variables serve as the foundational constructs for defining and evaluating Thailand's sustainable tourism development goals. The results of the empirical analysis are presented as follows.

Based on Table 1, the results indicate that all selected indicators successfully meet the measurement criteria of the Logit-PA model. Only indicators that passed the evaluation criteria were deemed appropriate for inclusion as observed variables in the Logit-PA model, with statistical significance at the $\alpha = 0.01$ level. All 15 observed variables are stationary at first difference, as the Tau-test values exceed the corresponding MacKinnon critical values. These results demonstrate

that the observed variables used in constructing the model provide a high level of reliability and robustness, making the model appropriate for analyzing the influences and relationships among variables, as presented in the subsequent analysis.

Table 1. Results of validity and reliability tests for observed variables in the Logit-PA model
*** denotes a significance, α = 0.01, Δ is the first difference, and ln is the natural logarithm

Tau Test				MacKinnon Critical Value		
Variables	Level I(0) Value	Variables	First Difference I(1) Value	1%	5%	10%
$\ln(\mathrm{BCG}-\mathrm{A})$	−2.50	$\Delta\ln(\mathrm{BCG}-\mathrm{A})$	−4.50***	−4.25	−3.55	−2.05
$\ln(\mathrm{BCG}-\mathrm{B})$	−2.99	$\Delta\ln(\mathrm{BCG}-\mathrm{B})$	−4.35***	−4.25	−3.55	−2.05
$\ln(\mathrm{BCG}-\mathrm{C})$	−2.05	$\Delta\ln(\mathrm{BCG}-\mathrm{C})$	−4.27***	−4.25	−3.55	−2.05
$\ln(\mathrm{BCG}-\mathrm{D})$	−2.59	$\Delta\ln(\mathrm{BCG}-\mathrm{D})$	−4.99***	−4.25	−3.55	−2.05
$\ln(\mathrm{BCG}-\mathrm{E})$	−3.52	$\Delta\ln(\mathrm{BCG}-\mathrm{E})$	−5.75***	−4.25	−3.55	−2.05
$\ln(\mathrm{So}-\mathrm{A})$	−3.25	$\Delta\ln(\mathrm{So}-\mathrm{A})$	−5.10***	−4.25	−3.55	−2.05
$\ln(\mathrm{So}-\mathrm{B})$	−3.45	$\Delta\ln(\mathrm{So}-\mathrm{B})$	−5.49***	−4.25	−3.55	−2.05
$\ln(\mathrm{So}-\mathrm{C})$	−3.10	$\Delta\ln(\mathrm{So}-\mathrm{C})$	−5.12***	−4.25	−3.55	−2.05
$\ln(\mathrm{So}-\mathrm{D})$	−-3.25	$\Delta\ln(\mathrm{So}-\mathrm{D})$	−5.15***	−4.25	−3.55	−2.05
$\ln(\mathrm{So}-\mathrm{E})$	−3.01	$\Delta\ln(\mathrm{So}-\mathrm{E})$	−4.99***	−4.25	−3.55	−2.05
$\ln(\mathrm{So}-\mathrm{F})$	−3.09	$\Delta\ln(\mathrm{So}-\mathrm{F})$	−4.97***	−4.25	−3.55	−2.05
$\ln(\mathrm{So}-\mathrm{G})$	−3.05	$\Delta\ln(\mathrm{So}-\mathrm{G})$	−5.12***	−4.25	−3.55	−2.05
$\ln(\mathrm{En}-\mathrm{A})$	−2.75	$\Delta\ln(\mathrm{En}-\mathrm{A})$	−4.50***	−4.25	−3.55	−2.05
$\ln(\mathrm{En}-\mathrm{B})$	-2.56	$\Delta\ln(\mathrm{En}-\mathrm{B})$	-4.55***	−4.25	−3.55	−2.05
$\ln(\mathrm{En}-\mathrm{C})$	-2.05	$\Delta\ln(\mathrm{En}-\mathrm{C})$	-4.95***	−4.25	−3.55	−2.05

Table 2. Causal relationship effects derived from the Logit-PA model
Note: In the above, *** denotes significance α = 0.01, DE is direct effect and IE is indirect effect

Dependent Variables	**Type of effect**	**Independent Variables**			
		Social-Culture sector	**Pro-environmental sector**	**BCG-economic sector**	**Policy adaptability**
Social-Culture sector	DE	-	0.34***	0.14***	-0.35***
	IE	-	0.10***	0.05***	
Pro-environmental sector	DE	0.62***	-	0.43***	-0.11***
	IE	0.09***	-	0.07***	
BCG-economic sector	DE	0.18***	-	-	-0.24***
	IE	-	-	-	

Formation of the Analytical Model Using the Logit-PA model

The researcher constructed the Logit-PA model to analyze the causal effects of key factors influencing the success of sustainable tourism, while ensuring that development remains within the carrying capacity defined by Thailand in the long term. The model examines the relationships among latent variables, which are influenced by their respective observed variables within each latent construct. The results of the relationship analysis are presented as follows.

Based on Table 2, the results of the causal relationship analysis derived from the Logit-PA model indicate that the social–cultural sector is influenced by two sectors: the pro-environmental sector and the BCG-economic sector, with effect sizes of 0.34% and 0.14%, respectively, at a significance level of α = 0.01. These results demonstrate that changes in the social–cultural sector are most strongly driven by changes in the pro-environmental sector. In addition, the findings reveal that the social–cultural sector exerts the strongest influence on the pro-environmental sector, with an effect size of 0.62%, which is greater than the influence exerted by the BCG-economic sector on the pro-environmental sector (0.43%). The next strongest influence is observed from the BCG-economic sector to the social–cultural sector, with an effect size of 0.18%, also significant at α = 0.01. Overall, the results indicate that the social–cultural sector plays a dominant role in driving changes in the pro-environmental sector. This implies that if the government aims to formulate effective and responsive policies for sustainable tourism, policy interventions should prioritize the social–cultural sector, as it demonstrates the highest responsiveness and transmission effect across sectors. Such an approach would enhance the likelihood of rapid and successful policy implementation compared with interventions targeting other sectors. Nevertheless, within the Logit-PA modeling framework, it is necessary to estimate new policy scenarios based on the observed variables through sensitivity analysis. The results of the sensitivity analysis are presented below.

Based on Figure 2, the three latent variables exhibit both direct and indirect effects, indicating strong interrelationships among them. The Logit-PA model demonstrates high validity and an excellent goodness-of-fit, satisfying all standard criteria: χ^2/df = 1.55, $RMSEA$ = 0.02, RMR = 0.001, GFI = 0.99, $AGFI$ = 0.95, R-squared = 0.93, F-statistic = 215.75 (p = 0.00), ARCH test = 15.85 (p = 0.10), and LM test = 1.20 (p = 0.10). These results confirm that the model is statistically appropriate, robust, and free from spurious relationships, thereby ensuring the reliability of the empirical findings.

Furthermore, the results of the sensitivity analysis indicate that the observed variables with sensitivity values exceeding the 90% threshold are Public Participation Rate $(So-B)$ and Cultural and Traditional Tourism Rate $(BCG-E)$. Specifically, the public participation rate exerts the strongest influence on changes in the social–cultural sector, with a sensitivity value of 92%, followed by the cultural and traditional tourism rate, which influences the BCG-economic sector with a sensitivity value of 90%. All remaining observed variables exhibit sensitivity values below 90%.

Accordingly, this study designates public participation rate and cultural and traditional tourism rate as new policy scenario variables, to be utilized as key instruments for steering long-term sustainable tourism development.

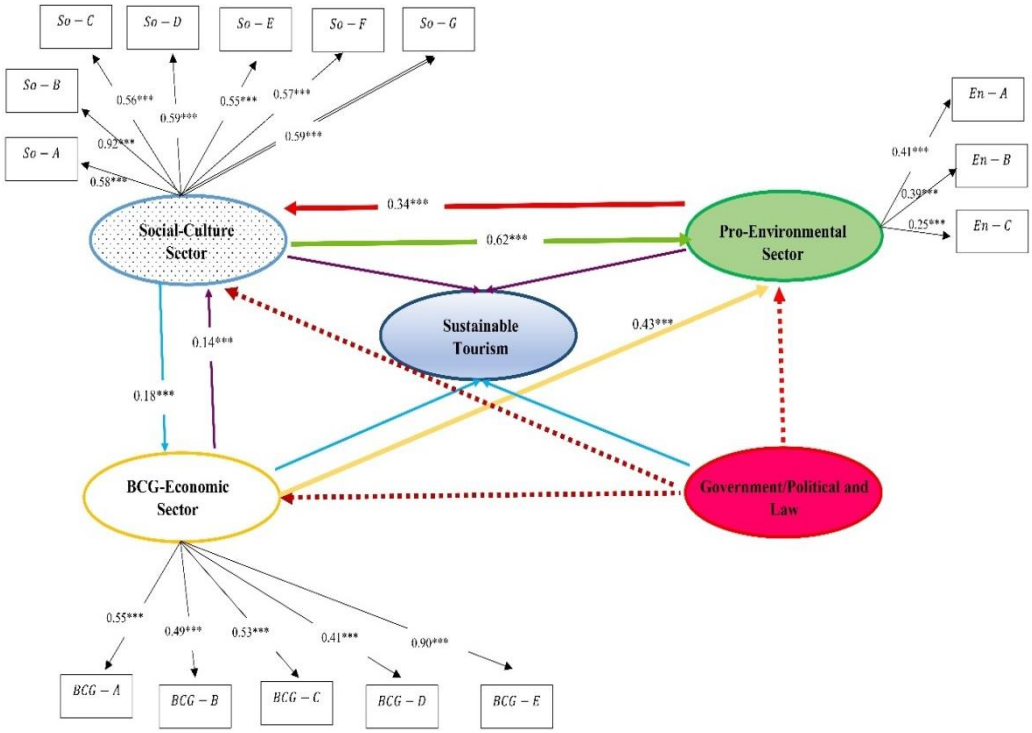


Figure 2. Intersectoral influence relationships derived from sensitivity analysis using the Logit-PA model

Forecasting Greenhouse Gas Emissions under the New Policy Scenario

In this study, a new policy scenario is incorporated into the Logit-PA model, and the resulting forecasts of greenhouse gas (GHG) emissions in the future are presented accordingly. For the forecasting exercise, the performance of the proposed model is evaluated by comparing it with the forecasting models that have been employed by Thailand from 1992 to 2025. The evaluation is conducted using standard accuracy measures, namely the Mean Absolute Percentage Error (MAPE) and the Root Mean Square Error (RMSE). The results of the model performance assessment are reported in Table 3.

Table 3. Model performance evaluation of the Logit-PA model (Source: Author's Estimate (2025)

Forecasting Model	MAPE (%)	RMSE (%)
OLS model	10.49	11.89
ANN model	4.95	5.15
Fuzzy model	4.59	4.98
GM(1,1) model	4.13	4.54
ANIF model	3.90	3.98
ARIMAX model	3.15	3.59
Logit-PA model	1.10	1.25

Based on Table 4, the researcher compares the performance of the Logit-PA model with forecasting models that have previously been used by Thailand for policy formulation and national planning under the sustainability policy framework. These benchmark models include the Autoregressive Integrated Moving Average with Exogenous Variables (ARIMAX) model, Adaptive Neuro-Fuzzy Inference System (ANFIS) model, Grey Model (GM(1,1)), Fuzzy model, Artificial Neural Network (ANN) model, and Ordinary Least Squares (OLS) model. The empirical results indicate that the Logit-PA model exhibits the highest forecasting performance, with MAPE and RMSE values of 1.10% and 1.25%, respectively. The second-best performance is observed for the ARIMAX model, with MAPE and RMSE values of 3.15% and 3.59%, respectively, followed by the ANFIS model (3.90% and 3.98%), the GM(1,1) model (4.13% and 4.54%), the Fuzzy model (4.59% and 4.98%), the ANN model (4.95% and 5.15%), and finally the OLS model, which shows the weakest performance with MAPE and RMSE values of 10.49% and 11.89%, respectively. These findings confirm that the Logit-PA model is highly suitable for long-term forecasting of greenhouse gas emissions.

Based on Figure 3, the results indicate that during the period 2025–2065, despite Thailand having implemented sustainable development policies since 1992, greenhouse gas emissions from the tourism sector continue to increase steadily. The projected growth rate reaches 55.1%, which exceeds the government's target threshold of 40%. However, when the new scenario policy, namely Public Participation Rate and Cultural and Traditional Tourism Rate, is adopted as the primary policy indicators for managing sustainable tourism within the Logit-PA model, the projected greenhouse gas emission growth rate

declines significantly to 29.55%. This level remains within the acceptable range for achieving the national net zero emission target by 2065. These findings demonstrate that the integration of an appropriate scenario-based policy framework with a suitable analytical model enables more effective strategic planning and policy implementation, yielding substantially higher efficiency and accuracy than the conventional models previously employed by the government.

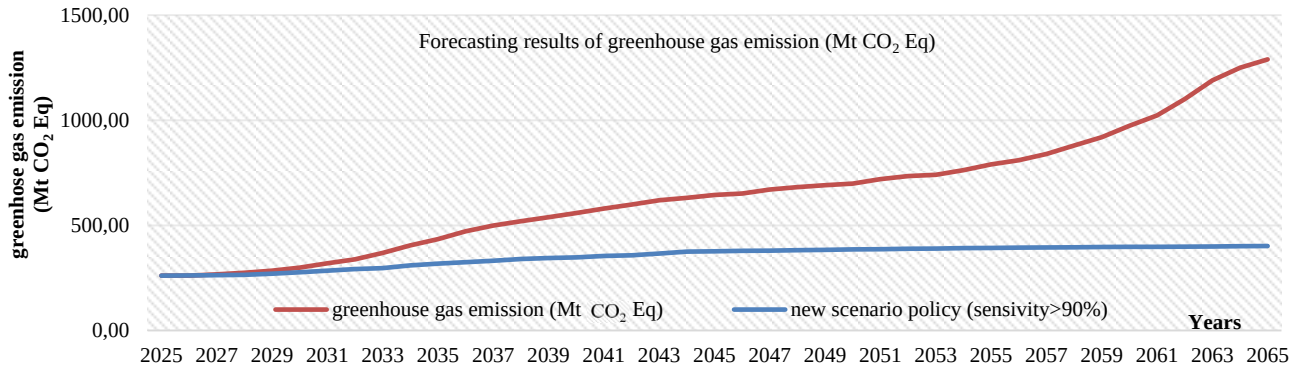


Figure 3. Projected growth of greenhouse gas emissions in the future (2025–2065)
(Source: Thailand Greenhouse Gas Management Organization, 2025)

Results of the Synthesis of Future Sustainable Tourism Development Strategies

Based on the quantitative research findings, the results presented above demonstrate a high level of appropriateness and reveal clear distinctions from previous studies. These differences help explain why Thailand has historically lacked a clear direction for managing tourism in a sustainable manner. In contrast, the findings of this study provide a practical foundation that can be effectively applied to support successful implementation in the future. Sustainable tourism is defined as tourism that fully considers its economic, social, and environmental impacts in both the present and the future, while addressing the needs of tourists, the tourism industry, the environment, and host communities. The principles of sustainability encompass the environmental, economic, and socio-cultural dimensions of tourism development and require an appropriate balance among these three dimensions to ensure long-term sustainability. These principles are consistent with the Global Sustainable Tourism Council (GSTC) standards, which serve as globally recognized benchmarks for sustainability in travel and tourism. The GSTC standards are widely used for education and awareness-building, policy formulation for businesses, government agencies, and other organizations, measurement and evaluation processes, and as a foundation for certification and carrying capacity assessment. These standards emerged from global efforts to establish a common framework for sustainable tourism and are organized around four core pillars: (1) sustainable governance and management, (2) economic impacts, (3) social and cultural impacts, and (4) environmental impacts, including resource use, pollution reduction, and the conservation of biodiversity and landscapes. The GSTC standards are founded on decades of global experience and prior work and were developed through consideration of a wide range of sustainable tourism guidelines and standards from all continents. During the development process, they underwent extensive global consultation across both developed and developing countries and in multiple languages, reflecting a collective effort to achieve a global consensus on sustainable tourism. Accordingly, the GSTC standards represent minimum criteria that businesses, governments, and destinations should meet to achieve social and cultural, environmental, and economic sustainability. As each destination possesses its own unique cultural context, environmental conditions, traditions, and legal frameworks, the standards are designed to be adaptable to local circumstances and supplemented with additional criteria for specific destinations and activities. Thailand, likewise, is required to align its tourism development efforts with these standards in order to achieve sustainable tourism in the future. Furthermore, implementation must be accompanied by integrated ESG analysis, encompassing Environmental sustainability (E), which requires that greenhouse gas emissions do not exceed the carrying capacity of destinations; Social and cultural sustainability (S), which emphasizes equitable income distribution, preservation of traditional culture, and the cultivation of environmental stewardship as a shared social value; and Governance (G), which entails effective regulation and oversight of national policies to ensure appropriate governance across all sectors. Consequently, the formulation of strategies under these frameworks necessitates an integrated, cross-sectoral approach, which is essential for achieving long-term sustainability in the future. The key components of this integrated strategy are presented as follows.

Issue 1: Economic sustainability: enhancing the capacity of tourism service providers for efficient resource management

Tourism service providers, encompassing all twelve sectors of the tourism industry, represent a critical group within the tourism supply chain. These sectors utilize a wide range of resources and consume substantial quantities in the delivery of tourism services, making them a primary target of this strategic framework. Accordingly, the strategy emphasizes strengthening the knowledge and understanding of relevant stakeholders regarding the principles and operational approaches of the Bio-Circular-Green (BCG) economic model, enabling its adaptation and integration into existing operational processes. Such implementation contributes to the sustainable use of natural resources and environmental assets at the local level, thereby allowing Thailand to preserve high-quality tourism destinations that remain attractive and competitive in the long term.

To achieve this objective, the following goals are established:

1. Tourism entrepreneurs adopt clear, standardized operational guidelines aligned with the BCG economic model that can be flexibly adapted to suit specific business contexts.

2. Tourism entrepreneurs enhance business value while reducing carbon dioxide emissions and improving waste management practices through a comprehensive understanding of resource management concepts at both local and community levels.

The strategic implementation under Issue 1: Economic Sustainability comprises three core strategies:

1. Promoting sustainable business operations among tourism service providers (Operations);
2. Developing and upgrading tourism business standards in accordance with the BCG economic model (Standards);
3. Enhancing business capacity and strengthening knowledge related to efficient and sustainable resource utilization among tourism sector personnel (Knowledge).

Issue 2: Social and cultural sustainability: promoting the value and stimulating consumption of tourism products and services under the bcg concept

Encouraging tourism entrepreneurs and related stakeholders to transition toward operations aligned with the Bio-Circular-Green (BCG) economic model requires substantial investment in sustainable practices. Such investments can only be sustained if tourists likewise recognize and value these principles, thereby generating continued consumption of tourism products and services and fostering long-term economic circulation at the local level. This approach supports the practical implementation of circular tourism. Beyond promoting BCG-aligned operational processes among tourism providers, stimulating demand from tourists encourages healthy competition among entrepreneurs, accelerating the development of products and services that better respond to evolving tourist preferences. Accordingly, development in this area should focus on raising awareness among tourists and, most importantly, the general public regarding the significance of various forms of circular tourism, alongside fostering an environmental stewardship culture among local stakeholders. This process encourages a sense of ownership and collective responsibility for preserving cultural and environmental assets, protecting both present and future heritage from degradation.

The key objectives under this issue are as follows:

1. To cultivate a shared sustainability culture among stakeholders and promote comprehensive collaboration at the local level, while enhancing awareness and understanding of the core components of sustainable tourism under the BCG economic model.
2. To ensure that the government provides support mechanisms and policy incentives for tourism entrepreneurs and tourists who prioritize sustainable tourism practices.

The strategic framework under Issue 2: Social and Cultural Sustainability comprises two main strategies:

1. Communicating information to raise awareness among stakeholders, tourism entrepreneurs, and tourists (Awareness);
2. Establishing and enhancing incentive mechanisms to encourage stakeholders, tourism businesses, and tourists to prioritize sustainable tourism practices (Incentives).

Issue 3: Environmental sustainability: strengthening supporting factors to enhance resource management efficiency in the tourism sector. Beyond stimulating operational changes among tourism entrepreneurs and increasing demand from tourists, the effective implementation of circular tourism requires strong emphasis on the development of a comprehensive enabling ecosystem. This ecosystem reflects both the constraints and driving forces that determine whether policy implementation can be successfully realized in practice. Key elements include regulatory frameworks, laws, public policies, support measures, data systems, and collaborative networks that act as partners and leaders at multiple levels. In addition, the government must ensure the transparent and accurate dissemination of information to the general public and all relevant stakeholders. The objectives under this issue are defined as follows:

1. To review, revise, and improve relevant laws and regulations to enable tourism entrepreneurs and related agencies to effectively operate in alignment with the BCG economic model.
2. To integrate tourism-related data with BCG-oriented tourism development and establish inter-agency data governance mechanisms, enabling public agencies to jointly manage tourism sustainably, while also collecting and disseminating information for stakeholders interested in adopting the BCG framework.
3. To establish multi-sectoral collaboration networks involving government agencies, the private sector, and civil society, ensuring coordinated and connected implementation both within and across regions, ultimately contributing to national-level success in sustainable tourism development.

The strategic implementation under Issue 3: Environmental Sustainability comprises three core strategies:

1. Reviewing and revising regulations to promote sustainable tourism development (Regulations);
2. Developing research-based decision-support tools to enable informed and appropriate policy and national management decisions (Decision Support Tools); and
3. Strengthening the integration of data systems, digital technologies, and supporting infrastructure to enable BCG-oriented tourism development (Enablers).

DISCUSSION

Sustainable tourism is considered a fundamental principle of contemporary tourism promotion, as it represents a form of tourism that minimizes negative environmental impacts, maximizes benefits for local communities, and fosters sustainability across three key dimensions. Economic sustainability encompasses infrastructure development, service quality, labor conditions, and tourism-related occupations that support long-term economic resilience. Social and cultural sustainability emphasizes the preservation of local identity and traditional culture for both present and future generations, the prevention of social problems that may undermine community cohesion, and the cultivation of a

participatory culture in which stakeholders develop a strong sense of environmental stewardship and collective ownership, ensuring long-term protection against degradation. Environmental sustainability focuses on conserving natural resources, preventing environmental degradation and excessive waste generation, and reducing greenhouse gas emissions in alignment with Thailand's long-term climate targets, particularly the achievement of net-zero greenhouse gas emissions by 2065. This study finds that the most critical factor in integrating tourism development toward sustainability while achieving higher growth rates across all dimensions is the establishment of a shared culture and comprehensive understanding among all stakeholders regarding conservation, preservation, and responsible resource utilization. The social and cultural dimension emerges as the most sensitive scenario in the development of an integrated sustainable tourism model. Historically, Thailand has insufficiently emphasized this dimension, resulting in ineffective implementation, failure to achieve policy objectives, and an inability to realize long-term national development plans. In addition, sustainable tourism development requires the promotion of multi-dimensional collaboration networks with the active participation of all relevant sectors. The public sector should also ensure the adequate development of tourism infrastructure to meet the needs of target tourist segments, including accommodation facilities, transportation networks, public utilities, waste management systems, energy systems, and landscape management at tourism destinations.

Furthermore, careful prioritization of indicators used in scenario modeling is essential to prevent environmental degradation, particularly to ensure that greenhouse gas emissions do not exceed the carrying capacity of destinations before irreversible damage occurs. The government must therefore adopt clear and coherent strategies to simultaneously enhance sustainability across all dimensions. Although Thailand has introduced various initiatives—such as green tourism, community-based tourism promotion, assessments of urban carrying capacity, and policies to disperse tourists to secondary destinations—these efforts have lacked a clear long-term operational direction. Moreover, Thailand has long relied on outdated policy tools with high levels of error, leading to misaligned national governance outcomes.

The integrated modeling framework developed in this research provides a robust and practical tool that can significantly enhance national governance and support the successful achievement of sustainable tourism in Thailand over the long term. Under the recommendations of this study, the findings indicate that Thailand has not yet managed national development in an appropriately balanced direction, resulting in tourism growth that primarily benefits the economic sector while failing to foster social and cultural development and contributing to the continued degradation of the environmental sector. This research provides the government with an effective strategic management tool to support more accurate and appropriate policy formulation, thereby enhancing both efficiency and effectiveness in the future.

To achieve sustainable tourism development, growth across the three sectors; economic, social and cultural, and environmental, must occur simultaneously. The key recommendations are as follows:

1. Economic Sector: The government should promote greater access for local entrepreneurs to relevant business knowledge and operational principles related to tourism development. Priority should be given to accelerating the development of accommodation facilities that emphasize cleanliness and safety, enforcing appropriate occupational practices aligned with the characteristics of tourism destinations, and upgrading the quality and value of local souvenir products. In addition, local Thai lifestyles and community ways of life should be integrated as unique selling points to create added value, while cultural and traditional activities should be developed to enhance attractiveness for tourists. The government should also support the development of new tourism routes, such as community-based and experiential tourism, by actively encouraging community participation in tourism planning and implementation.

2. Social and Cultural Sector: The government should actively promote meaningful public participation in both the planning and implementation of tourism-related activities. This includes supporting local communities, citizens, and local administrative organizations in playing a direct role in public communication, as well as in the preservation and conservation of local wisdom and valuable cultural heritage. Efforts should focus on improving community well-being by maintaining traditional lifestyles, preserving local customs and cultural practices, and strengthening community identity so that cultural heritage is valued as a shared asset collectively owned and protected by community members, rather than merely as a public good accessible without responsibility. Furthermore, capacity-building programs should be provided to enhance community knowledge and understanding of sustainable tourism development, facilitate knowledge exchange in technology adoption, and strengthen networks with other local communities. The integration of efforts among relevant government agencies and collaboration with the private sector are also essential to ensure that communities play a meaningful role in tourism development and gain a deeper and more comprehensive understanding of sustainable tourism practices.

3. Environmental Sector: The government should enhance tourism routes and surrounding landscapes to ensure they are green, aesthetically pleasing, and well-organized throughout the entire area. Environmentally friendly tourism should be actively promoted through clearly defined guidelines and standards that can be implemented consistently and sustainably in practice. In addition, local communities should be educated on the conservation of natural resources and the environment within their own areas in order to foster environmental awareness, local stewardship, and a sense of responsibility toward their place of origin. Concrete environmental initiatives should be implemented, such as community waste bank programs, renewable energy projects at the community level, and tree bank schemes, alongside continuous efforts to cultivate environmental consciousness, particularly in relation to waste management and sustainable environmental practices. Public communication should also be directed toward tourists to promote environmentally responsible tourism behavior, while local residents and community leaders should serve as role models in environmental conservation.

Most importantly, the government must adopt proactive environmental measures, including the strengthening and enforcement of relevant laws and regulations. These measures must be clearly defined, enforceable, and effectively implemented to ensure tangible and lasting environmental sustainability outcomes. Regarding recommendations for applying this research, the researcher should carefully select indicators to ensure they are appropriate for each specific context. Importantly, all selected indicators must meet the same level of criteria or quality standards. Differences in quality levels may affect the accuracy of parameter estimation and could lead to significant spurious results. The researcher must also carry out every step with great caution in accordance with advanced statistical principles, giving particular consideration to maintaining the properties of white noise as much as possible. As for the limitations of this research, a major concern is the lack of existing studies in this field within the Thai context, as well as the absence of appropriate analytical tools that can effectively support evidence-based policy formulation and national planning.

As a result, Thailand has historically lacked accurate and suitable decision-making instruments, leading to misaligned governance directions and policy formulation. In practice, national policies have tended to prioritize economic growth as the primary objective, while insufficient attention has been given to environmental development alongside social progress. This imbalance has generated negative consequences, particularly the degradation of environmental systems and irreversible changes to social and cultural structures. Cultural values and traditions that have been altered or lost due to unsustainable development cannot be fully restored, similar to environmental resources that have deteriorated beyond recovery.

CONCLUSIONS

This study entitled A Causal Relationship Model of Social and Cultural Change Influencing the Future Success of Integrated and Sustainable Tourism Management in Thailand, developed and validated the Logit-PA model as an integrated analytical framework for examining the causal relationships among the social and cultural, BCG-economic, and pro-environmental sectors influencing sustainable tourism development in Thailand. The empirical findings demonstrate that the proposed model exhibits superior forecasting performance compared with conventional approaches, confirming its suitability for long-term policy analysis and strategic planning. The results further reveal that stakeholder participation within the social and cultural sector is the most influential factor affecting sustainable tourism success. At the same time, incorporating this variable into the proposed policy scenario substantially improves long-term environmental outcomes by reducing projected greenhouse gas emissions to a level consistent with Thailand's net-zero emissions target by 2065.

The study also demonstrates that sustainable tourism can only be achieved through the balanced integration of economic development, social and cultural preservation, and environmental protection under the principles of the BCG economy. Accordingly, enhancing the capacity of tourism service providers, strengthening stakeholder participation, promoting the consumption of sustainable tourism products and services, and improving environmental resource management should be implemented simultaneously to maximize policy effectiveness and long-term sustainability.

The principal contribution of this research lies in the development of a context-specific decision-support model that integrates quantitative forecasting with qualitative policy synthesis to support evidence-based national tourism planning. The proposed framework provides substantial practical value for policy formulation and implementation by enabling governments to identify high-impact policy priorities and evaluate alternative development scenarios with greater precision. Furthermore, although the model was developed within the context of sustainable tourism management in Thailand, its analytical framework may be adapted and applied to other development sectors and geographical contexts where integrated sustainability planning is required under changing future conditions.

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INTEGRATED CA-MARKOV AND GEO-IT MODELING OF FUTURE LAND USE CHANGE IN SAMUI ISLAND, SURAT THANI PROVINCE, THAILAND

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Abstract: Samui Island is a world-class marine tourism destination and a key economic driver for Thailand. Over the past several decades, Samui Island has experienced rapid spatial transformation. Development to support the tourism industry has led to rapid land use changes. The objective of this research is to analyze changes in land use patterns around Samui Island, Thailand, between 2006 and 2024 using Geo-information Technology (Geo-IT). Land use classification was performed from Landsat satellite images at each time period using the Random Forest classification method to detect and track changes in each type of land use. Future land use patterns in 2042 were then modelled using the CA-Markov model. Research results showed that in 2006, the majority of Samui Island's land area was covered by coconut, accounting for over 58.03% of the total area (137.28 km^2). This area is located on the steep slopes of the central part of Samui Island. After 18 years, the area under coconut cultivation decreased, and the area was transformed into durian plantations and villages. The overall accuracy of land use classification was 84.1%, 81.7%, and 75.3% in 2024, 2014, and 2006, respectively. A CA-Markov model simulation of land use patterns for the year 2042 shows that over the next 18 years, land use patterns for City, Town, Commercial (U1), and Institutional (U3) land use categories will increase by 1044.05% and 1050.27%, respectively. Urban expansion in the northeastern part of Samui Island, in the Bo Phut area, has seen grass land transformed into villages. In the southern part of Samui Island, around Na Mueang, Paddy Field has been transformed into a village, the same as the western part of Samui Island, around Taling Ngam. The results highlight the predicted spatial and temporal dynamics of land use changes in Samui Island, revealing land use changes resulting from urban expansion and agricultural expansion, particularly coconut and durian, which are local cash crops. Therefore, it is imperative to monitor the areas that are sensitive to the changes occurring in the plain landscape around the island, especially the areas of Paddy field, Grass land, Forest land, Orchards, and Perennial crops that are often converted into urban areas and villages. However, this research provides spatially-based land use data that will be useful for effective land use development planning in coastal tourism cities. This data will support decision-making in preparing for sustainable tourism development in the future.

Keywords: Future Land Use Change, CA-Markov Model, Geo-IT, Ko Samui Island, Surat Thani

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INTRODUCTION

Land use changes (LUC) in islands has more complex and severe impacts than on mainland areas (Oktavia et al., 2024; Han et al., 2024). This is because islands have limited, fragile ecosystems and limited natural resources (Moustakas et al., 2025; Wayesa et al., 2025). Forest and agricultural areas are inevitably affected by urban expansion and construction (Mustelier & Henríquez, 2024; Thien et al., 2025). The main impacts of LUC on the island can be divided into three main areas: environmental and ecological, resource, and socio-economic. Environmental and ecological impacts, such as destruction of local animal and plant habitats, coastal degradation, natural disasters (flood, landslide etc.) (Dieno & Pathan, 2025; Tsumita et al., 2025; Aldiansyah et al., 2025).

The impacts of limited resources include freshwater shortages, soil erosion, and waste disposal problems on the island (Kamaraj & Rangarajan, 2022; Bikis et al., 2025). And, social and economic impacts include land use conflicts, local economic vulnerability, and changes to traditional cultures and ways of life (Quintas-Soriano et al., 2022).

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Tourism is one of the most important drivers of land use change in areas with tourism potential, such as islands, coasts, or important World Heritage sites (Rimba et al., 2021; Liu et al., 2025; Ibarra-Núñez & Ortega-Rubio, 2025). This is often associated with the expansion of buildings, and the reduction of natural and agricultural areas (Birthal et al., 2021). Tourism acts as a magnet, attracting investment and creating demand for land in ways that are not conventional, leading to a rapid and intensive shift from traditional land use to commercial use. Research on the use of Geo-IT has often been applied to assess land use in major tourist cities such as Guangxi. It has been found that the majority of land use patterns are forested, but by 2020, the area will be affected by a shift from forestry to agriculture. It was also found that wetlands are decreasing (Qiu et al., 2021). In Hainan Island, the ecological system has been severely impacted by LUC for tourism development, with forest areas being converted into cities and farmland (Yang et al., 2024). Zhangjiajie, China, has been seen the largest increase in built-up area during 2000-2020, with most of its farmland and grasslands converted to built-up areas. The main cause is the shift to land use for tourism-related construction (Wang et al., 2023). In São Paulo, urban expansion has been found to have an impact on the area's freshwater resources, causing water shortages for the tourism sector (Petroni et al., 2022).

Tourism affects the physical processes of an area, particularly its natural resources and socio-economic aspects. For example, a study conducted in the tourist town of Menfi (Italy) found that during 2007-2022, there was a decrease in the area of grape cultivation, and an increase in the area for residential tourism (second homes). This, along with the cultivation of olives, has resulted in significant soil erosion. The main drivers are socioeconomics and the shift to olive cultivation in low-lying areas with landscape value (Tonolli et al., 2024). In the Sungai Karang coastal area (Malaysia), there was a rapid expansion of resorts and coastal infrastructure during 1966-2013 (Marzuki et al., 2024). Kolkata, India, during 2005-2019, experienced rapid urbanization, resulting in a decrease in vegetation cover, particularly in the urban core, and an increase in built-up area, which in turn increased surface temperatures (Chatterjee & Majumdar, 2022).

And in Ubud, Bali, they have analyzed the transformation of courtyard spaces to support sustainable tourism based on the principles of the Culture of Harmony. Qualitative research findings revealed that most courtyard areas (Palemahan or Teba), formerly used for animal breeding, raising/removing dirt, and gardening, have been transformed into tourist accommodations. Quantitative findings confirmed that this transformation has had positive economic, social, cultural, and environmental impacts, supporting sustainable tourism (Waridin & Astawa, 2021).

Therefore, it is imperative to urgently study LUC in major tourist destinations like Samui Island to prepare for economic growth while preserving quality of life, the environment, and local identity.

Samui Island is the second largest island in Thailand. It is located on the eastern coast of southern Thailand in the Gulf of Thailand. The word "Samui" has several uncertain origins, but the most reliable hypothesis is that it comes from the southern Tamil word "Samoi," meaning "waves," which later became corrupted into "Samui." Other theories suggest that the name comes from the Hainanese word "shao mui," which means "first checkpoint," or from the name of a tree called "mui," which grows widely on the island. Samui Island is a world-class marine tourism destination and a key economic driver for Thailand (Pongponrat, 2022; Iabsap & Phucharoen, 2025). Known for its beautiful beaches, crystal-clear waters, and iconic coconut groves, Samui Island has become a popular destination, attracting tourists from around the world. Over the past several decades, Samui Island has experienced dramatic spatial changes. Rapid development to support the tourism industry has led to the most pronounced changes in land use (Mustafa et al., 2019; Pongsakornrungsilp & Pongsakornrungsilp, 2023). The area has rapidly transformed from agricultural areas, particularly coconut plantations, into service areas. These areas have been intensively converted into hotels, resorts, vacation homes, and various tourism infrastructure. The expansion of construction has significantly diminished the original landscape of "Coconut Island" (Ubonsri & Daungthima, 2024). This shift, particularly in the easily accessible coastal plain, reflects a complete economic shift from agriculture to the service sector. Spatial changes on Samui Island thus fully transform from an agricultural society into an international tourism hub. This has resulted in challenges in natural resource management, environmental impacts, and social pressures from rising land prices and the cost of living in the area. Therefore, sustainable management requires robust spatial planning to control urban expansion and strike an appropriate balance between economic growth and the sustainable preservation of the island's natural and cultural identity.

The objective of this research is to analyze land use pattern changes on Samui Island, Thailand, between 2006 and 2024 using geoinformatics technology and to model future land use patterns through 2042 using a CA-Markov model. This research utilized land use classification from Landsat satellite imagery at different times to detect and track changes in different land use types. This research process aligns with the Sustainable Development Goals (SDGs). Especially SDG 11, Sustainable Cities and Communities, as it contributes to understanding urban sprawl caused by tourism (Kelly-Fair et al., 2022; Enoh et al., 2023; Estoque et al., 2021; Ferdos et al., 2026). This research aims to inform urban planning and determine effective land use control measures. This research helps predict and prevent the loss of important areas, such as forests or agricultural areas. This aligns with SDG 15: Life on land, protecting and restoring terrestrial ecosystems (Cao et al., 2023; Utama et al., 2024). It also supports SDG 8: Decent work and economic growth by promoting sustainable tourism that balances economic benefits with the preservation of natural resources and the environment, which are the heart of long-term tourism (Song et al., 2023; Appelt et al., 2022; Suhud et al., 2025). The expected outcomes of this research include empirical spatial data and tools for policy decision-making. In particular, historical land use change maps and models predicting future urban expansion patterns will be obtained. This will enable local authorities to more effectively plan urban planning and implement land use control measures, preventing encroachment on environmentally sensitive areas and planning appropriate infrastructure and utility investments. Furthermore, these results provide an important foundation for promoting sustainable tourism by balancing economic growth with the long-term conservation of Samui Island's natural resources and unique identity.

MATERIALS AND METHODS

Study area and Background

Samui Island is the largest island in the Gulf of Thailand and the second largest after Phuket (Iabsap & Phucharoen, 2025). It covers an area of 236.57 km^2. Samui Island is located between latitudes 9°20' N to 9°40' N and longitudes 99°50' N to 100°10' N (Figure 1). Samui Island is located northeast of Surat Thani Province in the Gulf of Thailand, approximately 84 km off the coast. Samui Island's main topography is a mountainous region in the central part of the island, straddling the northwest to southeast. The highest peak is Khao Pom, at 645 m. high. The surrounding area is a coastal plain, which is why most settlements are located on this terrain (Bai et al., 2021).

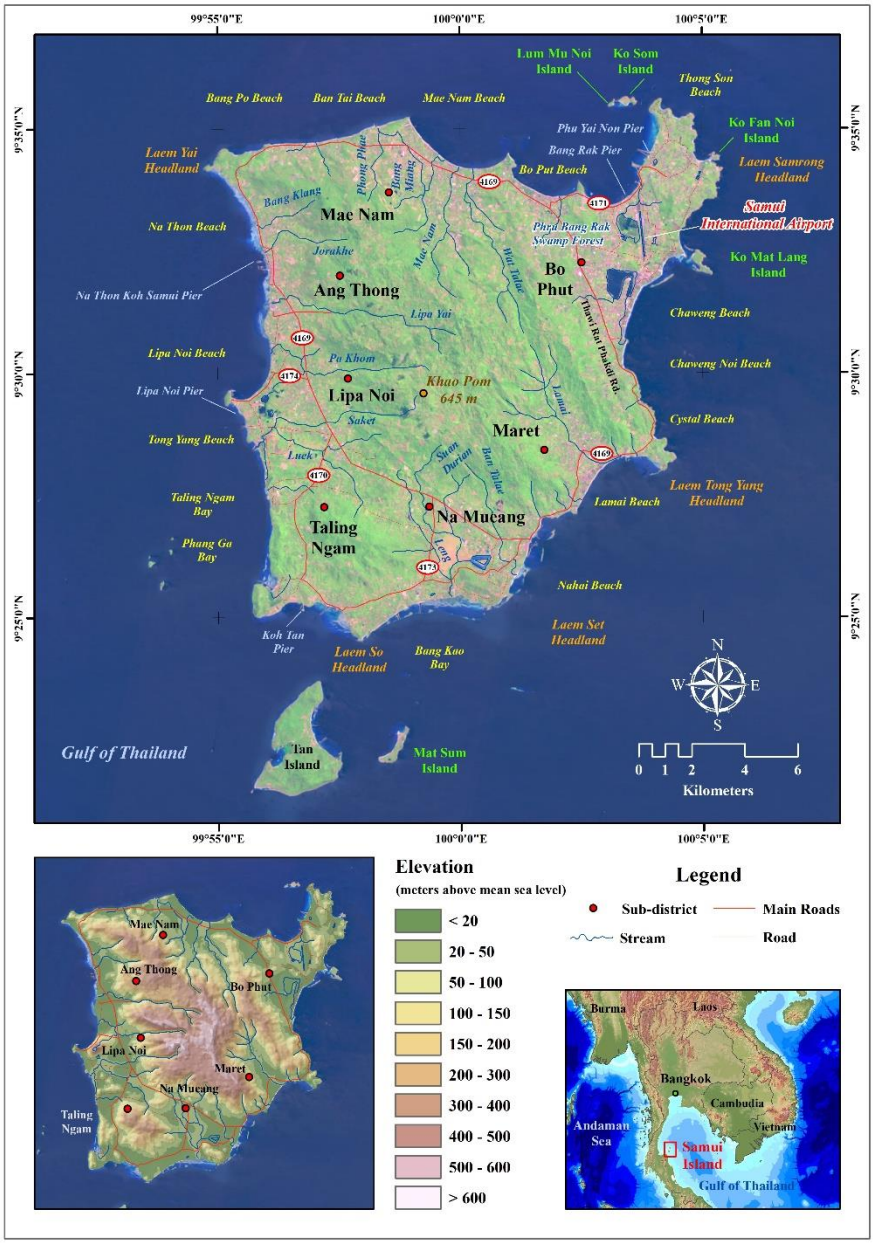


Figure 1. Location of Samui Island, Surat Thani Province, Thailand (Source: Collected and processed by authors)

The largest coastal plain covers the northeastern part of Samui Island, where Bo Phut subdistrict is located. This area has beautiful coastline and beaches, including Chaweng and Chaweng Noi beaches, which are the most beautiful on Samui Island. It is also home to Samui International Airport. The southern part of the island features a narrow coastal plain with beautiful beaches like Lamai and Nahai, located between Laem Tong Yai and Laem Set headlands. The southern part of the island features indented bays, including Bang Kao, Phang Ga, and Taling Ngam bays. The western part of the island features a long coastal plain with important beaches like Tong Yang, Lipa Noi, and Na Thon. Na Thon Beach is home to a major transport pier, Na Thon Koh Samui Pier, for travel between the island and the mainland.

The northern part of the island, from Laem Yai Headland to Laem Samrong Headland, features a long coastal landscape that extends to the northeastern coastal plain. Important beaches include Bang Po, Ban Tai, Mae Nam, Bo Put, and Thong Son beaches (Yeemin et al., 2024). Laem Samrong Headland is also home to important ports for travel

between other major islands in the Gulf of Thailand, namely Bang Rak and Phu Yai Non Pier. Samui Island's drainage system is characterized by a radial drainage system. Controlled by geological features, the central part of the island is a large Triassic igneous rock mountain range (Nazaruddin, 2020). As the mountain range was eroded by rainwater and streams, it formed a coastal plain around Samui Island, covered with modern sedimentary rocks, known as Quaternary Alluvial Deposits. The major drainage systems are: 1) River systems flowing into the Gulf of Thailand to the north, including the Phong Phae, Bang Miang, Mae Nam, and Wat Talea streams. 2) River systems flowing into the Gulf of Thailand to the south, including the Lamai, Ban Talae, Suan Durain, and Leng streams. And, 3) River systems flowing into the Gulf of Thailand to the east, including the Bang Klang, Jorakhe, Lipa Yai, Pa Khom, Saket, and Luek streams.

Tourism on Samui Island began in the 1970s with backpackers seeking the pristine nature, tranquil beaches, and simple island lifestyle. At that time, the main occupation of Samui Island residents was coconut farming, which led to the image of the "Coconut Island" alongside the beauty of the sea. In the 1980s, tourism on Samui Island began to expand rapidly, driven by infrastructure development. A pier and a road around the island, Thawi Rat Phakdi Road (Highway 4169), were built, making travel easier. In 1989, Bangkok Airways Public Company Limited opened Samui Airport, making travel from Bangkok convenient and faster, attracting more premium tourists (Vu & Turner, 2006).

Furthermore, investment in numerous world-class hotels and resorts has enabled Samui Island to cater to a diverse range of tourist groups, from backpackers to high-end travelers. Samui Island also boasts tourism resources, particularly its natural beauty, such as its beautiful beaches, such as Chaweng, Lamai, and Bophut. This has resulted in a variety of tourism activities, including water activities (snorkeling, scuba diving, kayaking, jet skiing, etc.), cultural activities such as temples and local communities, nature and adventure tourism such as trekking to waterfalls, an open zoo, ATV rides, and health tourism such as massage and spas, which are abundant on Samui Island.

Data Preparation

This research collected satellite imagery from Landsat 5TM, 8OLI/TIRS, and 9 OLI/TIRS satellites, covering the years 2006, 2014, and 2024, respectively (Table 1). These satellite images are available from the U.S. Geological Survey. Band combinations were then performed in ArcMap 10.8 software to obtain easily interpretable land cover and various land use patterns to track land use change over time. Band combinations were performed this time. Landsat 5TM satellite imagery has been blended with the R: G: B band of 543, which is a combination of short-wave infrared, near-infrared, and red bands (Thien et al., 2025; Le et al., 2025). Landsat 8OLI/TIRS and Landsat 9OLI/TIRS satellite imagery have been blended with the R: G: B band of 654, which is a combination of short-wave infrared, near-infrared, and red bands (Sales et al., 2023). Once the satellite imagery from the three time periods was acquired, it was processed through the Satellite Imagery Cloud Removal and Correction process, as satellite imagery covering the study area often exhibits cloud cover almost year-round due to the tropical equatorial climate. Radiometric correction using standard deviation was then performed to obtain sharper satellite imagery prior to land cover interpretation (Du et al., 2002; Hantson & Chuvieco, 2011).

Table 1. Satellite Image data over the Ao Nang area, Krabi Province

Database	Red:Green: Blue (R:G:B)	Path/Row	Resolution	Acquisition date	Format	Sources
Landsat 5TM	5:4:3	129/53	30 m	1 April 2006	Image file	https://earthexplorer.usgs.gov/
Landsat 8 OLI/TIRS	6:5:4	129/53	30 m	13 June 2014	Image file	https://earthexplorer.usgs.gov/
Landsat 9 OLI/TIRS	6:5:4	129/53	30 m	13 August 2024	Image file	https://earthexplorer.usgs.gov/

METHODOLOGY

The research process includes the Geo-IT process and the CA-Markov model, as shown in Figure 2. Details of each step are briefly explained below:

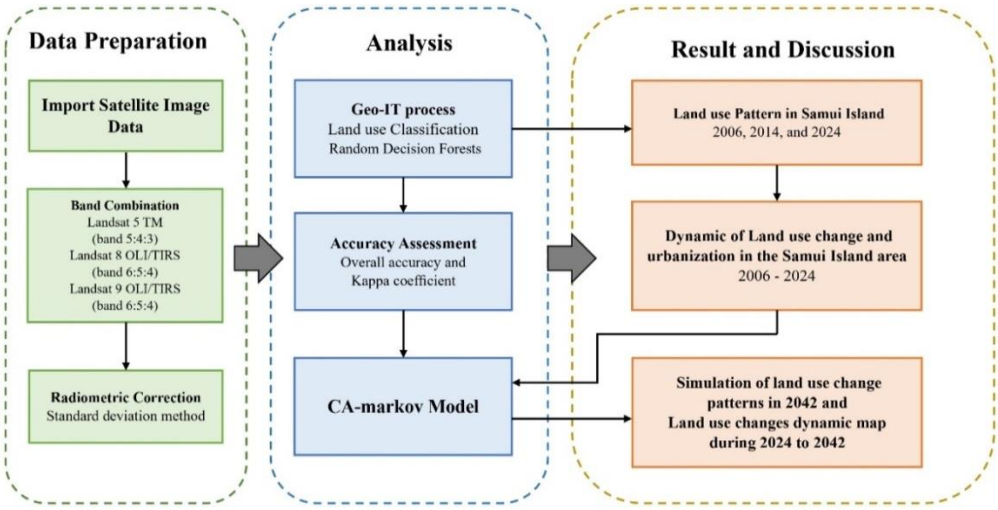


Figure 2. Flow chart of methodology

Geo-IT process

Geo-IT is a process that combines remote sensing and GIS. This research applied Geo-IT to land use and land cover classification. In this step, satellite imagery from three time periods (2006, 2014, and 2024) was imported into ArcGIS 10.8 software to analyze land use classification using machine learning principles. This approach utilises deep learning classification techniques, such as Random Decision Forests (or Random Forest), an ensemble learning method for land use and land cover classification. The Random Decision Forests method is a popular method for efficiently interpreting land use (Phinzi et al., 2023). Random Forest is a classification method that relies on an ensemble of decision trees. By combining the predictions of multiple weak learners, it generally attains higher accuracy than any single tree. The model's final output is produced by aggregating the decisions of all trees in the ensemble, most often through majority voting (Rodriguez-Galiano et al., 2012; Avci et al., 2023). The training process for a Random Forest is incremental, with decision trees added sequentially. After each tree is built, the algorithm assesses the model's performance using out-of-bag (OOB) samples. These samples are run through the forest, and their predicted labels are determined via majority voting (Jamali et al., 2024). The importance or contribution of each feature to an individual tree is then computed as described in Equation 1 (Krishna & Gopinath, 2022).

$$fi_i = \frac{\sum_{j:node\ j\ splits\ on\ feature\ i} ni_j}{\sum_{k \in all\ nodes} ni_j} \quad (1)$$

Where fi_i is the importance of feature i; ni_j is the importance of node j. These can then be normalized to a value between 0 and 1 by dividing by the sum of all feature importance values (Equation 2) (Krishna & Gopinath, 2022):

$$normfi_i = \frac{fi_i}{\sum_{j \in all\ features} fi_i} \quad (2)$$

The final feature importance, at the Random Forest level, is its average over all the trees. The sum of the feature's importance value on each tree is calculated and divided by the total number of trees (Equation 3) (Krishna & Gopinath, 2022):

$$RFfi_i = \frac{\sum_{j \in all\ trees} normfi_{ij}}{T} \quad (3)$$

Where $RFfi_i$ is the importance of feature i calculated from all trees in the Random Forest model; $normfi_{ij}$ is the normalized feature importance for i in tree j; and T is total number of trees. The results of the land use pattern interpretation are displayed as the overall accuracy and Kappa coefficient (KHAT) to assess the accuracy of the classification of various data that appear on satellite imagery (Foody, 2020; Chaaban et al., 2022). Sampling points in the study area were determined based on data from the Land Development Department (LDD), Thailand. To evaluate classification accuracy, this study utilizes the confusion matrix, overall accuracy (OA), and kappa coefficient. The matrix distinguishes between correct assignments (diagonal) and misclassifications (off-diagonal), specifically identifying commission errors (FP) that impact precision and omission errors (FN) that represent missed targets. Overall accuracy is derived from the ratio of correct predictions (TP + TN) to total samples. Additionally, the kappa coefficient accounts for chance-based agreement; values near +1 reflect high model reliability, whereas negative values suggest systematic discrepancies between classified results and reference data. The OA was calculated based on Equation 4 and the kappa coefficient calculated using Equation 5 (Sarvestani et al., 2025):

$$Overall\ accuracy\ = \frac{TP+TN}{TP+FP+TN+FN} \quad (4)$$

where *TP* is the number of correct positive predictions, *TN* is the number of correct negative predictions, *FP* is the commission error, and *FN* is the omission error.

$$\text{Kappa coefficient} = \frac{p_0 - p_e}{1 - p_e} \quad (5)$$

where P_0 is the observed accuracy, and P_e is the expected accuracy.

The validation was performed compared with the data obtained from the classification. The classification criteria were as follows (Herano et al., 2025): < 0 means unacceptable classification data; 0.01 – 0.40 means fair classification data; 0.41 – 0.60 means moderate classification data; 0.61 – 0.80 means good classification data; 0.81 – 1.00 means very good classification data. After validation of the data obtained from the land use pattern interpretation, the data that passed the Overall Accuracy and KHAT criteria were analyzed for land use change using the Change Detection method in the Tabulate area analysis function in ArcGIS 10.8 software. The change detection analysis can be calculated as Equation 6 (Puyravaud, 2003; Kiriwongwattana & Waiyasusri, 2024):

$$\Delta = [(A_2 - A_1) / A_1 \times 100] / (T_2 - T_1) \quad (6)$$

Where Δ is the percentage change in land use pattern. A_1 is the land use type at time one (T_1). A_2 is the land use type at time two (T_2). The results are displayed as the land use proportions of each type on a transition matrix map, which shows the land use change patterns from 2006 to 2024 on Samui Island.

CA-Markov model

The CA–Markov model is a dynamic, multi-scale, spatially explicit, raster-based approach capable of identifying locations with a high likelihood of future land use change (Guan et al., 2011; Jafari et al., 2016; Xu et al., 2023). In this framework, the CA–Markov component functions as the non-spatial demand module, estimating land use transitions over a series of years at an aggregate level. Markov chain analysis, a stochastic method, characterizes how specific conditions evolve step by step within a land use geospatial dataset. The model is built using land use distributions at the start (X_t) and end (X_{t+1}) of a discrete time interval, along with a transition matrix (X_{LU}) that captures the LUC occurring

during that period. The values in this matrix come directly from classifying the three multispectral Landsat images using the maximum likelihood algorithm, expressed as the proportion of each land use category (Adhikari & Southworth, 2012). This matrix is then used to establish the "link'' in the Markov chain, as represented in Equation 7.

$$P_{i,j} \times i_t = i_{t+1}, \qquad \begin{bmatrix} P_{uu} & P_{ua} & P_{uw} \\ P_{au} & P_{aa} & P_{aw} \\ P_{wu} & P_{wa} & P_{ww} \end{bmatrix} \begin{bmatrix} U_t \\ A_t \\ W_t \end{bmatrix} = \begin{bmatrix} U_{t+1} \\ A_{t+1} \\ W_{t+1} \end{bmatrix} \tag{7}$$

where t is the time (Year), $P_{i,j}$ is the transition probability matrix of the land use class i change to class j. i and j are the land use classes in the first year and the second year, respectively. The CA-Markov analysis was used to determine the demand for the probability of each land use pattern, where the probability of transition ($P_{i,j}$) is given for every ordered set of conditions. In a CA-Markov with a limited number of conditions, such as j, a new transition probability matrix is bounded, as in Equation 8 (Butt et al., 2015):

$$V_j \times P_{jk} = [V_1, V_2, V_3, \ldots, V_n] \begin{bmatrix} P_{11} & P_{12} & \ldots & P_{1m} \\ P_{21} & P_{22} & \ldots & P_{2m} \\ P_{31} & P_{32} & \ldots & P_{3m} \\ \vdots & \vdots & & \vdots \\ P_{n1} & P_{n2} & \ldots & P_{nm} \end{bmatrix}, \tag{8}$$

Where $Vj \times Pjk$ is the proportion of land use in the second year; P_{jk} is the land use activity (f) derived from the transition probability matrix; V_j is the proportion of land use in the first year; j is the type of land use in first year and; k is the type of land use in the second year. The results of the model will provide spatially representative land use data for 2042. This data will be used to plan island development and prepare for future spatial changes in the Samui Island area.

RESULTS

Land use pattern in Samui island area

Classifying land use patterns from Landsat satellite imagery from three time periods: 2006, 2014, and 2024, using the Random forest classification method, resulted in this research on the land use patterns in Samui. There are 15 types of island classifications: Paddy field (A1), Perennial crops (A3), Perennial crops (A4), Durian (A403), Coconut (A405), Forest land (F), Grass land (M1), Mineral (M3), Beach (M6), City, Town, Commercial (U1), Villages (U2), Institutional land (U3), Transportation (U4), Recreation area (U6), and Water bodies (W). The overall accuracy assessment of land use classification was 84.1%, 81.7%, and 75.3% in 2024, 2014, and 2006, respectively, with a Kappa coefficient of 0.81, 0.78, and 0.70, respectively. The classification results are considered good to very good.

In 2006, the majority of Samui Island's land use, over 58.03% of the total area (137.28 km²), was used for coconut cultivation. This is because the study area has long been a coconut-growing region, a local economic crop and a fundamental part of the Samui islanders' way of life, earning it the nickname "Coconut Island." The most popular coconut variety is the Samui Cooking Coconut. This variety has been renowned and cultivated for over 100 years due to its large size, good weight, rich and delicious coconut milk, and its acceptance in the market. The second most common land use on Samui Island was Forest land (16.33% of the total area), and Villages (8.60% of the total area), respectively. The second most popular crop after coconut was durian, covering 5.66% of the total area (13.38 km²). The majority of durian plantations are located in the central part of Samui Island. This area is characterized by mountainous and sloping terrain on the island. The most popular durian varieties grown are Monthong, Chanee, and Met Nai Samui. Monthong is the most popular variety for commercial cultivation and export to China. Chanee is primarily grown commercially domestically. Met Nai Samui is a rare local variety currently being developed and propagated on Samui Island.

Table 2. Land use pattern statistics in Samui island area in 2006, 2014, and 2024 (km^2) (Source: Processed by authors)

Land Use Pattern		2006		2014		2024		Area Change (km^2)		
		km^2	%	km^2	%	km^2	%	2006 to 2014	2014 to 2024	2006 to 2024
A1	Paddy field	6.83	2.89	6.71	2.84	5.86	2.48	-0.12	-0.85	-0.97
A3	Perennial crops	8.48	3.58	6.20	2.62	5.96	2.52	-2.28	-0.24	-2.52
A4	Orchards	1.68	0.71	12.79	5.41	9.74	4.12	11.11	-3.05	8.06
A403	Durian	13.38	5.66	19.04	8.05	20	8.45	5.66	0.96	6.62
A405	Coconut	137.28	58.03	68.81	29.09	61.19	25.86	-68.47	-7.62	-76.09
F	Forest land	38.63	16.33	58.95	24.92	57.29	24.22	20.32	-1.66	18.66
M1	Grass land	1.51	0.64	15.26	6.45	24.99	10.56	13.75	9.73	23.48
M3	Mineral	0.22	0.09	0.55	0.23	1.30	0.55	0.33	0.75	1.08
M6	Beach	1.37	0.58	1.39	0.59	1.37	0.58	0.02	-0.02	0.00
U1	City, Town, Commercial	1.26	0.53	1.25	0.53	1.26	0.53	-0.01	0.01	0.00
U2	Villages	20.34	8.60	35.06	14.82	38.15	16.13	14.72	3.09	17.81
U3	Institutional land	0.18	0.08	0.77	0.33	0.93	0.39	0.59	0.16	0.75
U4	Transportation	1.42	0.60	1.67	0.71	1.76	0.74	0.25	0.09	0.34
U6	Recreation area	2.25	0.95	4.40	1.86	4.58	1.94	2.15	0.18	2.33
W	Water bodies	1.75	0.74	3.73	1.58	2.2	0.93	1.98	-1.53	0.45
Total		236.58	100.00	236.58	100.00	236.58	100.00			
Overall Accuracy (%)		75.30		81.70		84.10				
Kappa Coefficient		0.70		0.78		0.81				

Dynamic of land use change in the Samui island area during 2006 to 2024

This research found that over the past 18 years, the area planted with coconut trees has decreased by more than 76.09 km², a reduction of over half. This change in coconut plantation area is due to the expansion of the tourism business and changes in the lifestyle of local people, shifting from agriculture to the tourism service sector. In addition, some coconut plantations have been replaced by other agricultural forms and expanded village areas. The trend shows that land use for durian, grass land, and villages is increasing exponentially. For example, durian cultivation has become the largest agricultural crop on Samui Island, surpassing coconuts in terms of production value. Turf land is awaiting conversion from traditional agriculture like coconut cultivation to construction or in preparation for expanding durian cultivation. Land use with less change includes paddy field, minerals, beach, city town and commercial, institutional land, and transportation. The proportions of each land use type are detailed in Figure 3 and Table 2.

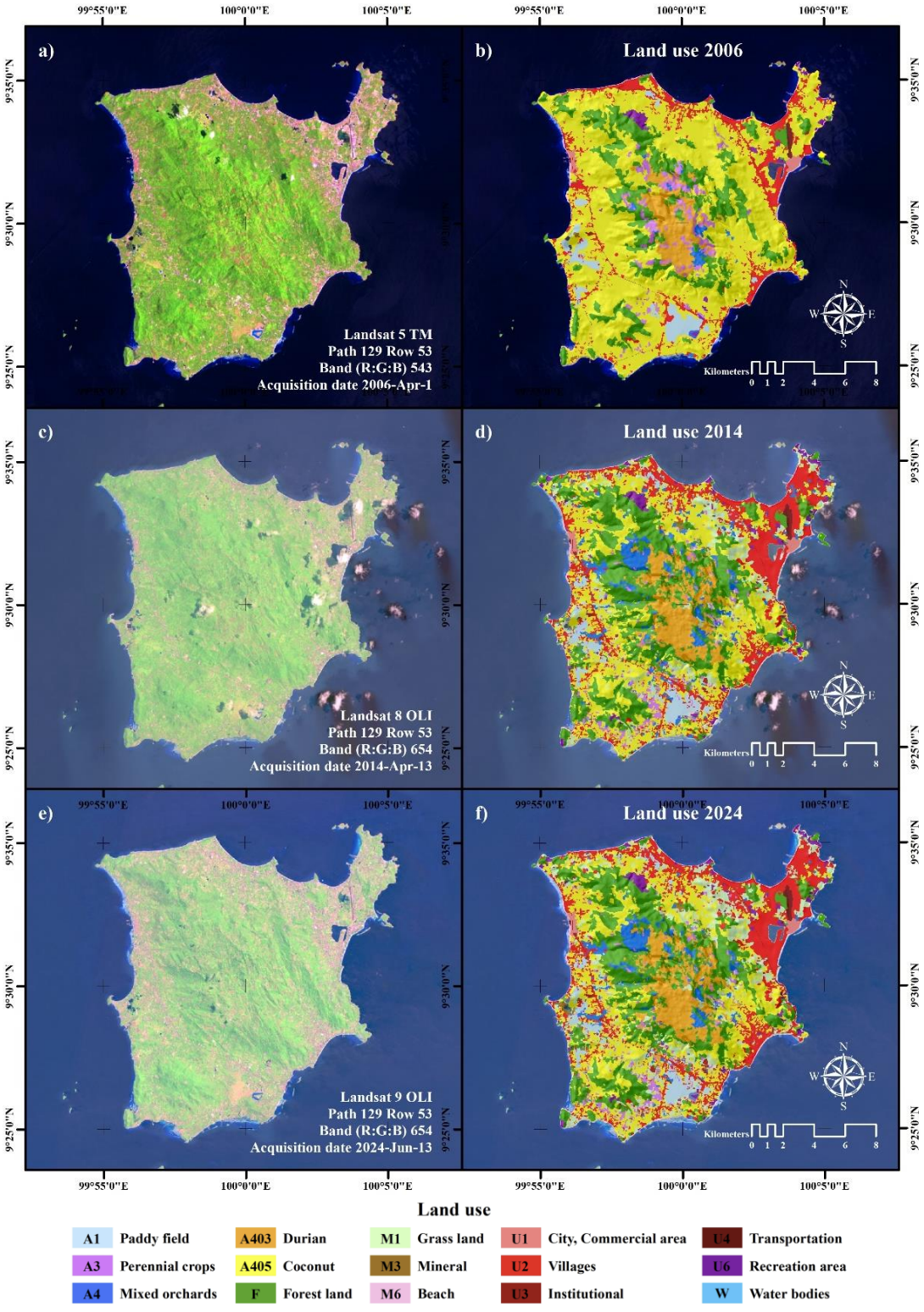


Figure 3. Landsat satellite imagery and land use pattern of Samui island area in 2006, 2014, and 2024 (Source: Collected and processed by authors)

Over the past 18 years, Samui Island has shown spatial changes, including changes in agricultural areas such as coconut, durian, and perennial plantations, as well as an increase in forest areas and urban expansion. Changes in land use between 2006 and 2024 were researched using the tabulate area method in ArcMap. The results are presented in the form of a metric table of LUC as shown in Table 3. This research found that, between 2006 and 2024, the most significant change in land use was observed in Samui Island, with a substantial increase of 1555.13% over the past 18 years. This type of land use, which was originally only 1.51 km², has now increased to 24.99 km².

Table 3. Matrix of Land use change in Samui island area during 2006 to 2024 (km^2)

Land use change		2024																Changing Area	
		A1	A3	A4	A403	A405	F	M1	M3	M6	U1	U2	U3	U4	U6	W	Total	km^2	%
2006	A1	4.87	0.13	0.10	0.02	0.13	0.03	0.53	0.22	0.00	0.00	0.50	0.12	0.00	0.02	0.16	6.83	-0.97	-14.21
	A3	0.00	0.43	1.11	2.98	0.26	2.95	0.63	0.07	0.00	0.00	0.05	0.01	0.00	0.00	0.01	8.48	-2.53	-29.87
	A4	0.00	0.02	1.26	0.04	0.06	0.25	0.03	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.02	1.68	8.06	479.46
	A403	0.00	0.18	0.28	10.41	0.14	2.01	0.27	0.00	0.00	0.00	0.08	0.01	0.00	0.00	0.00	13.38	6.62	49.51
	A405	0.82	4.70	5.55	4.22	57.34	20.99	20.36	0.83	0.03	0.05	19.51	0.23	0.21	2.13	0.32	137.28	-76.09	-55.43
	F	0.00	0.46	1.24	2.33	2.31	30.69	0.75	0.10	0.00	0.00	0.39	0.04	0.11	0.21	0.01	38.63	18.65	48.28
	M1	0.00	0.00	0.00	0.00	0.00	0.00	1.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.51	23.48	1555.13
	M3	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.02	0.00	0.00	0.01	0.00	0.02	0.00	0.00	0.23	1.08	477.78
	M6	0.00	0.00	0.00	0.00	0.02	0.00	0.01	0.00	1.21	0.00	0.05	0.00	0.00	0.01	0.06	1.35	0.03	2.04
	U1	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.00	1.16	0.02	0.02	0.04	0.00	0.00	1.27	-0.02	-1.38
	U2	0.17	0.03	0.16	0.01	0.88	0.33	0.53	0.07	0.03	0.03	17.10	0.17	0.27	0.53	0.05	20.34	17.82	87.61
	U3	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.03	0.14	0.00	0.00	0.00	0.18	0.75	422.54
	U4	0.00	0.01	0.00	0.00	0.04	0.02	0.05	0.00	0.00	0.01	0.22	0.01	1.09	0.01	0.00	1.46	0.30	20.17
	U6	0.00	0.00	0.01	0.00	0.01	0.00	0.17	0.00	0.02	0.00	0.14	0.19	0.02	1.67	0.02	2.24	2.34	104.58
	W	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.08	0.00	0.06	0.00	0.00	0.00	1.55	1.70	0.50	29.07
	Total	5.86	5.95	9.74	20.00	61.19	57.29	24.99	1.30	1.37	1.26	38.15	0.93	1.76	4.58	2.20			

This area is being prepared for future land use changes, such as durian cultivation, perennial tree plantations, or building construction. The second most significant change was in Orchards (A4), with a rate of change as high as 479.46%. Between 2006 and 2024, the proportion of this land use increased from 1.68 km² to 9.74 km². This is attributed to the increasing commercial cultivation of other fruit trees such as rambutan, mangosteen, and other fruits.

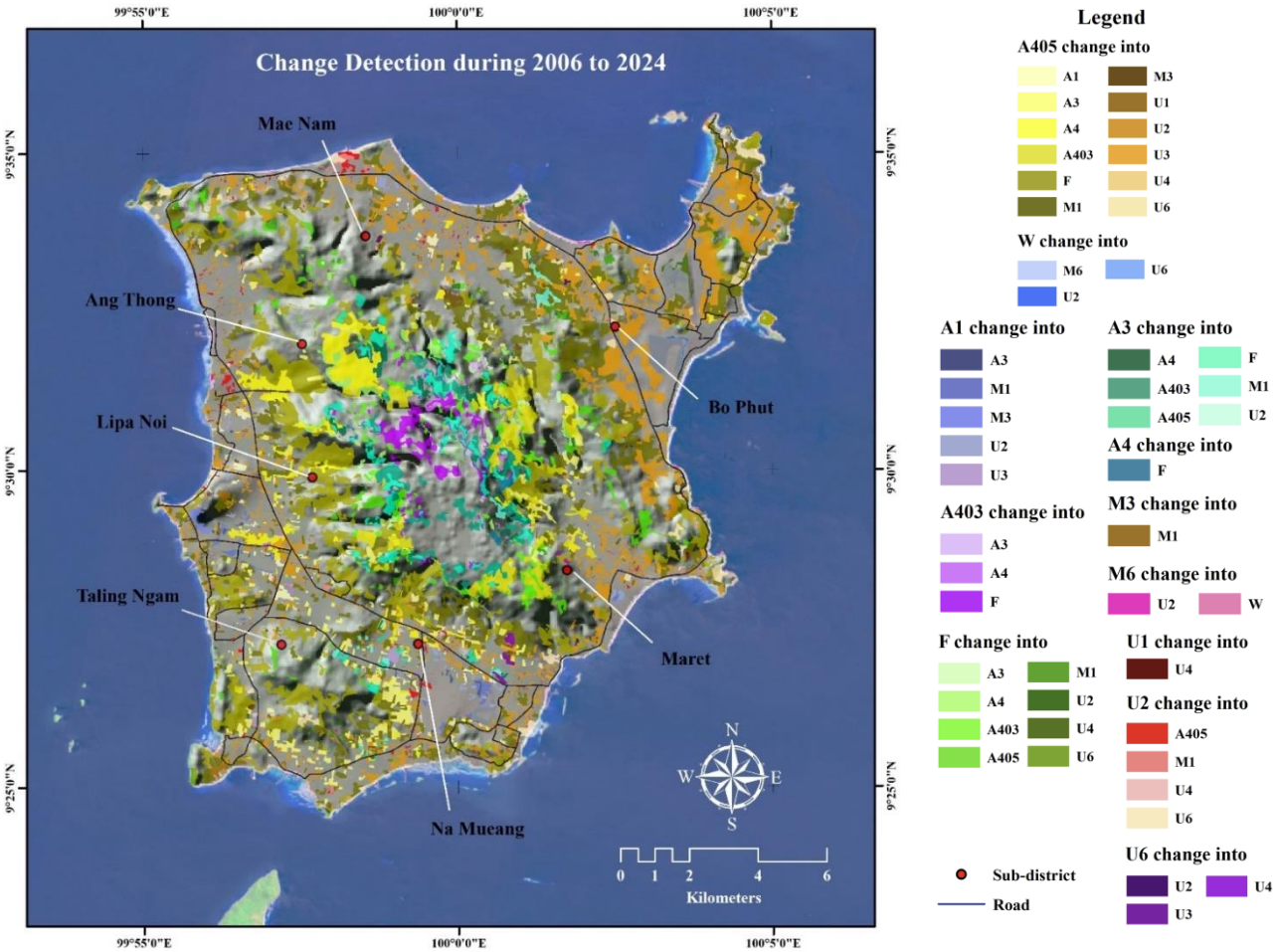


Figure 4. LUC dynamic map during 2006 to 2024 in Samui island area, Surat Thani Province (Source: Collected and processed by authors)

However, if we compare areas with the most significant land use changes, it would undoubtedly be coconut plantations. During 2006 to 2024, this area showed the largest decrease in land area, due to a land area reduction of 76.09 km^2. The coconut plantation area has been transformed into Forest land, Grass land, Villages, Orchards, Perennial crops, Durian, Recreation area, Minerals, Paddy field, Water bodies, Institutional land, Transportation, City Town Commercial, and Beach, respectively. The proportion of land changed to each of these land use types is 20.99, 20.36, 19.51, 5.55, 4.70, 4.22, 2.13, 0.83, 0.82, 0.32, 0.23, 0.21, 0.05, and 0.03 km^2, respectively.

Figure 4 shows the area changes in each land use type. It can be seen that the areas surrounding the sloping mountain range, where the coconut plantation was located, have been primarily transformed into forest land and durian orchards. In most lowlands, coconut plantations have been converted to fruit trees, perennial plants, and villages. Specifically in the southwestern plains of the island, most coconut plantations have been repurposed into fruit trees and perennial plants. The coastal area in the northeast (Laem Samrong) is also affected. In the northern and eastern parts of the island (along the Thawi Rat Phakdi Road (HW 4169)), most coconut plantations have been converted into villages. Coconut cultivation on Samui Island has declined significantly due to economic and land use changes. The expansion of tourism and real estate has led to the conversion of many coconut plantations into resorts and hotels. At the same time, unprofitable coconut prices and reduced competitiveness compared to other production areas have significantly hampered farmers' incentive to continue cultivation. Furthermore, pest infestations such as the black-headed caterpillar and black spiny beetle. In addition, the impact of erratic weather patterns further exacerbates the decline in yields, leading to a gradual decrease in the area planted with coconut trees, which are a symbol of the island.

Simulation of land use change patterns with the CA-markov model in the Samui Island area

The land use pattern simulation using the CA-Markov model shows the results of this research as follows: Over the next 18 years, land use patterns of City, Town, Commercial (U1) and Institutional land (U3) will increase by 1044.05% and 1050.27%, respectively. However, when compared in terms of area, land use patterns of Villages (U2) and City, Town, Commercial (U1) will see increases of 16.43 km^2 and 13.16 km^2, respectively. Table 4 shows the changes in land use patterns, indicating that Grass land (M1), Paddy field (A1), Durian (A405), Recreation area (U6), Forest land (F), Water bodies (W), Beach (M6), Orchards (A4), Perennial crops (A3), Mineral (M3), Institutional (U3), and City, Town, Commercial (U1) will see changes of 4.60, 4.41, and 13.16 km^2 respectively, respectively, as the land is transformed into Villages (U2). 3.22, 1.13, 1.11, 0.66, 0.50, 0.39, 0.37, 0.24, 0.17, and 0.04 km^2, respectively. Figure 4 shows areas with land-use change. In the northeast of Samui Island, in the Bo Phut area, grassland has been transformed into a village. Similarly, in the southern part of Samui Island, in the Na Mueang area, paddy fields have been transformed into villages. The same applies to the western part of Samui Island, in the Taling Ngam area.

Table 4. Matrix of Land use change in Samui Island area during 2024 to 2042 (km^2)

Land use change		2042																Changing Area	
		A1	A3	A4	A403	A405	F	M1	M3	M6	U1	U2	U3	U4	U6	W	Total	km^2	%
2024	A1	0.15	0.00	0.03	0.00	0.32	0.01	0.20	0.03	0.00	0.71	4.41	0.01	0.01	0.00	0.00	5.86	-5.67	-96.76
	A3	0.01	0.22	0.04	0.20	4.47	0.40	0.17	0.00	0.00	0.07	0.37	0.00	0.00	0.00	0.00	5.95	-1.69	-28.37
	A4	0.00	0.38	4.99	0.14	2.88	0.82	0.07	0.00	0.00	0.05	0.39	0.00	0.01	0.00	0.01	9.73	-4.29	-44.10
	A403	0.00	1.15	0.09	15.78	1.95	0.96	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	-2.79	-13.95
	A405	0.02	0.95	0.07	0.04	53.86	0.69	0.63	0.01	0.05	1.45	3.22	0.03	0.07	0.08	0.02	61.19	11.58	18.92
	F	0.00	1.43	0.15	1.01	3.29	40.76	0.15	0.02	0.10	0.15	1.11	9.00	0.02	0.11	0.00	57.29	-13.24	-23.12
	M1	0.01	0.11	0.04	0.04	5.97	0.23	3.87	0.00	0.02	10.03	4.60	0.00	0.02	0.04	0.01	24.99	-19.50	-78.02
	M3	0.00	0.02	0.01	0.01	0.00	0.01	0.22	0.01	0.00	0.25	0.24	0.01	0.53	0.00	0.01	1.30	-1.24	-94.82
	M6	0.00	0.00	0.00	0.00	0.04	0.02	0.00	0.00	0.73	0.07	0.50	0.00	0.00	0.02	0.00	1.37	-0.30	-22.08
	U1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.18	0.04	0.01	0.03	0.00	0.00	1.26	13.16	1044.05
	U2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	37.73	0.07	0.35	0.00	0.00	38.15	16.43	43.06
	U3	0.00	0.00	0.01	0.00	0.00	0.02	0.03	0.00	0.00	0.10	0.17	0.59	0.00	0.00	0.00	0.93	9.77	1050.27
	U4	0.00	0.00	0.01	0.00	0.00	0.02	0.01	0.00	0.01	0.02	0.00	0.77	0.90	0.02	0.00	1.76	0.44	25.21
	U6	0.00	0.00	0.00	0.00	0.00	0.08	0.05	0.00	0.10	0.00	1.13	0.20	0.24	2.77	0.01	4.58	-1.52	-33.06
	W	0.00	0.00	0.00	0.00	0.00	0.04	0.02	0.00	0.07	0.33	0.66	0.01	0.02	0.03	1.01	2.20	-1.13	-51.54
	Total	0.19	4.26	5.44	17.21	72.77	44.04	5.49	0.07	1.07	14.42	54.57	10.70	2.20	3.07	1.07			

The land use areas, showing the largest decreases, were Paddy field and Mineral, with decreases of -96.76% and -94.82%, respectively. However, when compared in terms of area, the Grass land (U2) land use pattern showed a significant decrease of -19.50 km^2. However, the substantial increases in U1 and U3 land use categories, reaching 1,044.05% and 1,050.27% respectively, are primarily driven by the expansion of tourism in the Koh Samui Island. This growth has catalyzed urban sprawl and infrastructure development, particularly within residential areas, government offices, and commercial tourism zones. Details of the changes in land use proportions between 2024 and 2042 are shown in Table 4. The research results on future land use patterns obtained from the CA-Markov model are shown in Figure 5, and the future land use patterns between 2024 and 2042 in the Samui Island area are shown in Figure 6.

The validation of the CA–Markov simulation was performed by comparing the predicted 2024 map with the observed 2024 map. The results demonstrated an overall accuracy of 81.43% and a Kappa coefficient of 0.742, indicating that the CA–Markov model provides an acceptable and reliable level of simulation performance.

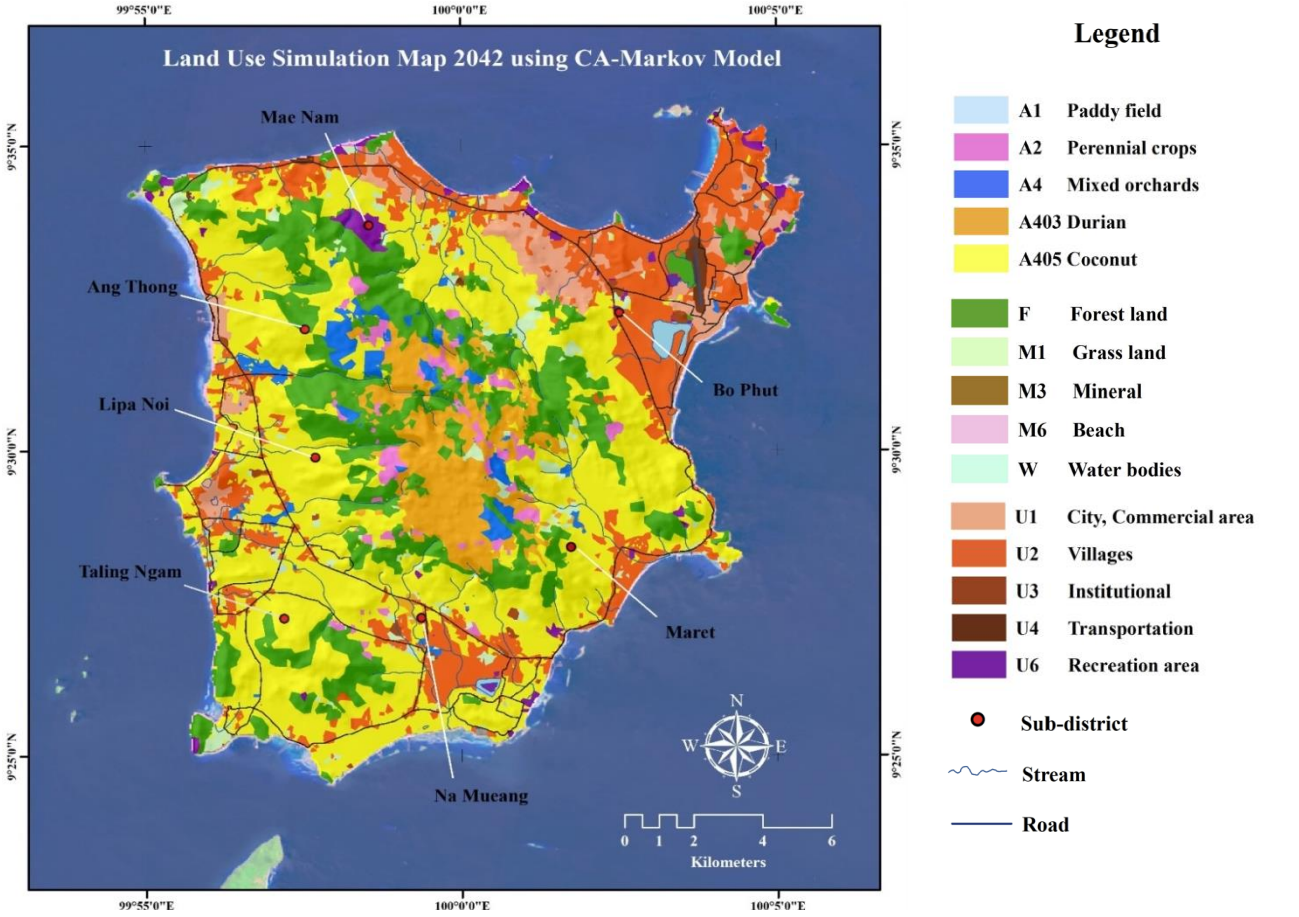


Figure 5. Predicted land use spatial patterns for 2042 generated by CA-Markov simulation (Source: Collected and processed by authors)

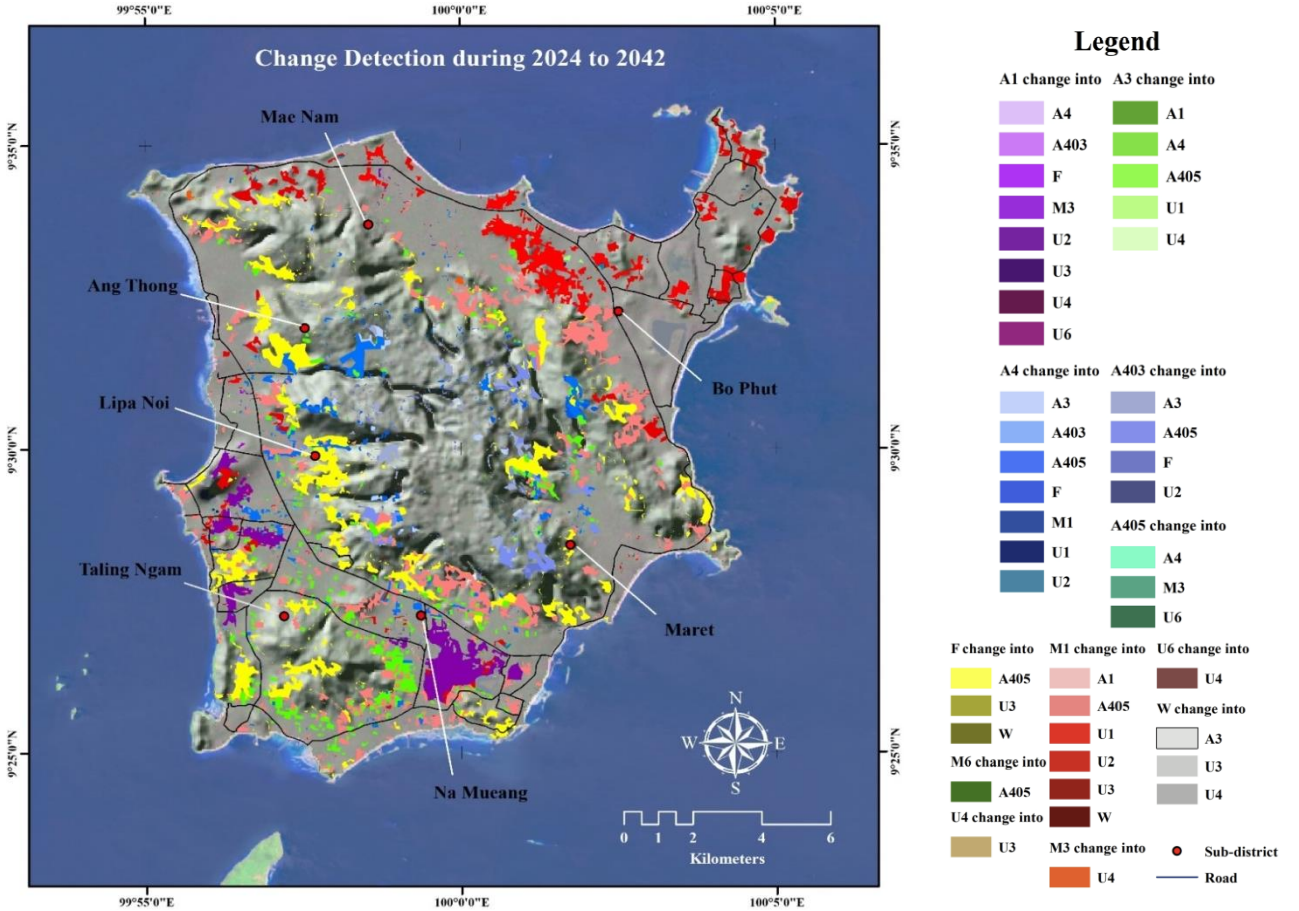


Figure 6. LUC dynamic map during 2024 to 2042 in Samui Island (Source: Collected and processed by authors)

DISCUSSION

Several research studies have applied the CA-Markov model to simulate future land use patterns. In Thailand, this model has been used to study future LUC in major cities, such as Pattaya (Wiboonwatchara et al., 2024), Nakhon Ratchasima (Kukuntod & Wijitkosum, 2025), and key cities in the Eastern Economic Corridor (EEC) (Waiyasusri et al., 2024), all of which are experiencing significant economic growth. The findings from these studies are consistent with this research, which concludes that cities with strong economic and tourism growth inevitably face challenges related to urban expansion and the expansion of agricultural land. Furthermore, this model has also been applied to various regions. Because analysis of potential impact areas, such as results from CA-Markov models, has helped plan and predict agricultural land use in the Mayurakshi river basin, India (Soren et al., 2024).

In Li, Xinjiang, China, research shows a rapid decrease in forest area (Luo et al., 2025). And in Okara district, Pakistan, future land use predictions from such models show urbanization in arid areas by 2044 (Duan et al., 2025). However, these research findings generally conclude with a similar trend of urban expansion, which differs from this research's findings that, in addition to urbanization in the northeast, south, and west of Samui Island, the central area shows a significant expansion of coconut cultivation.

This research forecasts future land use and creates a Matrix of Land Use Change between the current year and the future. This demonstrates the areas experiencing actual land use changes, something previous research did not analyze using this matrix, thus lacking a clear picture of the impact. Furthermore, land use classifications were not as diverse as in this research. The results highlight the predicted spatial and temporal dynamics of LUC in Samui Island, resulting from urban expansion and the expansion of agricultural land, particularly coconut and durian, which are local cash crops. Overall, this research reveals the potential challenges arising from various types of land use changes.

Therefore, it is crucial to monitor sensitive areas, especially paddy fields, grassland, forest land, orchards, and perennial crops, which are easily transformed into urban areas, villages, or coconut and durian plantations. A particularly concerning area is the central part of Samui Island, which is largely susceptible to conversion into coconut and durian plantations due to its hilly and sloping terrain. If neglected, this could lead to soil erosion and future landslides. This research contributes to a concrete understanding by simulating future land use patterns using a CA-Markov model. The data is presented as a spatial database for planning how to address areas sensitive to change. This model is beneficial for sustainable land use planning. Currently, Samui Island needs to adapt to become a sustainable, ecotourism destination. The results of this model will be useful for spatial development planning in coastal tourist cities, focusing on development that minimizes disruption to nature and promotes more environmentally friendly activities.

CONCLUSION

This research applied the CA-Markov model to predict future land use change (LUC) changes over the next 18 years (up to 2042) to support effective spatial planning in coastal tourist cities, using Samui Island as a case study. The predictive model reveals a substantial expansion of urban areas by 2042, with City, Town, Commercial (U1) and Institutional (U3) areas projected to surge dramatically by 1,044.05% and 1,050.27%, respectively.

This urban expansion is heavily concentrated in the northeastern region and progressively spreads along the northern and eastern corridors, driven primarily by intense commercial and tourism-related activities. Consequently, this rapid urbanization induces significant land use pressure on surrounding areas; to compensate for lost agricultural lands, coconut plantations are projected to encroach into forest borders, particularly along the foothill regions across the island. These spatial projections reflect current planning vulnerabilities, such as unmanaged urban density, deteriorating and narrow road infrastructure, and severe traffic congestion—most notably in Bo Phut Subdistrict.

To mitigate these unsustainable trends, urgent land use regulation, updated spatial zoning, and comprehensive infrastructure development must be enforced alongside strict legal compliance. Future research should further enhance model precision by incorporating additional socioeconomic variables, infrastructure constraints, and policy interventions. Ultimately, this study provides critical baseline spatial data to guide sustainable tourism development, directly aligning with Sustainable Development Goals (SDG 8: Decent Work and Economic Growth, SDG 11: Sustainable Cities and Communities, and SDG 15: Life on Land) for Samui Island.

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Use of Generative AI: During the preparation of this manuscript, the authors utilized Gemini 1.5 Flash, developed by Google, as an assistive tool to refine sentence structure, enhance academic clarity, and organize selected text sections while strictly preserving the original content and meaning. The tool was neither employed to generate or fabricate research data, perform autonomous statistical analyses, nor make final scientific interpretations. All figures and tables were originally created by the authors. Following the use of this tool, the authors critically reviewed, verified, and revised all AI-assisted outputs, taking full responsibility for the accuracy, integrity, and final content of the published work.

Glossary: Geo-IT – Geo-information Technology; LUC – Land use changes; SDGs – Sustainable Development Goals; KHAT – Kappa coefficient; OA – overall accuracy; A1 – Paddy field; A3 – Perennial crops; A4 – Perennial crops; A403 – Durian; A405 – Coconut; F – Forest land; M1 – Grass land; M3 – Mineral; Beach; U1 – City, Town, Commercial; U2 – Villages; U3 – Institutional land; U4 – Transportation; U6 – Recreation area; W – Water bodies

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THE INTERPLAY BETWEEN THE HANDMADE CARPET "ZARBIA" PRODUCTION AND TOURISM IN GHARDAIA, ALGERIA: A QUALITATIVE AND QUANTITATIVE ANALYSIS

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Abstract: Ghardaia, a prominent tourist destination in Algeria, attracts numerous visitors annually, contributing significantly to the region's economy. Known for its rich historical, cultural, and natural heritage, the region's urban landmarksearned UNESCO World Heritage status in 1982. One of its most important traditional industries is the handmade carpet "Zarbia" sector, which has been part of the region's heritage for thousands of years. Despite the challenges posed by modern industries, this eco-friendly craft remains highly valued, providing a source of livelihood for local women and accommodating workers of all ages, from young people to the elderly. However, in recent years, the industry has faced a decline, posing a risk to its survival. The study aims to identify strategies for sustaining the handmade carpet "Zarbia" weaving as a viable income source, while enhancing tourism in Ghardaia and Algeria. This paper explores the relationship between Zarbia production and tourism in Ghardaia, Algeria, using both qualitative and quantitative approaches. The study analyzes survey data, tourism flow statistics, and artisans 'distribution to identify key trends, challenges, and opportunities. The findings suggest that Zarbia production plays a significant role in cultural tourism, but challenges, such as high costs and limited marketing, hinder its full potential. Data analysis utilized SPSS and Excel. The paper concludes with recommendations for integrating Zarbia into the tourism sector and making predictions for future growth.

Keywords: Handmade carpet "Zarbia" weaving, Cultural heritage tourism, Women artisans, Handicraft sustainability, Ghardaia, Algeria

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INTRODUCTION

Traditional industries are increasingly recognized as a vital component of intangible cultural heritage, encompassing the practices, skills, and symbolic meanings passed down through generations (UNESCO, 2003). Beyond their cultural value, they are also an important source of livelihood and identity, linking communities to both their history and their socio-economic environment. Recent scholarship highlights that traditional crafts play a dual role: they safeguard heritage while also functioning as economic assets in the growing global market for cultural and heritage tourism (Richards, 2018; Zargham, 2007; Bano, 2021; Geçikli et al., 2024, Tho-Ard et al., 2026). The relationship between handicrafts and tourism has been well-documented, with studies showing that tourism creates new market opportunities for artisans, while traditional crafts add authenticity and cultural depth to the visitor experience (Zargham, 2007; Mustafa, 2011; John, 2014; Kherrour et al., 2020; Boulhila et al., 2022; Kelfaoui et al., 2021; Domniku & Kacamakovic, 2025; Wang et al., 2024; Tran et al., 2025). In many countries, governments invest in craft-based industries not only for heritage preservation but also as tools for economic diversification and rural development (McAreavey & McDonagh, 2011).

In Algeria, for example, traditional crafts contributed nearly 350 billion DA (2.65 billion USD) to GDP in 2022, underscoring their macroeconomic relevance (MFA, 2022). Algeria boasts a diverse range of traditional crafts, including ceramics, carpentry, leatherwork, jewelry, goldsmithing, silversmithing, metalwork, traditional clothing, local cuisine, and handmade carpets "Zarbia" (Figure 2). These crafts form an integral part of the country's regional identity and are actively protected and promoted by government initiatives. One such effort is the Horizon 2020 project, launched in 2009 to support artisans by creating jobs, improving access to financial resources, and enhancing marketing and export opportunities (Brahmi, 2016; Djemai, 2019). The project also aims to integrate traditional crafts into a broader economic framework, ensuring their long-term sustainability while boosting competitiveness. Ghardaia, a province in southern Algeria (Figure 1),

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is renowned for its rich artisanal traditions, particularly the handmade carpet industry. Zarbia —a locally crafted carpet— holds deep historical roots, dating back centuries and passed down through generations (Betchim, 2022). Its distinctive geometric patterns, vibrant colors, and intricate motifs (Figure 2) reflect the daily lives and cultural narratives of the crafts women who weave them. More than just a product, each "Zarbia" piece represents an artistic expression of the region's heritage, making it a significant cultural attraction. An annual cultural festival is held in March coinciding with the spring holidays, locally known as "Eid Zarbia" (Figure 3), in the midst of folkloric groups, women's art is highlighted from local heritage and cultural origins, as this event provides an opportunity for artisans to exchange experiences (Domniku et al., 2025; Xie, 2025) market services and products, attract tourism investments, and thus stimulate the commercial and tourism sectors.

Festivals are the preferred destination during the holiday period (Skoultsos, 2014), they act as a bridge of two sides "tourism and culture", combining both the economic and cultural aspects. The province employs a strategic approach to promote tourism and handicrafts through Cultural festivals, they play a crucial role in attracting and promoting tourism, with the aim of showcasing heritage nationally and internationally (Almuqataf, 2026). In addition to evaluating handicraft activities and integrating them into economic development, this strategy includes organizing national demonstrations, participating in international exhibitions and salons, and contributing to local holiday celebrations, with large numbers of visitors (Kelfaoui et al.,2021; Li & Chen, 2024), revitalizing the commercial and economic activities in the region.

Overall, Festivals are a vital event to promote tourism and support the local economy through the preservation and celebration of cultural heritage particularly traditional crafts. Within this context, handmade carpets represent one of the most resilient and marketable craft traditions. Previous research has explored their artistic and historical dimensions (Taheri et al., 2024) as well as the socio-economic roles they play in sustaining households (Bano, 2016). In Ghardaia specifically, the *Zarbia* has long been a symbol of cultural identity and female economic participation (Sharma, 2021). The craft empowers women, many of whom weave carpets at home while balancing family responsibilities, contributing directly to household stability (Pourmoradian et al., 2021). This dedication to quality distinguishes handmade carpets, as the effort invested in their production is reflected in their enduring value (Goswami, 2018).

At the same time, the literature points to serious challenges facing the sector. Modernization, urban migration, and the influx of cheaper, mass-produced carpets have undermined traditional weaving across North Africa (Hassan, 2020; Elgammal & Refaat, 2013). In Ghardaia, artisans face shortages of raw materials, rising costs, weak integration with tourism markets, and limited marketing skills. These constraints mirror global patterns where artisans struggle to compete in increasingly commercialized craft markets (De Munck, 2019). Despite the growing body of work on cultural tourism and handicrafts, two key gaps remain. First, much of the existing research has been tourist-centered, focusing on consumer demand rather than the lived realities of artisans (Sather-Wagstaff, 2008). Second, while several studies analyze the heritage or artistic aspects of carpets, few address the economic and strategic integration of crafts into tourism development frameworks. This study seeks to address these gaps by adopting a mixed-methods approach that combines artisans' perspectives with quantitative data on production and tourism flows. By doing so, it contributes to a more holistic understanding of the interplay between craft heritage, local livelihoods, and sustainable tourism in Ghardaia.

MATERIALS AND METHODS

Study area

Administratively, Ghardaia is located in the northern Algerian Sahara, resulting from the administrative division under Law No. 84-09 of February 4, 1984, concerning the territorial organization of the State. Geographically, our study area lies between latitudes 32.80° and 33.20° N and longitudes 0.40° and 4.30° E (Figure 1).

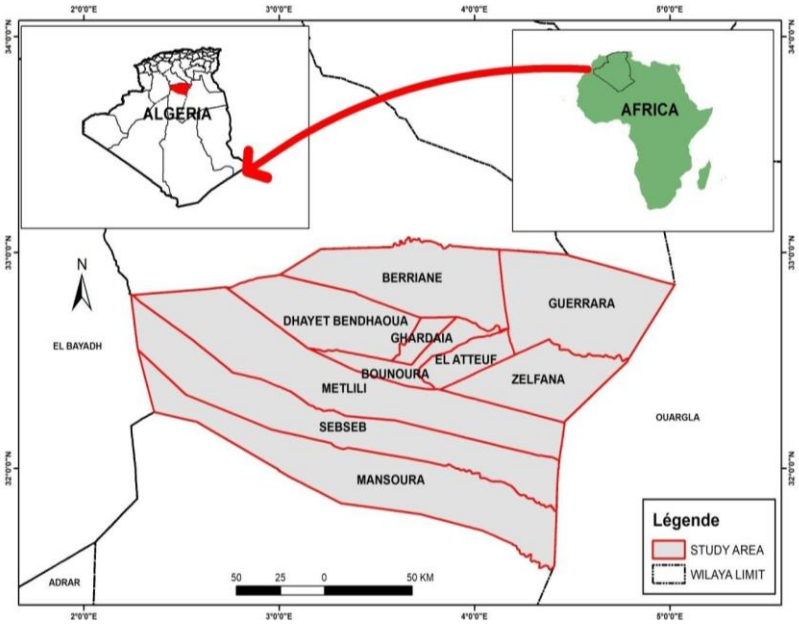


Figure 1.Geographical Situation of the study area, Ghardaia province, Algeria (Source: Generated by authors, 2025)

It is situated approximately 600 km south of Algiers, the capital, with an average elevation of 530 m above sea level and a distance of about 730 km from Oran and Constantine. Ghardaia is accessible via National Road No. 01, which connects Algiers to Tamanrasset. Covering an area of 26,165.13 km², the population was estimated to be 477,953 in 2019, according to the Budget Programming and Monitoring Directorate (DPSB).The province is bordered to the north by Laghouat and Djelfa, to the east by Ouargla, to the west by El Bayadh, and to the south by El Ménia.

It has a dry desert climate, characterized by cold, dry winters and hot, dry summers. According to the Algerian National Office of Meteorology, temperatures range from a minimum of 5°C in winter to a maximum of 50°C in summer. Spring and autumn are mild, and the sky remains clear for most of the year. The area experiences cold northwesterly winds in winter, sand-laden southwesterly winds in spring, and hot southerly winds, known as the Sirocco, in summer. This desert climate provides a comparative advantage for the tourist season. Ghardaia is one of Algeria's oldest cities.

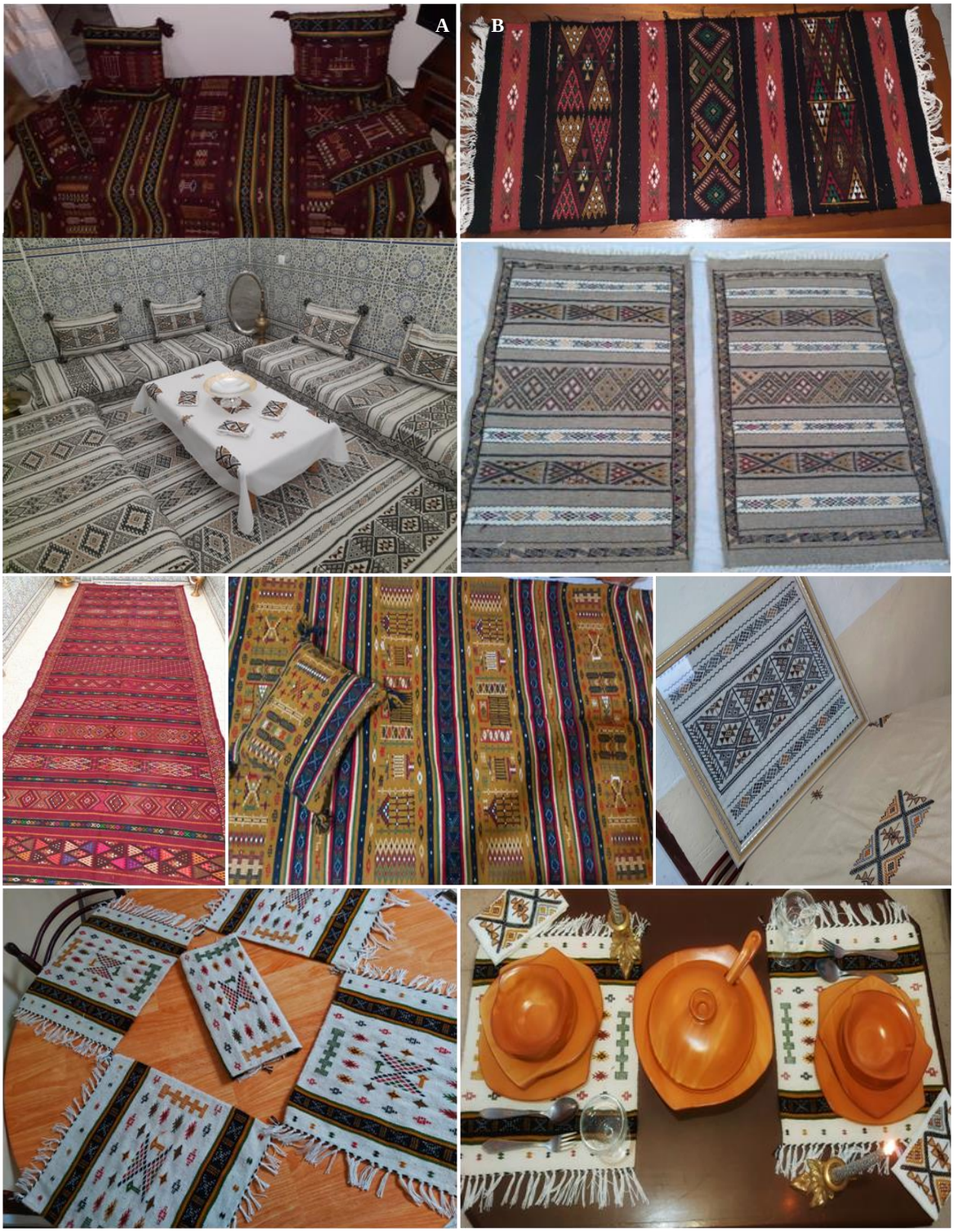


Figure 2. Pictures of Hand made Carpet Industry woven by crafts women
(Source: A and B taken by the authors, 2025, the rest wereprovided bythe Directorate of Tourism and Handicrafts "DTH")

Its historical and cultural significancestems from its wealth of historical landmarks and archaeologicalsites dating back to different eras, many of which remain well preserved today. These include traditional ksour (fortified villages) that form the core of the region as well as its palm groves (Souid, 2025). This rich history and valuable cultural diversity,led to the M'zab Valley zone being designated as part of Algeria'sNational Heritage in 1971and being inscribed as a UNESCO World Heritage Site in 1982. Furthermore, the Algerian Ministry of Culture also designated it as a protected area in 2005.

In addition, Ghardaia's strategic location as a gateway to the Sahara and a crossroads linking Northernand Southern Algeria, as well as eastern and western regions, has established it as a cultural hub, providing the region with considerable tourism and economic potential. The province is endowed with diverse natural landscapes and abundant cultural, thermal, and tourism resources that offer significant potential for rural development and positioning Ghardaia as a prominent tourist destination. It is particularly renowned for its historic palaces, known locally as “Ksour”, notably those in the M'zab Valley ksours (El Atteuf, Bounoura, Beni Isguen, Melika, Ghardaia), ksarMetlili, ksarEl Guerrara and ksar Berriane.

These traditional residential communities are outstanding examples of the region’s urban, historical, and touristic heritage, spanning various historical eras.Their distinctive architectural style, developed over several centuries, has made the region one of the most important examples of Saharan architectural and cultural heritage at both the national and international levels (OPVM).In addition,the region is famous for its oases, which support the cultivation of date palms and other crops, including fruit trees, fodder, and vegetables (Souid et al., 2024). Irrigation is managed traditionally, with unique water division methods. Other natural and cultural features include expansive sand dunes, mineral springs, and an array of traditional industries, such as copperwork, pottery, leather craftsmanship, traditional jewelry, and weaving, particularly handmade carpets "Zarbia"(Figure 2). The region also celebrates folk arts and festivals like Eid El-Zarbia (Figure 3) and Eid EL-Mehri (OPVM), all of which contribute to the rich cultural heritage. These resources position Ghardaia as an ideal site for developing various types of tourism, including cultural, exploratory, thermal, religious, scientific, and commercial tourism.



Figure 3. Pictures of zarbia festivals “Eid Zarbia” (Source: OPVM)

Data Sources

This study integrates primary and secondary data to provide a comprehensive understanding of the relationship between Zarbia production and tourism in Ghardaia. By combining survey evidence with official statistics and scholarly insights, the study ensures both empirical grounding and contextual depth.

- Primary data were collected through a structured survey of Zarbia artisans, focusing on demographics, economic conditions, production practices, market integration, challenges, and perceptions of tourism. The survey was administered in person between January and March 2023, and was designed with both closed-ended (multiple choice, Likert scale) and open-ended questions. A total of *81 artisans participated*, representing a significant share of the active weaving community in Ghardaia. Respondents were selected through purposive sampling, targeting artisans known to be active in the sector. The results were processed using SPSS and Excel to distinguish patterns and generalize the results
- Secondary data were gathered from local authorities knowledgeable in the field of handicrafts and tourism. These stakeholders include heads and members of local associations, directors of vocational training centers, employees of the Directorate of Tourism and Handicrafts, and traders in traditional industries, other data were obtained from official reports of the Ministry of Tourism and Handicrafts (MTH), statistical yearbooks, local development plans, and relevant academic studies. These sources provided contextual information on tourism flows, the contribution of the handicraft sector to employment, and national policies affecting traditional industries. *The detailed methodology* is outlined in the flowchart provided below (Figure 4).

Survey Design and Validation

The survey questionnaire included four sections:

1. Demographic characteristics (gender, age, education, marital status).

2. Economic indicators (profitability, reinvestment, exports, income use).
3. Tourism perceptions and engagement (views on tourism's role, participation in events, integration with markets).
4. Challenges and opportunities (production constraints, marketing strategies, policy expectations).

To ensure content validity, the questionnaire was reviewed by two local experts in cultural heritage and tourism, and piloted with five artisans prior to full deployment. Interviews were conducted in Arabic and French, with translation into English for analysis. The Cronbach alpha test was conducted in order to determine the degree of internal consistency between the questions, andthe result was that Alpha =0,9150.

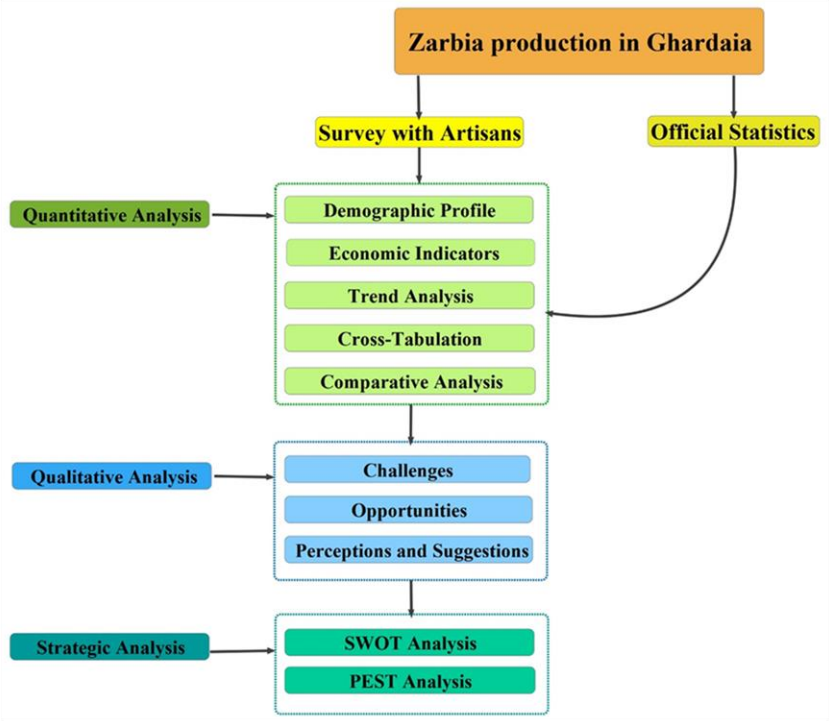


Figure 4. Flowchart illustrating the methodology followed in our study (Source: Generated by the authors, 2025)

Analytical Framework

The study employed a mixed-methods approach, combining quantitative and qualitative analyses:

- Quantitative Analysis
  - Descriptive statistics (frequencies, percentages) to summarize demographic and economic data.
- Trend analysis of tourism arrivals (2015–2023), Artisan participation in events (2019–2023) and the contribution of handicraft sector to employment (2018–2023).
- Tourism perceptions according to artisans'responses.
  - ✓ Cross-tabulation to explore relationships between education level and tourism engagement.
  - ✓ Comparative analysis to assess economic outcomes of artisans engaged in tourism vs. those who are not.
- Qualitative Analysis.
  - Open-ended survey responses were analyzed using thematic analysis, focusing on artisans' narratives of challenges, opportunities, and suggestions for sustaining the craft.
  - This allowed the integration of artisans'lived experiences alongside numerical trends.
- Strategic Analysis.
  - A SWOT analysis was used to identify internal strengths and weaknesses as well as external opportunities and threats.
  - A PESTEL framework (Political, Economic, Social, Technological, Environmental, Legal) contextualized Zarbia production within the broader macro-environment. These frameworks provided a strategic interpretation of the findings and informed recommendations.

Limitations

While the study offers important insights, several limitations should be noted:

- The sample size (81 artisans) does not fully capture Ghardaia's artisan population, though it represents a substantial portion of active weavers.
- The purposive sampling approach may introduce selection bias, as more visible or active artisans were more likely to be included.
- Some survey responses rely on self-reporting, which may involve recall bias or subjective interpretation.
- Tourism-related data are limited, particularly regarding the share of Zarbia sales to tourists; proxy indicators such as total handicraft spending, were used where direct measures were unavailable.

RESULTS

Demographic Profile: we have collected several demographic data regarding the 81 artisans surveyed.

Table 1summarizes the demographic characteristics, including gender, age group, education level, and marital status.

The survey of 81 artisans revealed that Zarbia weaving is overwhelmingly female-dominated, with women representing 97.5% of respondents. The majority of artisans belong to the older age groups (35.8% aged 55–65 and 21% aged over 65), while younger participation is very limited (less than 5% under 34). Educational attainment is also low, with 60.5% of artisans having completed only primary school and just 3.7% holding university degrees. Most participants were married (71.6%).

These findings suggest that Zarbia weaving is sustained mainly by older women with limited formal education, raising concerns about intergenerational transmission and the craft's long-term sustainability.

Table 1. Demographic characteristics of surveyed artisans (Source: generated by authors, 2025)

Variable	Category	Count	Percentage (%)
Gender	Male	2	2.5%
	Female	79	97.5%
Age Group	25–34	4	4.9%
	35–44	12	14.8%
	45–54	19	23.5%
	55–65	29	35.8%
	65+	17	21.0%
Education Level	Elementary School	49	60.5%
	Middle School	24	29.6%
	High School	5	6.2%
	University	3	3.7%
Marital Status	Single	11	13.6%
	Married	58	71.6%
	Divorced	9	3.7%
	Widowed	3	11.1%

Economic Indicators: The surveyed sample were asked if they achieve self-sufficiency by selling their Zarbia and how they use the money they earn. The results are presented in the bar chart (Figure 5) that illustrates the percentage of artisans who reported that Zarbia production is profitable and contributes to their self-sufficiency.

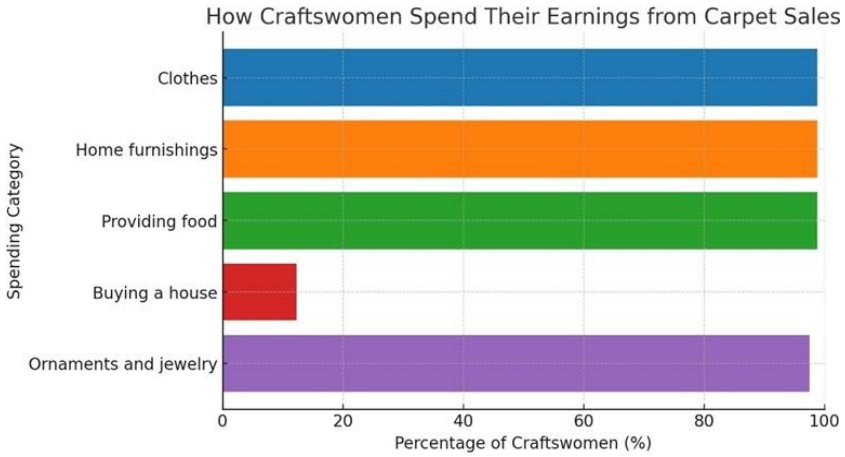


Figure 5. Profitabilityand Self-Sufficiency of ZarbiaProduction (Source: Generated by the authors, 2025)

The Figure 5 shows that: almost all artisans (98.8%) reported that Zarbia weaving is profitable and contributes to household self-sufficiency, with earnings used for essential expenditures such as food, housing, and home furnishings. Importantly, 77.8% reinvest part of their earnings back into production, and 80.2% reported exporting their carpets outside Ghardaia (Table 2). These results highlight the economic centrality of Zarbia weaving, not only for household stability but also for its role in local and regional markets.

Table 2. Investment and Exportation in ZarbiaProduction (Source: Generated by authors, 2025)

Variable	Response	Count	Percentage (%)
Investment	Yes	63	77.8%
	No	18	22.2%
Exportation	Yes	65	80.2%
	No	16	19.8%

Perceptions of Tourism

In order to better understand the relationship between the Zarbia production and tourism, we have asked the surveyed

samples some questions about their perception of tourism integration within their crafts (Table 3). Their answer together with some official statistics from the ministry of tourism and handicraft suggest a complex interaction.

Table 3. Artisans' Perceptions of Tourism's Role in Zarbia Production (Source: Generated by authors, 2025)

Perception	Count	Percentage (%)
Tourism helps maintain tradition	80	98.8%
Tourism improves living standards	80	98.8%
Tourism boosts zarbia sales	65	80.2%

Table 3 illustrates that: The artisans expressed overwhelmingly positive views on the role of tourism. Nearly all respondents (98.8%) believed that tourism helps maintain tradition and improve living standards, while 80.2% considered it a driver of increased Zarbiasales.This indicates that artisans see tourism as both an economic opportunity and a mechanism of cultural preservation, aligning with broader narratives of sustainable cultural tourism.

Trends in Tourism, Artisan Participation in events, and the contribution of handicraft sector to employment

Tourist arrivals (2015–2023): The line chart in figure 6 illustrates the variation in tourist arrivals to the city of Ghardaia from 2015 to 2023. Ghardaia experienced steady growth in tourism until 2019, peaking at 72,775 visitors. Numbers dropped sharply during the COVID-19 pandemic (39,987 in 2020) but rebounded to 69,469 in 2023. Notably, international tourists represented only a small fraction (3,121 in 2023), underscoring the region's reliance on domestic tourism.

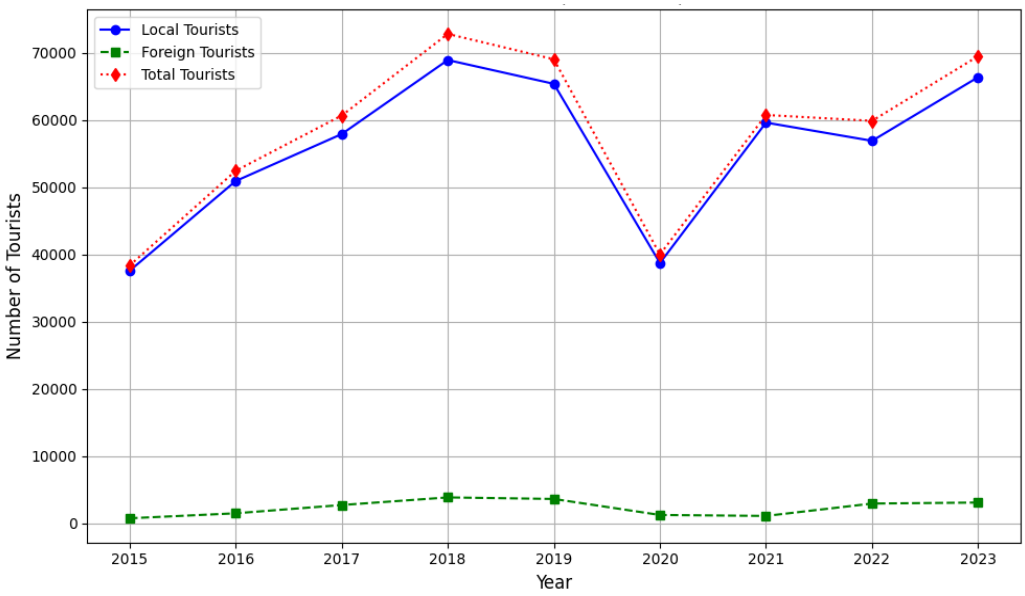


Figure 6. Tourist Arrival Trends (2015–2023) (Source: The authors, generated from the Directorate of Tourism and Handicrafts)

Participation in events: Contribution of culture festivals to tourism. Table 4 shows the number of artisans participating in local, national, and international events from 2019 to 2023. Artisan participation in exhibitions has been uneven. Numbers surged after the pandemic (285 artisans in 2022) but fell again in 2023 (69 + 2 associations), though that year marked the first international presence, with 7 artisans showcasing Zarbia abroad. Together, these trends show that while Ghardaia's tourism sector is recovering**,** international exposure for Zarbia remains limited.

Table 1. Craftsmen Participation in Events (2019–2023)(Source: authors, generated from the Directorate of Tourism and Handicrafts)

Year	Local events	National events	International events	Total participating artisans
2019	45	COVID-19 pandemic		45
2020	64	COVID-19 pandemic		64
2021	64	0	0	64
2022	270 +15 associations	0	0	285
2023	27 + 1 association	35+ 1 association	7	69 + 2 associations

The contribution of the handicraft sector to employment: The Table 5 shows the correlation between the number of artisans and employment in the sector over recent years, from 2018 to 2023. The handicraft sector created 14,180 jobs and employed more than 7,090 artisans by the end of 2023. However, the sector's contribution to job creation fluctuated between 2019 and 2020, with job numbers ranging from 14,908 to 15,122. In 2021, a significant drop occurred, with the number of jobs falling to 13,236 due to the COVID-19 pandemic, which led to the closure of many institutions. In recent years, the sector has shown signs of recovery, with job numbers reaching 14,270 in 2022 and 14,180 in 2023. Therefore, it can be concluded that the handicraft sector significantly contributes to social development by creating jobs and reducing unemployment.

Table 2. The contribution of handicraft sector to employment (2018-2023)
(Source: Authors, generated from the Directorate of Tourism and Handicrafts)

Year	Number of artisans	Employment contribution
2018	7.084	20.909
2019	7.454	14.908
2020	7.561	15.122
2021	6.618	13.236
2022	7.135	14.270
2023	7.090	14.180

Education and Tourism Engagement

Table 6 shows the percentage of artisans engaged in tourism-related activities, broken down by education level.

Cross-tabulation analysis revealed a strong link between education level and participation in tourism-related activities. Notably, 45.7% of the total sample had completed only elementary school engaged in tourism markets, whereasjust2.5% were university graduates, this demonstrates a dual impact ofeducationinthis field, itserves both as a strength and a limitation. On one hand, the accessibility of the tourism market to artisans across various educational backgrounds promotes inclusivity and broad participation, and therefore, navigate business opportunities, and adapt to market demands. On the other hand, limited education particularly in language proficiency can hinder effective communication with international tourists. Therefore, education must be recognized as a critical enabler for global engagement in tourism, and efforts should be made to address the challenges posed by lower educational attainment (Meng et al., 2024).

Table 6. Education level vs. engagement in tourism-related activities (Source: Generated by authors, 2025)

Education level	Engaged in tourism (%)	Not engaged in tourism (%)
Elementary school	45.7%	14.8%
Middle school	27.2%	2.5%
High school	4.9%	1.2%
University	2.5%	1.2%

Economic Benefits of Tourism Engagement

Table 7 compares the economic performance of artisans engaged in tourism-related sales versus those who are not.

Artisans engaged in tourism-related sales consistently outperformed those who were not. They reported higher profitability (96.3% vs. 77.8%), greater self-sufficiency (95.1% vs. 61.7%), and stronger reinvestment in production (85% vs. 56.8%). They were also more likely to export (90% vs.54.3%). Tourism integration appears to amplify economic resilience, reinforcing the value of linking Zarbia to the tourism sector.

Table 7. Economic Performance of Artisans Engaged vs. Not Engaged in Tourism (Source: Generated by authors, 2025)

Economic indicator	Engaged in tourism (%)	Not engaged in tourism (%)
Profitability	96.3%	77.8%
Self-sufficiency	95.1%	61.7%
Investment in production	85%	56.8%
Exportation	90%	54.3%

Challenges and Opportunities

The surveyed sample was asked about the various challenges encountered during the production of their craft. The bar chart (Figure 7) illustrates the key challenges faced by artisans.

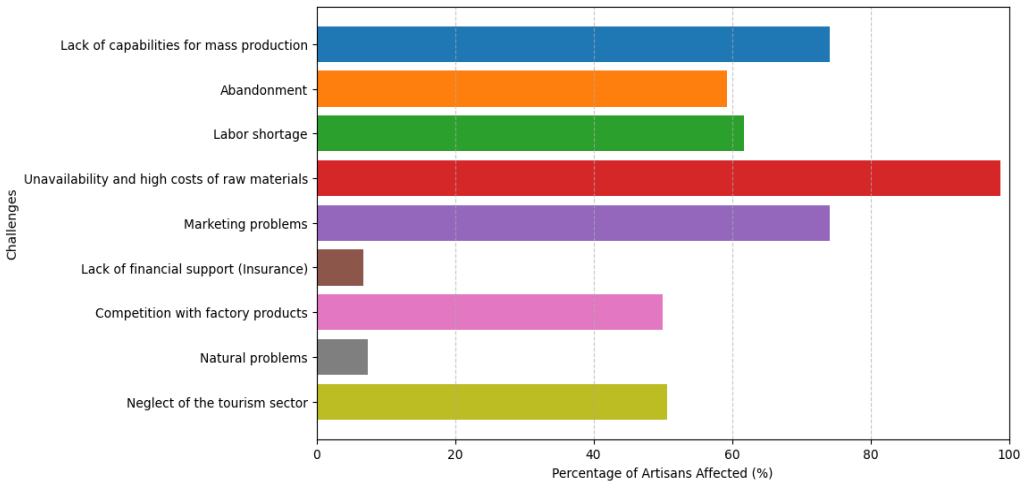


Figure 7. Challenges Faced by Artisans in Zarbia Production (Source: Generated by authors, 2025)



Figure 8. A - Exampleof Factory-Produced Carpets; B - Original Handmade Carpet "Zarbia" (Source: The authors, 2025)

The most critical challenges reported were shortages of raw materials and high production costs (97.5%), followed by competition from cheaper, mass-produced carpets (86.4%) (Figure 8). Conversely, artisans identified three key opportunities (Table 8): government policy support (98.8%), growth through tourism (55.7%), and digital marketing tools (27.2%). These findings suggest that while Zarbia weaving faces serious structural constraints, artisans are aware of emerging strategies, especially digital platforms and policy interventions, that could sustain the craft.

Table 8. Opportunities for ZarbiaProduction (Source: Generated by authors, 2025)

Opportunity	Count	Percentage (%)
Growth through tourism	54	55.7%
Digital marketing	22	27.2%
Policy support	80	98.8%

Strategic Analysis

The SWOT and PESTEL analyses provide a strategic lens through which the dynamics of Zarbia weaving in Ghardaia can be understood. The SWOT results, presented in Table 9, reveal a sector rooted in strong cultural identity and women's economic empowerment but weakened by aging demographics, raw material shortages, and limited marketing skills. Opportunities exist in tourism growth, digital platforms, and international exposure, yet these are offset by threats from machine-made competition and the volatility of tourism flows.

Table 9. SWOT Analysis of Zarbia Production and Tourism Integration (Source: Generated by authors, 2025)

Strengths	Weaknesses
• Unique craftsmanship, UNESCO heritage recognition	• Aging artisan population (56% above 55 years)
• 97.5% female artisans; 98.8% report profitability	• 60.5% with only primary education → weak market access
• 80.2% export beyond Ghardaia	• 97.5% face raw material shortages & high costs
• Strong cultural commitment, community pride	• Limited marketing/digital adoption
Opportunities	**Threats**
• Tourism growth: 70k visitors in 2023, 98.8% see tourism as beneficial	• Competition from machine-made carpets (49.4%)
• Rising interest in digital platforms (27.2%)	• Declining youth participation in weaving only 140 women artisans are graduates in textile in 2023
• Government policy support (Horizon 2020, subsidies, events)	• Economic volatility: fluctuating raw material costs
• First international exposure in 2023 exhibitions	• Tourism vulnerability to crises (COVID-19, instability)

The PESTEL framework presented in Table 10 complements this by situating Zarbia weaving within broader structural forces: political support and cultural recognition create favorable conditions, but economic pressures, low digital adoption, environmental constraints, and weak legal protections undermine resilience. Together, these analyses highlight that while

Zarbia weaving retains significant cultural and economic value, its sustainability depends on targeted interventions, particularly in education, digital integration, and legal safeguarding, to transform vulnerabilities into opportunities.

Table 10. PESTEL Analysis of Zarbia Production and Tourism Integration (Source: Generated by authors, 2025)

Factor	Key Issues	Implications
Political	Horizon 2020 support programs; weak IP protection	Potential for policy-driven growth, but Zarbia patterns risk imitation
Economic	98.8% profitability; 80.2% exports; high raw material costs	Strong income role, but profitability depends on subsidies & trade access
Social	Female-dominated craft; aging artisans; festivals (Eid El-Zarbia)	Empowerment of women; risk of generational discontinuity
Technological	Low digital adoption (27.2% interested); e-commerce potential	Digital tools could expand markets but require training
Environmental	Reliance on wool & dyes; Sahara water scarcity	Risk to production; eco-labeling as a market advantage
Legal	No geographical indication (GI) protection	Weak protection against counterfeit; limits international expansion

DISCUSSION

The findings of this study demonstrate that Zarbia weaving in Ghardaia remains a cornerstone of both cultural identity and economic livelihoods, yet it is also a fragile tradition facing structural challenges. The results highlight a paradox: while artisans overwhelmingly perceive their craft as profitable and central to household self-sufficiency, the sector is constrained by aging demographics, high production costs, and limited integration into the global tourism economy.

The demographic profile shows that Zarbia weaving is almost exclusively practiced by women (97.5%), particularly those above the age of 55. This confirms the literature that situates weaving as both a form of women's empowerment (Azil et al., 2020) and a mechanism for sustaining households (Zargham, 2007). However, the scarcity of younger artisans raises serious concerns about intergenerational transmission, according to the statistics of the Vocational Training Center registrations. This lack of interest among young girls is evident in the data, where only 140 graduates specializing in textiles were recorded in the first quarter of 2023, which is a lower record compared to the past generation when Zarbia weaving was a common household activity and used to be woven in all houses in the region. Similar patterns have been observed in Morocco and Tunisia, where younger generations are reluctant to pursue artisanal professions due to lower prestige and economic insecurity (Ratnam, 2014). Unless mechanisms are put in place to attract and train youth, the continuity of Zarbia weaving is at risk, even as its cultural value increases.

The survey revealed that nearly all artisans (98.8%) consider weaving profitable, with earnings reinvested into households and production. This finding is consistent with global studies showing that crafts contribute significantly to women's financial independence and local economies (Bano, 2016; Goswami & Goswami, 2018; Konjengbam & Chakravarty, 2026). The high percentage of artisans engaged in exports (80.2%) underscores Zarbia's market potential beyond Ghardaia. However, market integration is uneven: interestingly, many artisans with only elementary education engage actively more with tourism and enjoy higher profits, while the majority of university graduates remain marginalized in formal markets, this highlights the dual role of education in this field, it functions both as an asset and a constraint: the artisan sectoris inclusive and capable of accommodating workers with varying educational levels (Ismail & Mohammad, 2020), and those who did not have the opportunity to pursue a professional career, even without formal qualifications still have the chance to learn the craft and benefit financially from it, however education level may act as a barrier for some artisans' limited language or communication skills can hinder direct interaction with tourists, reducing investment opportunities and potential income. This aligns with studies that highlight education as a critical enabler for artisans' participation in tourism economies (Guillén-Peñafiel et al., 2024; Refaat & Hassan, 2025).

Artisans' overwhelmingly positive perception of tourism (98.8% viewing it as a tool for tradition preservation and livelihood improvement) suggests a strong alignment between local knowledge and cultural tourism models. Yet, the results also reveal that Ghardaia's tourism remains highly domestic, with only 3,121 international visitors recorded in 2023. This reliance on local tourism mirrors findings from desert tourism studies in Algeria, which note the underdevelopment of international tourism infrastructure despite strong cultural assets (Ramdan & Mourad, 2025). The participation of artisans in international exhibitions in 2023 is therefore a promising development, marking the first steps toward broader global exposure. The sector attracts a large labour force and has the flexibility to expand (curbing unemployment by Creating new job opportunities: 20,909 jobs / 7,084 artisans in 2018) especially with the availability of raw materials. And it does not require large capital investments, and relies on simple machines (Ismail & Mohammad,2020).These limited possibilities can generate substantial returns when fully exploited, contributing to balanced economic development between rural and urban areas (Aissani & Chanbi,2024). In Australia, in 2012 the number of local and foreign visitors reached 2.82 million people at the festival which contributed to spending more than 58 million AUD (excluding tickets) achieving profits estimated at 62.9 million AUD. As a result, the top 10Festivals contributed to create 790 permanent jobs (Skoultsos, 2014). This is consistent with what (UNESCO, 2015) have asserted that Tourists' discovery of diverse traditions and cultural festivals of traditional crafts and all that is considered intangible cultural heritage generates revenues and provides jobs for local individuals while nurturing a sense of pride in the community and thus providing inclusive economic developmentas one of the criteria of sustainable development (Hu et al., 2024).

The challenges identified, scarcity of raw materials, high costs, and competition from machine-made carpets, are consistent with regional trends across North Africa, where industrial imports increasingly displace traditional crafts (Islam & Burmester, 2020). Importantly, artisans themselves pointed to solutions: policy support (98.8%), tourism growth

(55.7%), and digital marketing (27.2%). These align with broader global findings where digital platforms (e.g., Etsy, Instagram) have expanded artisans' access to international buyers (Singh et al., 2022). Yet, without targeted training in digital literacy, most Ghardaia artisans will remain excluded from these opportunities.

The SWOT and PESTEL analyses confirm that while Zarbia weaving is culturally strong and economically viable, it is structurally fragile. Strengths such as heritage authenticity and export potential are undermined by weaknesses including an aging workforce and limited education. Opportunities such as digital marketing and tourism growth are offset by threats like global crises and competition from mass-produced goods. From a policy perspective, this suggests the need for integrated strategies: securing raw material supply chains, protecting intellectual property (through geographical indications), and investing in artisan training (Wu et al., 2025).

The results of this study have clear implications for the UN Sustainable Development Goals. Zarbia weaving contributes to SDG 5 (Gender Equality) by empowering women artisans, SDG 8 (Decent Work and Economic Growth) through income generation and exports, and SDG 11 (Sustainable Cities and Communities) by preserving intangible cultural heritage (Figure 9). However, without intervention, these contributions are at risk due to demographic and market challenges.



Figure 9. Sustainable Development Goals supported by the development of the Zarbia industry (Source: The authors, 2025)

From a theoretical perspective, this study contributes to debates on the commodification of heritage (Gill-Robinson, 2007), showing that commodification does not necessarily erode authenticity but can provide artisans with economic stability. Practically, the findings point to actionable recommendations:

- Policy interventions to subsidize raw materials and support artisan cooperatives.
- Capacity-building in digital literacy and foreign languages to connect artisans with global markets.
- Youth engagement strategies, such as vocational training programs linking schools with weaving workshops.
- Tourism integration, embedding Zarbia experiences into cultural tours and festivals to increase exposure.

While this study provides valuable insights, it is based on a purposive sample of 81 artisans, which may not fully represent the diversity of Ghardaia's weaving community. Additionally, sales data specific to tourists were unavailable, limiting the analysis of direct tourism–craft linkages. Future research should adopt longitudinal designs to track changes over time, and comparative studies with other North African carpet traditions could further illuminate the regional dynamics of craft survival.

CONCLUSION

This study examined the interplay between Zarbia weaving and tourism in Ghardaia, highlighting the dual role of the craft as both a cultural heritage and a vital source of women's economic empowerment. The results show that while Zarbiaweaving remains profitable and widely practiced among older women artisans, its long-term sustainability is threatened by rising production costs, limited market access, and declining youth engagement. At the same time, artisans overwhelmingly recognize tourism as a key driver of tradition preservation, livelihood improvement, and market expansion.

By integrating survey data, trend analysis, and strategic frameworks, the study contributes to the literature on cultural heritage tourism and women's livelihoods, offering a holistic view that foregrounds artisans' voices. The findings also demonstrate that stronger links between Zarbia production and tourism could generate significant benefits, not only for local households but also for regional economic diversification and Algeria's broader cultural tourism strategy.

To safeguard the future of Zarbia weaving, targeted interventions are needed: policies that stabilize raw material supplies, training programs that enhance digital and marketing skills, legal protections such as geographical indications, and youth engagement initiatives to ensure intergenerational transmission. International exposure and integration into global tourism markets also represent untapped opportunities for growth.

Ultimately, Zarbia weaving embodies more than a craft: it is a living heritage that connects cultural identity with economic sustainability. Preserving and revitalizing this tradition requires coordinated efforts by policymakers, artisans,

and tourism stakeholders. Doing so will not only protect an endangered craft but also position Ghardaia as a model for how intangible heritage can be leveraged for sustainable development in North Africa and beyond.

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EXPLAINING TOURISM AND HOSPITALITY STUDENTS' ADOPTION OF LARGE LANGUAGE MODELS IN HIGHER EDUCATION: AN INTEGRATED TAM–UTAUT FRAMEWORK USING PLS-SEM AND NECESSARY CONDITION ANALYSIS

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Abstract: The rapid integration of large language models (LLMs) in higher education has transformed students' learning practices, particularly in applied disciplines such as tourism and hospitality education. Yet, limited empirical research explains the factors driving their adoption. Drawing on the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT), this study examines tourism and hospitality students' behavioural intention to use LLM-based learning tools by incorporating content reliability, learner motivation, and social influence as extended antecedents. Data were collected from 365 university students enrolled in tourism, hospitality and management courses in addition to the students enrolled in other allied programs having tourism as an elective course in India and analysed using partial least squares structural equation modelling (PLS-SEM) and Necessary Condition Analysis (NCA). The findings indicate that perceived usefulness remains central to adoption, while learner motivation and social influence play critical enabling roles. NCA further reveals that perceived usefulness, learner motivation, and social influence constitute necessary conditions for achieving high adoption intention. By integrating net-effect and necessity-based approaches, the study advances technology acceptance theory in AI-enabled education in tourism and hospitality. It offers practical insights for the responsible integration of LLMs in professional learning contexts.

Keywords: Large Language Models (LLMs), Artificial Intelligence, education, Technology Acceptance Model (TAM), Unified Theory of Acceptance and Use of Technology (UTAUT), Necessary Condition Analysis (NCA)

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INTRODUCTION

The increasing integration of artificial intelligence (AI) into higher education has transformed traditional learning environments by redefining how students access information, construct knowledge, and engage with academic tasks. Among recent technological developments, large language models (LLMs) have emerged as powerful educational tools that can generate explanations, examples, feedback, and learning support across diverse academic disciplines, including practice-oriented fields such as tourism and hospitality education. Unlike conventional digital learning systems that primarily facilitate content delivery, LLMs actively participate in cognitive processes through conversational interaction and adaptive responses, thereby reshaping the learner–technology relationship (Hou & Yu, 2023; Monzon & Hays, 2025).

Prior research indicates that AI-supported learning tools can enhance student engagement, self-regulated learning, and perceived learning effectiveness when appropriately integrated into instructional contexts (Gao et al., 2024; Teo, 2019). In tourism and hospitality programs, where applied knowledge, case-based learning, service simulations, and problem-solving are central, LLMs offer new opportunities for contextualised learning support. At the same time, the rapid diffusion of generative AI has raised concerns related to content accuracy, ethical use, and the risk of overreliance on AI-generated outputs, particularly in academic settings where credibility and rigour are paramount (Correia et al., 2024; Misiejuk et al., 2024). As universities increasingly experiment with AI-enabled learning tools, understanding how tourism and hospitality students evaluate and adopt LLM-based systems has become a pressing research concern.

From a theoretical perspective, technology acceptance research offers a robust foundation for examining students' adoption of emerging educational technologies. The Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) have been widely applied to explain behavioural intention in contexts such as e-learning, mobile learning, and intelligent tutoring systems (Nistor et al., 2019; Teo, 2019), including hospitality and

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tourism education settings where technology-mediated learning is increasingly prevalent. These models emphasise perceived usefulness and perceived ease of use as key cognitive beliefs that influence acceptance, while UTAUT further highlights the roles of social influence and facilitating conditions (Palau-Saumell et al., 2019; Venkatesh & Davis, 2000).

Empirical evidence consistently demonstrates that students are more likely to adopt digital learning technologies when they perceive them as beneficial for academic performance and easy to operate (Hou & Yu, 2023; Shahzad et al., 2024). In tourism and hospitality education, where learning outcomes are closely tied to industry relevance and employability, perceived usefulness may be significant. However, scholars increasingly argue that traditional acceptance models need to be refined when applied to AI-enabled learning systems. The autonomous, generative, and interactive nature of LLMs introduces new evaluative criteria—such as trust in AI outputs and perceived content reliability—that extend beyond the scope of core TAM constructs (Al-Zahrani, 2024; Cui et al., 2025). Despite the growing body of research on AI in education, several theoretical and empirical gaps remain evident. Much of the existing literature focuses on the functional benefits of AI tools, such as efficiency and performance gains, while paying little attention to students' concerns about the reliability and credibility of AI-generated content. This gap is particularly salient in tourism and hospitality education, where inaccurate or biased information may directly affect professional judgment and service decision-making. Research on AI hallucination and misinformation suggests that uncertainty about content accuracy can undermine academic trust and weaken sustained adoption intentions (Correia et al., 2024; Misiejuk et al., 2024). Furthermore, although learner motivation has been widely studied in digital learning contexts, its role within extended technology acceptance frameworks for generative AI remains underexplored, particularly in relation to perceived usefulness and behavioural intention (Cerasoli et al., 2014; Huang et al., 2025).

Similarly, while social influence has been examined in general technology adoption research, its role in legitimising the use of LLMs within tourism and hospitality academic communities has received limited empirical attention. As a result, there is a lack of integrative models that examine simultaneously cognitive, motivational, social, and trust-related mechanisms shaping students' adoption of LLM-based learning tools in higher education within tourism and hospitality.

To address these gaps, the present study aims to examine tourism and hospitality students' behavioural intention to use LLM-based learning tools by extending TAM and UTAUT with AI-specific constructs. Specifically, the study investigates perceived usefulness and perceived ease of use as core acceptance beliefs, while incorporating content reliability, learner motivation, and social influence as critical antecedents shaping these beliefs and behavioural intention.

Perceived usefulness is further conceptualised as a central mediating mechanism linking ease of use, content reliability, motivation, and social influence to behavioural intention. By integrating these constructs within a unified theoretical framework, the study offers a more comprehensive explanation of LLM adoption in tourism and hospitality education. The originality of this research lies in its explicit treatment of content reliability as a trust-related construct and its simultaneous examination of motivational and social drivers within an extended acceptance model. In doing so, the study advances technology acceptance theory in the context of generative AI. It provides actionable insights for educators and institutions seeking to integrate LLMs into teaching and learning practices responsibly. Accordingly, this study aims to examine tourism and hospitality students' behavioural intention to adopt LLM-based learning tools by extending the TAM–UTAUT framework with content reliability, learner motivation, and social influence, and to identify the necessary conditions for high adoption intention using an integrated PLS-SEM and Necessary Condition Analysis (NCA) approach.

LITERATURE REVIEW

Theory Relevance and AI Learning

Technology acceptance theories, such as the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT), have been widely applied to explain students' adoption of educational technologies. Within these frameworks, behavioural intention is conceptualised as a learner's willingness to use a technology and is widely accepted as a reliable predictor of actual usage behaviour. Empirical studies in e-learning and online education contexts demonstrate that perceived usefulness and perceived ease of use play a central role in shaping behavioural intention, influencing learners' satisfaction and continued engagement with digital platforms (Hou & Yu, 2023; Teo, 2019). Extensions of UTAUT further highlight the importance of facilitating conditions, hedonic motivation, habit, and self-efficacy in predicting behavioural intention across technology-mediated learning environments (Zheng et al., 2025). These findings suggest that students are more likely to adopt learning technologies when they perceive them as valuable, easy to use, and supported by institutional and social structures. Collectively, this body of research confirms the robustness of TAM and UTAUT in explaining technology acceptance in higher education while also indicating the need for contextual adaptation as learning technologies evolve.

However, the increasing integration of artificial intelligence and large language models (LLMs) into higher education presents challenges that extend beyond the explanatory scope of traditional TAM and UTAUT. Unlike conventional learning technologies, LLMs actively generate instructional content, provide automated feedback, and simulate conversational interactions, raising critical concerns about content accuracy, reliability, and trust. Prior research highlights that students' acceptance of generative AI tools is strongly influenced by perceptions of content quality and the risk of AI hallucinations, which can undermine academic trust and integrity (Correia et al., 2024; Misiejuk et al., 2024). Studies further indicate that trust in AI systems is closely associated with technological performance, transparency, and ethical use, all of which shape behavioural intention toward AI adoption (Al-Zahrani, 2024; Cui et al., 2025). These concerns suggest that learner motivation and perceptions of content reliability are critical determinants of AI acceptance.

Consequently, extending TAM and UTAUT by incorporating AI-specific constructs provides a more comprehensive theoretical framework for understanding students' intentions to adopt LLM-based learning tools in higher education.

Constructs under Study

Behavioural intention (BI) is widely recognised as a core outcome variable in technology acceptance research and represents an individual's willingness to adopt and continue using a technological system. In educational technology contexts, BI has consistently been employed as a reliable predictor of actual usage behaviour, particularly in e-learning and AI-supported learning environments (Hou & Yu, 2023; Teo, 2019). Prior studies demonstrate that students' behavioural intention is shaped by perceptions of usefulness, ease of use, and motivational factors, reinforcing its relevance as a proxy for learning technology adoption (Zheng et al., 2025). Research further highlights the role of facilitating conditions, hedonic motivation, and habit in strengthening behavioural intention toward digital learning platforms, suggesting that both cognitive and affective factors influence students' willingness to engage with technology (Zheng et al., 2025). Additionally, self-efficacy and attitudes toward technology use have been validated as significant predictors of BI in higher education contexts, emphasising the importance of learner confidence and perceived competence (Teo, 2019). Collectively, these findings establish behavioural intention as an appropriate and theoretically grounded dependent variable for examining students' acceptance of LLM-based learning tools.

Perceived Ease of Use and Perceived Usefulness

Perceived ease of use (PEOU) and perceived usefulness (PU) constitute the foundational constructs of the Technology Acceptance Model and have been extensively validated in educational technology research. PEOU refers to the extent to which learners believe that using a system requires minimal effort, while PU reflects the degree to which a system enhances learning performance and outcomes (Teo, 2019). In AI-supported learning environments, these constructs take on greater significance due to the interactive and adaptive nature of intelligent systems. Studies indicate that user-friendly interfaces and conversational designs, such as those used by AI chatbots, enhance learners' perceptions of ease of use, which, in turn, positively influence motivation and engagement (Foroughi et al., 2024; Gao et al., 2024). Moreover, PU has been empirically linked to improved learning outcomes, self-regulated learning, and academic performance in AI-based tutoring systems (Hou & Yu, 2023). Research grounded in UTAUT further demonstrates that performance expectancy and effort expectancy jointly shape learners' acceptance of intelligent learning tools, reinforcing the mediating role of PU between PEOU and behavioural intention (Nistor et al., 2019). These findings confirm the central role of PEOU and PU in explaining students' adoption of LLM-based educational technologies.

Content Reliability

Content reliability in AI-supported learning environments refers to the perceived accuracy, consistency, and trustworthiness of AI-generated or AI-assisted educational content. As LLMs increasingly generate instructional materials and feedback, content reliability has emerged as a critical determinant of student trust and acceptance (Correia et al., 2024). Prior research highlights that discrepancies between AI-generated outputs and human judgment, particularly in assessment and coding tasks, can undermine learners' confidence in AI systems, necessitating hybrid human–AI approaches to ensure reliability (Misiejuk et al., 2024). Studies examining AI-generated text further emphasise the importance of alignment between AI outputs and established knowledge bases to enhance credibility and reduce epistemic uncertainty (Sanz et al., 2012; Virani et al., 2020). Ethical considerations, including algorithmic bias, transparency, and data privacy, also influence perceptions of content reliability, thereby shaping students' trust in AI-supported learning tools (Al-Zahrani, 2024). Additionally, technological performance and explainability have been identified as key antecedents of reliability perceptions, suggesting that reliable AI outputs reduce cognitive effort and enhance perceived usefulness (Cui et al., 2025). These findings position content reliability as a crucial extension to traditional technology acceptance models in AI-enabled education

Learner Motivation and Social Influence

Learner motivation plays a pivotal role in shaping the adoption of educational technologies by influencing students' engagement, persistence, and acceptance of digital learning tools. Research grounded in motivational theories distinguishes between intrinsic motivation, driven by interest and enjoyment, and extrinsic motivation, driven by external rewards and performance outcomes (Cerasoli et al., 2014). Empirical studies demonstrate that both motivational types significantly predict behavioural intention toward LLM-based learning tools, with intrinsic motivation influencing the quality of engagement and extrinsic motivation affecting the frequency of use (Huang et al., 2025). Generative AI systems further support learner motivation by enabling personalised and self-directed learning experiences, thereby enhancing autonomy and academic confidence (Monzon & Hays, 2025). In parallel, social influence—derived from peers, instructors, and institutional norms—has been shown to shape students' perceptions of technology credibility and usefulness (Venkatesh & Davis, 2000). Social cues and endorsements can strengthen trust in AI-generated content, particularly in uncertain learning contexts, thereby increasing behavioural intention (Palau-Saumell et al., 2019). Together, learner motivation and social influence represent critical psychological and social drivers of LLM adoption in higher education

Hypothesis Formulation

Prior research grounded in the Technology Acceptance Model (TAM) consistently demonstrates that perceived ease of use and perceived usefulness are core determinants of behavioural intention in technology-based learning environments. Perceived ease of use reflects how much learners believe interacting with a system requires minimal effort. In contrast, perceived usefulness captures the extent to which a technology enhances academic performance and learning effectiveness.

Empirical studies in e-learning and AI-supported education show that systems perceived as easy to use are more likely to be evaluated as applicable, as reduced cognitive effort allows learners to focus on learning outcomes rather than system operation (Shahzad et al., 2024; Sheppard & Vibert, 2019). Furthermore, perceived usefulness has been identified as a direct predictor of behavioural intention across diverse educational technologies, including AI-based tutoring systems and conversational agents (Li, 2020; Liu & Ma, 2024). In the context of LLM-based learning tools, intuitive interaction and conversational design are expected to strengthen these relationships. Accordingly, the following hypotheses are proposed:

H1: Perceived ease of use positively influences perceived usefulness.

H2: Perceived usefulness positively influences behavioural intention.

H3: Perceived ease of use positively influences behavioural intention.

Beyond core TAM relationships, content reliability has emerged as a critical factor influencing students' acceptance of AI-generated learning materials. Content reliability refers to learners' perceptions of the accuracy, consistency, and trustworthiness of AI-generated outputs. Prior research highlights that concerns related to hallucinations, misinformation, and lack of transparency can undermine trust in AI-supported learning systems, thereby reducing perceived usefulness and adoption intention (Al-Zahrani, 2024; Misiejuk et al., 2024). Conversely, when AI-generated content is perceived as reliable and aligned with established knowledge, learners are more likely to recognise its instructional value and integrate it into their learning processes (Cui et al., 2025). Studies extending TAM and UTAUT further demonstrate that credibility-related constructs significantly enhance the explanatory power of technology acceptance models by strengthening perceived usefulness and behavioural intention (Palau-Saumell et al., 2019; Singh et al., 2025). In LLM-based learning contexts, reliable content is therefore expected to play a central role in shaping students' perceptions and intentions. Thus,

H4: Content reliability positively influences perceived usefulness.

H5: Content reliability positively influences behavioural intention.

Learner motivation has been widely acknowledged as a key psychological driver of technology adoption in higher education. Motivated learners are more inclined to adopt educational technologies when they perceive them as supporting academic goals and self-directed learning. Prior studies grounded in UTAUT highlight performance expectancy and effort expectancy as critical mechanisms through which motivation influences behavioural intention (Nistor et al., 2019). Research on generative AI further indicates that LLMs enhance learner motivation by enabling personalised learning experiences and fostering autonomy, thereby increasing engagement and perceived learning value (Monzon & Hays, 2025). Both intrinsic and extrinsic motivation have been shown to predict behavioural intention toward AI tools, with intrinsic motivation influencing the depth of engagement and extrinsic motivation shaping continued usage (Cerasoli et al., 2014; Huang et al., 2025). As motivated learners are more likely to recognise the benefits of AI-supported learning tools, motivation is expected to strengthen perceived usefulness and behavioural intention. Accordingly,

H6: Learner motivation positively influences perceived usefulness.

H7: Learner motivation positively influences behavioural intention.

Social influence represents an important social determinant of technology acceptance, particularly in educational settings where peer interaction and institutional norms shape learning behaviour. UTAUT posits that social influence affects individuals' perceptions of technology usefulness and their intention to adopt new systems. Empirical studies show that recommendations from peers, instructor endorsement, and institutional support can legitimise emerging technologies and reduce uncertainty associated with their use (Palau-Saumell et al., 2019; Venkatesh & Davis, 2000). In AI-supported learning environments, social cues play a critical role in shaping students' trust in AI-generated content and their perceptions of the system's value. When LLM-based tools are endorsed within academic communities, students are more likely to view them as credible and beneficial for learning (Oc et al., 2025). Consequently, social influence is expected to directly shape both perceived usefulness and behavioural intention toward LLM-based learning tools. Therefore,

H8: Social influence positively influences perceived usefulness.

H9: Social influence positively influences behavioural intention.

In addition to influencing perceived usefulness and intention, recent studies suggest that external factors such as motivation, content reliability, and social influence also shape perceived ease of use in intelligent learning systems. Motivated learners tend to invest greater effort in exploring system features, thereby reducing perceived complexity and enhancing ease of use (Nistor et al., 2019). Similarly, reliable AI-generated content reduces verification effort and cognitive load, leading learners to perceive LLM-based tools as easier to use (Misiejuk et al., 2024). Social influence further contributes to perceived ease of use by facilitating observational learning and knowledge sharing among peers, which lowers perceived operational difficulty (Venkatesh & Davis, 2000). In LLM-based learning environments, these mechanisms suggest that perceived ease of use is not solely a technical attribute but is also shaped by psychological and social factors. Hence,

H10: Learner motivation positively influences perceived ease of use.

H11: Content reliability positively influences perceived ease of use.

Taken together, these hypothesised relationships reflect an integrative extension of TAM and UTAUT tailored to AI-enabled learning contexts. By incorporating content reliability and learner motivation alongside traditional acceptance constructs, the proposed framework captures the cognitive, psychological, and social mechanisms underlying students' adoption of LLM-based learning tools. This integrative approach responds to recent calls for more comprehensive models that address trust, reliability, and motivation in AI-supported education (Xu et al., 2024; Yan et al., 2024). The proposed hypotheses collectively explain how learners evaluate the usefulness and usability of LLMs and how these evaluations

translate into behavioural intention. This framework, therefore, provides a theoretically grounded basis for empirically examining students' acceptance of LLM-based learning tools in higher education.

Mediating Hypotheses

Perceived usefulness (PU) has long been recognised as a central mediating construct within the Technology Acceptance Model, translating users' system evaluations into behavioural intention. In AI-enhanced learning environments, PU plays an even more critical role due to the complexity and autonomy of intelligent systems. Prior studies demonstrate that perceived ease of use enhances perceived usefulness by reducing cognitive effort and increasing learners' trust and engagement with AI tools (Shahzad et al., 2024; Sheppard & Vibert, 2019). Empirical research on AI-based tutoring and LLM-supported learning further confirms that PU mediates the relationship between system characteristics and behavioural intention, particularly when learners perceive AI tools as supporting academic performance and self-regulated learning (Li, 2020; Liu & Ma, 2024). Extensions of TAM and UTAUT incorporating credibility-related constructs also indicate that trust-enhancing factors strengthen PU, which in turn drives adoption intention (Palau-Saumell et al., 2019; Singh et al., 2025). Accordingly, PU is expected to mediate the effects of perceived ease of use, content reliability, learner motivation, and social influence on behavioural intention in LLM-based learning contexts. Thus,

H12: Perceived usefulness mediates the relationship between perceived ease of use and behavioural intention.

H13: Perceived usefulness mediates the relationship between content reliability and behavioural intention.

H14: Perceived usefulness mediates the relationship between learner motivation and behavioural intention.

H15: Perceived usefulness mediates the relationship between social influence and behavioural intention.

RESEARCH METHODOLOGY

This study employed a quantitative, cross-sectional survey design to examine students' adoption of large language models (LLMs) for learning, with a specific emphasis on tourism and hospitality education. The research was conducted in India, a context that is theoretically and empirically relevant for studying AI-enabled learning adoption. India hosts one of the world's largest higher education systems. It has witnessed rapid growth in digital infrastructure, mobile internet penetration, and technology-mediated learning, making it an appropriate setting for examining behavioural intention toward emerging AI tools. Prior research highlights that technology adoption dynamics in emerging economies offer critical insights due to heterogeneous access, rapid diffusion, and evolving institutional norms surrounding digital learning technologies (Palau-Saumell et al., 2019; Venkatesh & Davis, 2000). Data were collected with the assistance of trained enumerators whom the authors directly supervised to ensure data quality and adherence to standardised procedures. Respondents were informed of the study's academic purpose, assured of anonymity and confidentiality, and participation was strictly voluntary. Informed consent was obtained prior to survey administration, in line with established ethical standards for social science research. A structured questionnaire was used as the survey instrument, consisting of previously validated measurement items adapted to the context of LLM-based learning. Screening questions were included to ensure respondent relevance; only students with both an internet-enabled smartphone and a laptop with active internet access were included, as meaningful interaction with LLMs requires consistent multi-device access—the questionnaire measured six constructs. Perceived Ease of Use and Perceived Usefulness were adapted from established TAM scales to capture the ease of learning, operational simplicity, and learning effectiveness of AI tools. Content Reliability was measured using items adapted from tourism and information reliability literature, emphasising accuracy, trustworthiness, bias-free content, completeness, and professional quality. Social Influence items captured peer, instructor, and normative pressure to use AI tools, grounded in TAM and UTAUT (Davis, 2004; Venkatesh & Davis, 2000). Learner Motivation items were adapted from motivation research emphasising enjoyment, curiosity, and the value of learning. Behavioural Intention was measured using intention-to-use items that reflect future reliance on and continued exploration of AI tools.

The final sample comprised 365 valid student responses, meeting established thresholds for PLS-SEM analysis. According to Hair et al. (2019), a minimum sample size of 200 and a sample-to-item ratio of at least 10:1 are sufficient for reliable model estimation and adequate statistical power in complex models. With six latent constructs and reflective indicators, the sample size exceeds the recommended minimum, ensuring analytical adequacy. Descriptive analysis revealed diverse LLM usage patterns, with ChatGPT being the most widely used tool (94.2%), followed by Perplexity (41.4%), Copilot (23.6%), DeepSeek (8.0%), Gemini variants (4.0%), Google alone (0.8%), and Grok (0.8%). Data screening and preliminary analyses were conducted using SPSS 27 to assess missing values, outliers, and distributional properties. Hypothesis testing and structural relationships were examined using SmartPLS, which is well-suited for exploratory models involving multiple predictors and complex causal relationships. This methodological approach ensures rigour, robustness, and alignment with best practices in technology acceptance and AI-in-education research.

RESULTS

Table 1 presents the demographic profile of the respondents. The sample was predominantly male (81.1%) and composed mainly of undergraduate students (90.4%), reflecting the typical demographic structure of technology-intensive programs in Indian higher education. Public and private institutions were almost equally represented, ensuring institutional diversity. A majority of respondents reported daily use of AI tools (64.4%), with most indicating intermediate levels of AI experience (45.5%). Students from tourism and hospitality disciplines constituted the largest group (45.75%), followed by engineering and management students (27.12% each). This disciplinary spread enhances the generalizability of the findings

across applied and professional education domains. The descriptive statistics further confirm that the sample is appropriate for examining behavioural intention toward LLM-based learning tools in a multi-disciplinary academic context.

Table 1. Demographic variables result

Characteristic	Category	Frequency (n)	Percentage (%)
Gender	Male	296	81.1
	Female	69	18.9
Education Level	Undergraduate	330	90.4
	Postgraduate	35	9.6
Type of Institution	Public	181	49.6
	Private	184	50.4
AI Usage Frequency	Daily	235	64.4
	Weekly	130	35.6
Experience with AI	Intermediate	166	45.5
	Beginner	108	29.6
	Advanced	91	24.9
Discipline	Tourism & Hospitality	167	45.75
	Engineering	99	27.12
	Management	99	27.12

Measurement model results

The measurement model was evaluated by examining indicator reliability, internal consistency, convergent validity, and discriminant validity, following established guidelines for PLS-SEM analysis. Indicator reliability was first assessed using standardised factor loadings. All observed indicators load firmly on their respective latent constructs, with values exceeding the recommended threshold of 0.70, indicating that each item explains at least 50% of the variance in the underlying construct (Hair et al., 2019). Specifically, factor loadings ranged from 0.741 to 0.895 for perceived ease of use, 0.834 to 0.884 for perceived usefulness, 0.843 to 0.884 for content reliability, 0.755 to 0.850 for social influence, 0.864 to 0.884 for learner motivation, and 0.876 to 0.886 for behavioural intention. These results confirm the strong reliability of the indicators and justify retaining all measurement items in the model (Table 2). Internal consistency reliability was assessed using Cronbach's alpha and composite reliability.

Table 2. Measurement model results (α: Cronbach's alpha; CR: Composite reliability; AVE: Average variance extracted)

Cosntruct and Items	Code	Loadings	VIF	α	CR (rho_a)	CR (rho_c)	AVE
Perceived Ease of Use (Martínez-Torres et al., 2008; Venkatesh & Davis, 2000)				0.852	0.856	0.901	0.696
It is easy to learn how to use AI tools for my studies.	PE1	0.741	1.475				
I can quickly find what I need using AI tools.	PE3	0.849	2.196				
The steps to use AI tools are simple.	PE4	0.895	2.726				
AI tools are easy to understand and operate.	PE5	0.844	2.269				
Perceived Usefullness (Martínez-Torres et al., 2008; Venkatesh & Davis, 2000)				0.879	0.882	0.916	0.733
AI tools improve my learning in tourism/hospitality/airline courses.	PU1	0.851	2.408				
AI tools help me complete course-related tasks more easily.	PU2	0.884	2.672				
AI tools are more effective than traditional methods for learning tourism	PU3	0.834	2.057				
AI tools help me quickly find useful content for my studies.	PU4	0.855	2.180				
Content Reliability(Ayeh et al., 2013)				0.912	0.913	0.934	0.739
The content from AI tools is accurate.	CR1	0.843	2.391				
The content is trustworthy.	CR2	0.873	2.690				
The content is free from bias.	CR3	0.884	2.844				
The content is complete and relevant.	CR4	0.849	2.324				
The content is professionally written.	CR5	0.849	2.447				
Social Influence (Venkatesh & Davis, 2000)				0.881	0.883	0.913	0.678
My classmates use AI tools for our field of study.	INF1	0.755	1.671				
My teachers encourage the use of AI tools.	INF2	0.833	2.220				
My friends suggest using AI tools for learning.	INF3	0.837	2.206				
People around me think I should use AI tools.	INF4	0.850	2.399				
Successful students I know use AI tools.	INF5	0.839	2.229				
Learner Motivation (Deci et al., 2001)				0.897	0.898	0.928	0.764
I enjoy learning my course topics using AI tools.	LM1	0.864	2.422				
I want to learn more through AI tools.	LM2	0.877	2.547				
AI tools make learning more valuable to me.	LM3	0.884	2.612				
AI tools make me curious to explore my subjects further.	LM4	0.871	2.419				
Behavioural Intention (Venkatesh & Davis, 2000)				0.857	0.859	0.913	0.778
I plan to use AI tools regularly for studying.	BI1	0.876	2.147				
I expect to rely on AI tools next semester.	BI2	0.883	2.090				
I want to explore new topics using AI tools.	BI3	0.886	2.211				

All constructs demonstrate values well above the recommended minimum threshold of 0.70, indicating satisfactory reliability (Hair et al., 2019). Composite reliability values ranged from 0.901 to 0.934, indicating high internal consistency without redundancy. Convergent validity was evaluated using average variance extracted (AVE). All AVE values exceed the recommended cutoff of 0.50, confirming that each construct explains more than half of the variance of its indicators (Fornell & Larcker, 1981). Additionally, variance inflation factor (VIF) values were examined to assess collinearity at the indicator level. All VIF values fall below the conservative threshold of 5, indicating no multicollinearity concerns and supporting the stability of the parameter estimates (Hair et al., 2019).

Discriminant validity was assessed using both the Fornell–Larcker criterion and the heterotrait–monotrait (HTMT) ratio. According to the Fornell–Larcker criterion, the square root of AVE for each construct should exceed its correlations with other constructs (Fornell & Larcker, 1981). This condition is satisfied for all constructs in the model. Furthermore, HTMT values were examined, as this method is considered more sensitive in detecting discriminant validity issues (Henseler et al., 2015). All HTMT ratios are below the conservative threshold of 0.90, confirming adequate discriminant validity. Collectively, these results indicate that the measurement model demonstrates strong reliability and validity, providing a sound basis for subsequent structural and necessity analyses (Table 3).

Table 3. Discriminant validity using Fornell-Larcker criteria and HTMT ratio

Heterotrait-Monotrait ratio (HTMT) ratio						
	Behavioral Intention	**Content Reliability**	**Learner Motivation**	**Perceived Ease of Use**	**Perceived Usefulness**	**Social Influence**
Behavioral Intention						
Content Reliability	0.739					
Learner Motivation	0.751	0.744				
Perceived Ease of Use	0.718	0.817	0.713			
Perceived Usefulness	0.767	0.750	0.875	0.776		
Social Influence	0.864	0.709	0.654	0.788	0.692	
Fornell-Larcker criterion						
Behavioral Intention	0.882					
Content Reliability	0.655	0.860				
Learner Motivation	0.659	0.674	0.874			
Perceived Ease of Use	0.616	0.722	0.622	0.834		
Perceived Usefulness	0.668	0.675	0.781	0.674	0.856	
Social Influence	0.755	0.639	0.583	0.682	0.611	0.823

Path analysis

The structural model was evaluated by examining path coefficients (β), t-statistics, p-values, and the significance of direct and indirect effects (Table 4 & Figure 1). Consistent with the Technology Acceptance Model, perceived ease of use positively affects perceived usefulness ($\beta = 0.201$, $p < 0.01$), indicating that students who find AI tools easier to use are more likely to perceive them as applicable for academic learning. However, perceived ease of use does not directly influence behavioural intention ($\beta = -0.041$, $p > 0.05$), suggesting that ease alone is insufficient to drive adoption unless students also perceive tangible learning benefits. Perceived usefulness significantly predicts behavioural intention ($\beta = 0.163$, $p < 0.05$), reaffirming its central role as a key determinant of technology adoption.

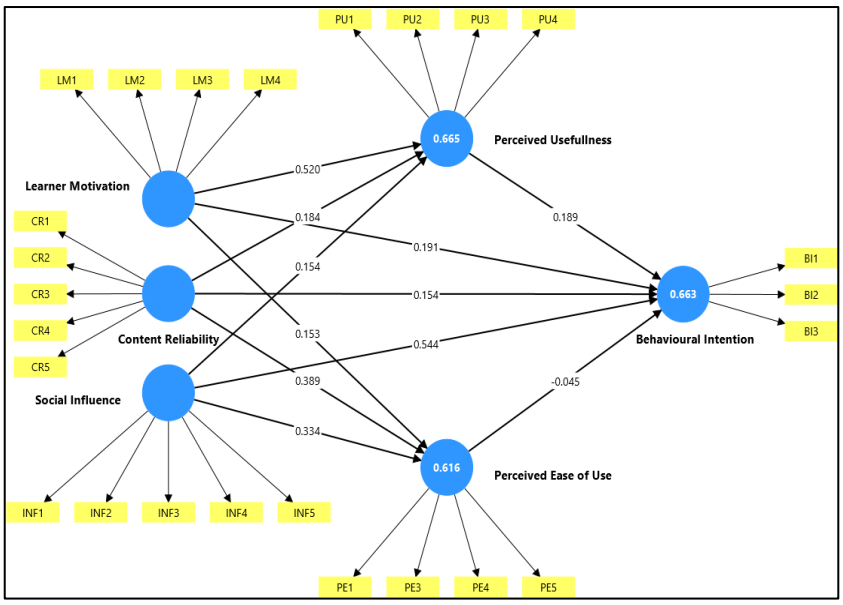


Figure 1. Results of path analysis using PLS SEM

Content Reliability demonstrates a strong positive influence on perceived usefulness ($\beta = 0.199$, $p < 0.01$), highlighting that students' perceptions of accuracy, trustworthiness, and completeness of AI-generated content substantially enhance perceived learning value. Although the direct effect of content reliability on behavioural intention is not significant, this finding suggests that credibility primarily operates through cognitive evaluations rather than directly influencing intention formation. Learner motivation emerges as the strongest predictor of perceived usefulness ($\beta = 0.553$, $p < 0.001$) and also exerts a significant direct effect on behavioural intention ($\beta = 0.175$, $p < 0.05$).

This indicates that intrinsically motivated learners are more likely to recognise the value of AI tools and intend to use them. Social influence significantly affects both perceived usefulness ($\beta = 0.161$, $p < 0.01$) and behavioural intention ($\beta = 0.490$, $p < 0.001$), underscoring the decisive role of peers, instructors, and academic norms in legitimising AI use. Mediation analysis reveals that only the indirect effect of social influence on behavioural intention via perceived usefulness is significant, while other mediating paths are not supported. These findings suggest that social endorsement strengthens adoption primarily by enhancing perceptions of usefulness rather than by altering perceptions of usability.

Table 4. Path analysis results

Path	Beta	Lower	Upper	T statistics	P values	Result
H1: Perceived Ease of Use -> Perceived Usefulness	**0.201**			**2.879**	**0.004****	**Supported**
H2: Perceived Ease of Use -> Behavioral Intention	-0.041			0.580	0.562^{NS}	Not-Supported
H3: Perceived Usefulness -> Behavioral Intention	**0.163**			**2.046**	**0.041***	**Supported**
H4: Content Reliability -> Perceived Usefulness	**0.199**			**3.048**	**0.002****	**Supported**
H5: Content Reliability -> Behavioral Intention	0.143			1.906	0.057^{NS}	Not-Supported
H6: Learner Motivation -> Perceived Usefulness	**0.553**			**7.869**	**0.000*****	**Supported**
H7: Learner Motivation -> Behavioral Intention	**0.175**			**2.163**	**0.031***	**Supported**
H8: Social Influence -> Perceived Usefulness	**0.161**			**2.716**	**0.007***	**Supported**
H9: Social Influence -> Behavioral Intention	**0.490**			**6.770**	**0.000*****	**Supported**
H10: Learner Motivation -> Perceived Ease of Use	0.156			2.363	0.018^{NS}	Not-Supported
H11: Content Reliability -> Perceived Ease of Use	**0.403**			**5.309**	**0.000*****	**Supported**
H12: Perceived Ease of Use -> Perceived Usefulness -> Behavioral Intention	0.033	0.001	0.07	1.800	0.072^{NS}	Not-Supported
H13: Content Reliability -> Perceived Usefulness -> Behavioral Intention	0.032	0.005	0.090	1.620	0.105^{NS}	Not-Supported
H14: Learner Motivation -> Perceived Usefulness -> Behavioral Intention	0.090	0.007	0.203	1.839	0.066^{NS}	Not-Supported
H15: Social Influence -> Perceived Usefulness -> Behavioral Intention	**0.026**	**0.006**	**0.060**	**1.963**	**0.050***	**Supported**

NCA Analysis

To complement the net-effect logic of PLS-SEM, a Necessary Condition Analysis (NCA) was conducted to determine whether specific antecedents constitute indispensable conditions for achieving higher levels of behavioural intention toward AI-based learning tools. Unlike SEM, which explains average causal effects, NCA focuses on identifying conditions that must be present at minimum levels for an outcome to occur (Dul et al., 2023). The presence of empty spaces in the upper-left corners of the ceiling line charts indicates necessity relationships, suggesting that higher levels of behavioural intention cannot be achieved when key antecedents remain below certain thresholds.

The effect size results (Table 6) reveal that perceived usefulness emerges as the strongest necessary condition ($d = 0.32$), exceeding the threshold for a medium-to-strong necessity effect as proposed by Dul (2016). This indicates that without a minimum level of perceived usefulness, high behavioural intention toward AI tools cannot be attained. Learner motivation ($d = 0.207$), content credibility ($d = 0.21$), and social influence ($d = 0.185$) demonstrate medium necessity effects, suggesting that each of these conditions must reach certain minimum levels to enable higher adoption intention. Perceived ease of use shows a more negligible yet meaningful necessity effect ($d = 0.193$), indicating that usability acts as a basic enabling condition rather than a dominant driver. All permutation tests are significant ($p = 0.000$), confirming that the identified necessity effects are statistically robust and not attributable to random variation.

Table 5. NCA Bottleneck table

	Behavioral intention	Content reliability	Learner motivation	Perceived ease of use	Perceived usefulness	Social influence
0.00%	-4.172	NN	NN	NN	NN	NN
10.00%	-3.645	NN	NN	NN	NN	NN
20.00%	-3.118	NN	NN	NN	NN	NN
30.00%	-2.591	NN	-4.076	NN	-3.913	NN
40.00%	-2.064	-3.232	-4.076	-3.321	-3.08	-3.567
50.00%	-1.537	-3.232	-4.076	-3.321	-3.08	-3.567
60.00%	-1.01	-3.232	-2.64	-3.321	-3.08	-3.567
70.00%	-0.482	-3.232	-2.64	-3.321	-2.556	-3.192
80.00%	0.045	-2.232	-2.459	-3.321	-2.556	-3.192
90.00%	0.572	-1.951	-1.523	-3.058	-1.374	-0.467
100.00%	1.099	-1.753	-1.523	-1.106	-0.64	-0.098

The bottleneck analysis (Table 5) further clarifies the minimum levels required for different degrees of behavioural intention. At lower outcome levels (below 30%), no antecedent imposes a binding constraint, indicating that minimal intention can occur even with low levels of the predictors. However, as behavioural intention increases, clear bottlenecks emerge. For example, achieving moderate adoption levels (50%) requires a minimum threshold for content credibility, learner motivation, perceived ease of use, perceived usefulness, and social influence. At higher outcome levels (70–90%), perceived usefulness and learner motivation impose the most stringent bottlenecks, indicating that firm adoption intention cannot be achieved unless students perceive AI tools as genuinely beneficial and are intrinsically motivated to use them. Social influence also becomes increasingly constraining at higher levels of behavioural intention, highlighting the role of peer and institutional validation in legitimising the use of AI. Importantly, comparison with PLS-SEM results highlights causal asymmetry. While some constructs—such as perceived ease of use and content credibility—exhibit weak or non-significant direct effects in the structural model, NCA demonstrates that they remain necessary conditions at higher adoption levels. This confirms that conditions may be necessary without being sufficient, reinforcing the complementary value of combining SEM and NCA (Dul, 2016). Overall, the NCA findings provide a nuanced understanding of AI adoption by revealing critical bottlenecks that must be addressed to foster students' behavioural intention towards AI-based learning tools.

Table 6. NCA effect size

	Beta Estimate	95.00%	Result
Content Reliability	0.21	0.114	An increase in exogenous construct will increase the outcome, no minimum level of construct needed to ensure the outcome
Learner Motivation	0.207	0.075	Increase in exogeneous construct will increase the outcome, a certain level (bottleneck) is necessary for the outcome
Perceived Ease of Use	0.193	0.113	An increase in exogeneous construct will increase the outcome, no minimum level of construct needed to ensure the outcome
Perceived Usefulness	0.32	0.106	Increase in exogeneous construct will increase the outcome, a certain level (bottleneck) is necessary for the outcome
Social Influence	0.185	0.06	Increase in exogeneous construct will increase the outcome, a certain level (bottleneck) is necessary for the outcome

DISCUSSION AND CONCLUSION

The findings of this study provide nuanced insights into how tourism and hospitality students evaluate and adopt LLM-based learning tools within higher education contexts. Overall, the results reaffirm the central importance of perceived usefulness as the primary driver of adoption intention. Students appear to place greater emphasis on the academic value and learning enhancement offered by AI tools than on their operational simplicity. This observation aligns with prior research suggesting that learners adopt educational technologies when they clearly support performance improvement and knowledge acquisition rather than merely offering convenience (Hou & Yu, 2023; Teo, 2019). Interestingly, perceived ease of use does not directly translate into stronger adoption intention, indicating that contemporary students—already accustomed to digital platforms—may consider usability as a baseline expectation rather than a decisive motivator. In technology-saturated learning environments, ease of use functions as a hygiene factor, necessary but insufficient to stimulate adoption.

This shift reflects the maturation of digital learning ecosystems, in which students increasingly evaluate technologies based on their pedagogical contribution rather than their technical novelty. Consequently, the findings suggest that institutions seeking to promote LLM adoption must foreground the value of learning and the relevance of outcomes rather than focusing solely on interface design or technical accessibility. A second key insight concerns the role of content reliability in shaping students' cognitive evaluations of AI tools. While content reliability does not directly influence behavioural intention, it significantly strengthens perceptions of usefulness, suggesting that students assess credibility before acknowledging the learning value of AI-generated content. This finding resonates with growing scholarly concern over AI hallucinations, misinformation, and epistemic uncertainty associated with generative models (Correia et al., 2024; Misiejuk et al., 2024).

Students appear cautious in integrating AI tools into their academic routines unless the content is perceived as accurate, unbiased, and professionally articulated. Rather than acting as a direct motivator, content reliability operates as an enabling condition that legitimises the perceived benefits of LLMs. This underscores a critical distinction between trust and utility: students may recognise the potential usefulness of AI tools, but sustained adoption depends on confidence in the quality of the content. The findings, therefore, highlight the importance of trust-related constructs in AI adoption research and suggest that content reliability plays a foundational role in shaping meaningful engagement with generative AI in educational settings. Learner motivation and social influence emerge as particularly salient drivers of LLM adoption, reinforcing the importance of psychological and social mechanisms in technology acceptance. Motivated learners are more inclined to experiment with AI tools, recognise their pedagogical value, and integrate them into self-directed learning practices.

This finding aligns with motivational theory, which emphasises the role of intrinsic interest and perceived value in sustaining engagement with learning technologies (Cerasoli et al., 2014; Huang et al., 2025). Social influence further amplifies adoption by shaping normative beliefs and reducing uncertainty surrounding AI use. Peer usage, instructor encouragement, and institutional acceptance appear to legitimise AI tools, thereby strengthening students' intention to adopt them. Notably, integrating PLS-SEM and NCA reveals causal asymmetry: some factors may not exert strong average effects but remain indispensable for achieving higher levels of adoption. These findings challenge linear assumptions embedded in traditional acceptance models and demonstrate that a combination of drivers and constraints shapes AI adoption. Together, these results offer a more nuanced understanding of student decision-making in AI-enhanced learning environments.

Theoretical implications

This study advances technology acceptance theory by extending TAM and UTAUT to reflect better the distinctive characteristics of generative AI systems in tourism and hospitality education. By integrating content reliability and learner motivation alongside traditional acceptance constructs, the study responds to calls for more context-sensitive frameworks that can explain the adoption of autonomous and generative technologies.

The findings reaffirm perceived usefulness as the central explanatory construct, yet demonstrate that trust-related and motivational mechanisms shape usefulness itself. This challenges the sufficiency of conventional acceptance models when applied to AI-driven learning environments and supports emerging scholarship that emphasises trust, credibility, and epistemic evaluation as integral components of AI acceptance (Al-Zahrani, 2024; Cui et al., 2025). Consequently, the study contributes to theory by repositioning content reliability as a foundational antecedent that conditions cognitive evaluations of AI systems rather than acting as a direct behavioural driver.

A second theoretical contribution lies in the methodological integration of net-effect and necessity-based perspectives. While PLS-SEM identifies dominant predictors of adoption intention, NCA reveals the minimum conditions required to achieve higher levels of acceptance. The finding that specific constructs are necessary but not sufficient introduces causal asymmetry into AI adoption research, extending prior work that assumes symmetric causal relationships. This dual-theoretical lens enriches understanding by distinguishing between drivers that increase the likelihood of adoption and conditions that must be present to avoid adoption failure. As such, the study contributes to a more nuanced and realistic theorisation of technology acceptance in AI-enabled education.

Practical implications

The findings offer several actionable implications for educators, institutional leaders, and AI developers seeking to responsibly integrate LLMs into higher education. First, institutions should prioritise demonstrating the academic value of AI tools rather than emphasising technical features alone. Students are more likely to adopt LLMs when they clearly improve learning outcomes, facilitate deeper understanding, and support task completion.

Embedding AI tools into curricula through guided learning activities, reflective exercises, and assessment support can strengthen perceptions of usefulness and encourage sustained engagement. Second, ensuring content reliability is critical. Institutions should develop clear guidelines for AI use, promote verification practices, and encourage transparency regarding AI-generated outputs to build trust and reduce epistemic uncertainty among learners.

Equally important are learner motivation and social norms. Educators can foster positive attitudes toward AI by modelling ethical and purposeful use of LLMs in teaching and assessment. Peer-led demonstrations, instructor endorsement, and institutional support can normalise the use of AI and reduce apprehension about emerging technologies. Although perceived ease of use may no longer serve as a primary motivator, it remains a foundational requirement that enables higher-order evaluations of usefulness and motivation.

Ensuring intuitive interfaces, accessible support, and digital literacy training can therefore create an environment conducive to meaningful AI adoption. Together, these strategies can help institutions move from experimental adoption of AI to a pedagogically grounded, sustainable integration of LLM-based learning tools.

Limitations and future scope

Despite its contributions, this study has limitations that open avenues for future research. The cross-sectional design limits causal inference, suggesting the need for longitudinal studies to examine how students' perceptions and intentions toward LLMs evolve. The sample was drawn from Indian higher education, which may limit generalizability to other cultural or institutional contexts. Future studies could conduct cross-country comparisons or discipline-specific analyses to capture contextual variation. Additionally, future research may incorporate learning outcomes, ethical attitudes, or self-regulated learning behaviours to further enrich AI adoption models. Experimental and mixed-method approaches could also provide deeper insights into how students interact with LLMs in real learning scenarios.

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SUSTAINABLE TOURISM AND THE GREEN ECONOMY IN PERU: PERCEPTIONS FROM THE TOURISM SECTOR

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Abstract: Given the growing urgency of sustainable development worldwide, tourism is emerging as a strategic sector to drive the global ecological transition. The main objective of this research was to determine the relationship between sustainable tourism and the green economy in the Peruvian context, comprehensively analyzing its environmental, sociocultural, and economic dimensions. A quantitative approach was adopted, with a correlational scope and a non-experimental, cross-sectional design. The sample consisted of 153 participants in the tourism sector, selected through non-probability sampling based on predefined inclusion criteria. A structured survey of 32 items per variable, using a five-point Likert scale, was used. This survey was validated by expert judgment and demonstrated high reliability (Cronbach's alpha >0.8). Statistical analysis included normality tests (Kolmogorov-Smirnov) and Spearman's rank correlation coefficients. The results revealed a significant moderate positive correlation between the main variables (Rho = 0.501, p = 0.001). Specifically, the sociocultural dimension showed the strongest association (0.560), followed by the economic (0.337) and environmental (0.181) dimensions. The findings indicate that incorporating sustainable practices into tourism aligns with the core principles of the green economy: social equity, environmental protection, and economic growth. It was determined that, in Peru, the transition to a green economic model is facilitated by the promotion of responsible management, resource preservation, and active community involvement. This provides data for the design of empirically grounded public policies and business strategies that promote inclusive, balanced, and resilient development in the country.

Keywords: sustainable tourism, green economy, environmental management, tourism, economic development

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INTRODUCTION

Throughout history, humanity has devised a wide variety of activities to satisfy its needs, and currently, in a society that is moving towards a balance between work and private life, rest, entertainment, and leisure are becoming increasingly important. Among the various leisure activities that can be enjoyed today is tourism, which has existed for centuries (Kou et al., 2024; Rakhimzhanova et al., 2025). Conceptually, tourism is considered as the phenomenon that involves the movement (travel) of human beings to multiple destinations far removed from the reality in which they live, classifying as a tourist anyone who stays overnight in that destination. Currently, the tourism industry represents more than just a leisure activity; it is widely considered a significant multidisciplinary activity, encompassing cultural, social, environmental, political, and economic aspects. According to Toubes & Araújo (2022), the tourism sector significantly benefits the global economy. Prior to the pandemic, in 2019, tourism travel contributed a high percentage to global GDP, reaching 10.4% (equivalent to US$9.2 trillion), and accounting for 10.6% of global. In Peru, in 2019, the tourism sector represented 3.66% of the national GDP and employed 1.1 million workers in 2018. However, Peru was not immune to the global impact of COVID-19, which led to border closures and the cessation of most tourism services, resulting in a decline in suppliers such as travel agencies, accommodations, restaurants, and air transport. This meant that tourism was the economic activity that suffered the most negative impacts in the country due to the pandemic. In contrast, and optimistically, the situation has improved by 2025, with the tourism sector's contribution to the national GDP projected to grow to approximately 7.8%, representing 6.6% of national employment (United Nations [UN], 2023).

However, tourism can have effects that are not always positive. It was once believed that tourism only benefited the community, but without proper planning and clear policies for the tourism lifecycle, it could negatively impact local populations, especially in rural or remote areas, and their economies, as well as the environment (Cao et al., 2023; Marvin, 2024; Wang & Cheablam, 2025). Additionally, Ospanova et al. (2022) point out that the green economy aims to reduce the impact of economic activity on the environment. This leads to the modification of the conventional or brown

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economy, which aims only to obtain coins and is static, thus demonstrating that the green economy is dynamic and is shaped according to sustainable development, complying with the 17 Sustainable Development Goals and Targets, which include tourism (Manotungvorapun & Gerdsri, 2025; Jiménez et al., 2024).

This research seeks to determine the relationship between sustainable tourism and the green economy in Peru, analyzing its environmental, sociocultural, and economic dimensions. Within this framework, it evaluates how responsible environmental management, community participation, and equitable economic development can be linked to the principles of the green economy and contribute to the country's sustainable development.

LITERATURE REVIEW

Although sustainable tourism and the green economy share common goals, their conceptual frameworks have distinct origins and emphases that must be clearly differentiated. Sustainable tourism, rooted in the Brundtland Report, focuses primarily on managing the impacts of tourism activities, balancing environmental preservation, sociocultural equity, and economic viability at the destination level (Sharpley, 2021). In contrast, the green economy is a broader macroeconomic framework that seeks to improve human well-being and social equity while significantly reducing environmental risks and ecological scarcity (Akadiri & Ozkan, 2026). The critical intersection between both frameworks occurs where tourism's resource efficiency and social inclusion align with the green economy's principles of decarbonization and green employment. However, there is conceptual ambiguity in the literature where both terms are sometimes used interchangeably, generating inconsistencies in the measurement of their actual impacts (Toubes & Araújo, 2022).

Sustainable tourism

According to Yang et al. (2023), defines tourism as the activities undertaken by people when they travel to and stay in places outside their usual environment for a period of less than one year for recreational, business, or other purposes, without involving paid employment. Likewise, the UN indicates that tourist trips can be motivated by various reasons, such as healthcare, professional education, leisure, religious practices, among others. Taken together, all these aspects constitute tourism activities (Zhang et al., 2023).

Tourism evolved from the Grand Tour (17th-19th centuries) and mass tourism (1960s-1970s) towards sustainable tourism in the 1990s. This model integrates economic, environmental, and social dimensions to preserve the environment, culture, and long-term viability. Its fundamental pillars are natural resources, heritage, and community authenticity (Pié & Vilanova, 2012; Streimikiene et al., 2021; Sharpley, 2021; Marques et al., 2022).

Sustainable Development Goals

Regarding the 17 Sustainable Development Goals (SDGs) outlined in the 2030 Agenda, those directly associated with sustainable tourism are: SDG 8, which substantially contributes to economic growth at the local and national levels by creating decent jobs. SDG 11 further links social equity and reduces environmental impact, promoting inclusive, safe, resilient, and sustainable living environments. SDG 12 addresses responsible consumption practices, mitigating environmental impact and encouraging long-term sustainability. Finally, SDG 15 focuses on the preservation and sustainable use of ecosystems; in this case, tourism practices that respect the natural environment would be developed (UN, 2023).

According to Vrana (2023), sustainable tourism is based on three dimensions applicable to the Peruvian context: (1) environmental: responsible use of natural resources and participatory planning to minimize impacts (Akadiri & Ozkan, 2026; Jo et al., 2026); (2) sociocultural: multisectoral collaboration to preserve ancestral traditions and offer authentic experiences (Ferdian et al., 2024; Spadaro et al., 2023); and (3) economic: efficient management that generates sustainable income, equitable distribution of benefits and long-term financial viability (Chen et al., 2025; Xue et al., 2023).

Green economy

Over the years, sustainability has become a relevant issue worldwide, a concept that is and should be included in the development of all sectors, including the economic one. Compared to the discipline of conventional economics, the green economy is a relatively innovative concept that focuses on the free use of resources found in the natural environment within a territory and their distribution among the population to meet their basic needs (Sahabuddin et al., 2026; Surdez et al., 2026). Today, the planet faces environmental threats that hinder the full development of humanity, such as climate change. Therefore, in 2012, approaches were proposed to guide a green economy model, ensuring adequate growth in the countries where it is implemented. These approaches are: economic development and growth, environmental protection, low-carbon development, resilience, resource efficiency, ecological sustainability, human well-being, inclusion, and equity (Gong & Chen, 2023).

Economic development and growth

The current economic model followed by most powerful, industrialized, and more developed countries neglects resource conservation and has serious environmental repercussions, focusing solely on increasing national wealth and rendering it unsustainable for future generations. In Peru, the contemporary economy is driven by the efforts of innovative businesses and entrepreneurs seeking optimal market positioning, with ambitions for exports and international recognition (Berdenov et al., 2025). The growth of these businesses involves interdisciplinary interaction between markets and different economic sectors within the territory to generate income and provide a comprehensive overview that will allow them to offer customers something that meets their needs. As these businesses grow, and simultaneously the country's economy, developing under a green economy concept, as indicated in the guide to a green

economy, entails implementing structured social responsibility policies for the benefit of residents and their well-being, along with the appropriate use of resources in the natural environment (Singh et al., 2025; Guillen et al., 2025).

Several recent studies have explored the relationship between tourism and the sustainable economy, albeit using different methods. In ASEAN nations, Zhang et al. (2023) confirmed that ecotourism contributes to the ecological Gross Domestic Product through the Sustainable Tourism Index; however, its exclusive reliance on macroeconomic figures omitted the perspectives of microeconomic actors, limiting its usefulness for corporate strategies. In contrast, Chen (2023) recognized the benefits of ecotourism for individuals and the environment in ethnic areas of China. Finally, Han & Li (2021) underscored the importance of regulating emissions in low-carbon environments, although their work focused on technical indicators, overlooking essential sociocultural elements for local acceptance.

In Latin America, Esenarro et al. (2024) conducted research on the implementation of ecological corridors in Cusco, Peru, identifying shortcomings in ecological investment and an inequitable distribution of benefits for local communities. While this study is highly relevant to the present one, it focused on a specific location (Cusco) without considering the national landscape of official tourism. Wang & Cheablam (2025) identified beneficial links between sustainability and economic performance. However, their analysis is limited by its failure to differentiate between environmental, sociocultural, and economic aspects, treating them as a single unit. Finally, Singh et al. (2025) studied sustainable tourism techniques in developing nations and determined that corporate social responsibility plays a fundamental role as a mediator. However, they did not consider tourism operators or the public sector.

Table 1. Study Positioning

Similar Study	Main Focus	Limitation addressed by this research
Zhang et al. (2023)	Macroeconomics, green GDP, ASEAN	Macro-level analysis vs. micro-level (stakeholder perceptions)
Chen (2023)	Ecotourism, ethnic minorities, China	Qualitative approach vs. quantitative correlational design
Esenarro et al. (2024)	Green corridor, Cusco, Peru	Single-destination focus vs. national perspective (Lima)
Wang & Cheablam (2025)	Tourism hubs, Asia	No dimensional differentiation vs. three dimensions analyzed (environmental, sociocultural, economic)
Singh et al. (2025)	CSR, hotel sector, emerging economies	Hotel sector only vs. multiple stakeholder groups

Despite growing interest, the current literature reveals three significant gaps that this analysis aims to describe. First, there is a predominance of a macroeconomic approach that examines the relationship between tourism and sustainable growth at the national GDP level, leaving unexplored how these aspects are perceived and managed at the micro level (stakeholders and businesses) (Chen, 2023; Zhang et al., 2023). Second, there is a clear geographical bias, as most empirical research focuses on developed economies or East Asia, while information from developing nations such as those in Latin America is scarce (Esenarro et al., 2024). Finally, there is an unresolved theoretical tension regarding whether the adoption of sustainable practices is motivated by ethical convictions or by regulatory requirements and profitability, particularly in contexts with high levels of informality.

Responsible resource and waste management, the environmental pillar, is the instrument for achieving ecological efficiency and preserving the environment. Simultaneously, community participation and the safeguarding of heritage, the sociocultural component, align with social inclusion and intergenerational equity. Finally, the generation of decent employment and the boosting of local incomes, the economic dimension, are directly linked to sustainable growth and green employment. From this perspective, the strength of the link between these three pillars is determined by the degree of balance with which they are integrated into the operational practices of the tourism sector.

Given the identified limitations, this study aims to examine the link between sustainable tourism and the green economy in Peru, integrating its environmental, sociocultural, and economic dimensions from the perspective of key stakeholders in Lima. Its contribution is contextual and validating: it adapts and confirms existing theoretical frameworks on sustainable tourism and the green economy within a context marked by institutional constraints and significant ecological diversity, factors that introduce unique challenges.

MATERIALS AND METHODS

This research employed a quantitative approach, aiming to establish cause and effect between two variables or simply determine relationships between variables, which is what was done in this study. It is also known as empirical research because the results are evaluated precisely. Statistical analysis is performed to justify, anticipate, or control phenomena. Furthermore, it incorporates a rational component that moves from the general to the specific. The research had a relational scope, allowing for the analysis of two or more variables within a single group, and a non-experimental, cross-sectional design, which does not involve an experiment. This approach, however, amplifies the variance of individual variables and reduces any potential measurement flaws (Griffith, 2024).

The selection of the 153 participants was based on a non-probabilistic, purposive sampling approach, specifically focused on individuals in the tourism sector in Peru. The main criterion was their direct experience with sustainability practices; this decision allowed access to theoretically relevant information for examining the link between sustainable tourism and the green economy. Recruitment was conducted through institutional contacts and professional networks, prioritizing those with operational experience or decision-making capacity. The sample size was determined based on the requirements of the correlation analysis; therefore, the 153 participants provide sufficient robustness for Spearman's

rank correlation coefficients. Data collection took place in Lima, the country's main tourist hub and decision-making center, which facilitated gathering perspectives from stakeholders with national influence.

As a limitation of research, non-random sampling restricts external generalizability, meaning that the results primarily apply to the profile analyzed. To counteract this, recruitment aimed for balanced representation across groups. Additionally, requiring a minimum of two years of stable work experience ensured informed opinions by effectively filtering out responses from temporary or inexperienced staff.

Data collection was based on a survey technique with closed and multiple-choice questions (Salvador et al., 2021). The questionnaire consisted of 32 items per variable, measured using a five-point Likert scale (from "strongly disagree" to "strongly agree"). Before its implementation, a panel of experts validated the content to confirm that the items reflected the dimensions studied (Flores & Terán, 2022). The assessment of internal consistency using Cronbach's alpha coefficient confirmed the effectiveness of the instrument. The first variable obtained 0.8, while the second reached 0.9, reflecting adequate reliability (Raykov et al., 2024). The survey was conducted anonymously, protecting the privacy of the data provided by the participants. The collected data were statistically analyzed through: (1) a descriptive analysis to define the group and identify patterns, (2) a correlational study to explore the connections between the study variables, and (3) inferential methods for a better interpretation of the results. Presenting the results in tables facilitated the processing, analysis, and discussion of the information (Figure 1).

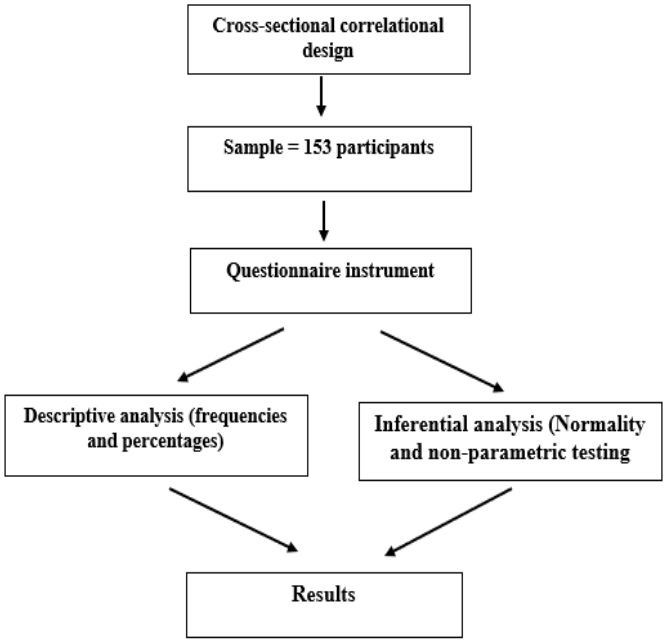


Figure 1. Quantitative analysis process

RESULTS AND DISCUSSION

Of those surveyed, 65.4% (100 participants) expressed agreement with the processes necessary to achieve sustainable tourism, and 31.4% (48 participants) indicated they strongly agreed. Regarding the second variable, the green economy, 62.1% (95 participants) concurred on the importance of implementing programs, guidelines, and business strategies that promote resource efficiency and proper waste management in the tourism sector, while 7.8% (12 people) strongly agreed (Table 2). These results demonstrate widespread recognition among participants of the relevance of sustainable tourism and the green economy in tourism activities, highlighting their close interrelationship. This connection is explained by the fact that sustainability in tourism seeks, among other objectives, to generate economic benefits for local communities, a purpose for which the green economy is fundamental.

Table 2. Frequency and percentage of study variables

	Sustainability		Green Economy	
	f	%	*f*	%
I completely disagree	1	0.7	1	0.7
Disagree	1	0.7	2	1.3
Neither agree nor disagree	3	2.0	43	28.1
OK	100	65.4	95	62.1
Totally agree	48	31.4	12	7.8
Total	153	100.0	153	100.0

In this study, the Kolmogorov-Smirnov normality test was used to examine whether the data collected from the sample followed a parametric or non-parametric distribution and to evaluate possible correlations between the variables (Table 3).

Table 3. Kolmogorov-Smirnov Normality Test

	Sustainable Tourism	Green economy	Environmental	Sociocultural	Economic
N	153	153	153	153	153
Sig. asin. (bilateral)	0.001	0.025	0.001	0.001	0.001

Table 4. Correlation between the variables Sustainable Tourism and the Green Economy

Green Economy			
Spearman's rho	Sustainable Tourism	Correlation coefficient	.501
		Sig. (bilateral)	0.001
		N	153

Statistical analysis shows a Spearman correlation coefficient of 0.501 ($p = 0.001$), indicating a moderate positive association between sustainable tourism and the green economy. Following Cohen's (1988) parameters, where moderate correlations range from 0.30 to 0.49 and strong correlations exceed 0.50, this result suggests that, in practice, stakeholders who perceive a higher level of sustainable practices in tourism demonstrate greater alignment with green economy principles in the Peruvian context (Table 4).

Although the statistical significance ($p < 0.05$) ensures that this connection is not random, the moderate magnitude of the coefficient implies that other factors not analyzed could influence the implementation of these practices. This result supports the proposed hypothesis and aligns with previous studies (Zhang et al., 2023; Chen, 2023), which also link visions of sustainability in tourism with broader economic and environmental frameworks.

Table 5. Correlation between the variables Green Economy and the dimensions of Sustainable Tourism

			Environmental	Sociocultural	Economic
Spearman's rho	Green economy	Correlation coefficient	.181	.560	.337
		Sig. (bilateral)	0.025	0.001	0.001
		N	153	153	153

According to table 5, the results of the Spearman correlation analysis allow for a clear distinction between the statistical significance and the practical significance of the findings. Following the benchmarks established by Cohen (1988), where values between 0.10 and 0.29 are considered weak, between 0.30 and 0.49 moderate, and above 0.50 strong, it is observed that the general correlation between sustainable tourism and the green economy ($\rho = 0.501$, $p = 0.001$) represents a statistically significant moderate association. This suggests that, in practice, the strengthening of sustainable tourism practices is substantially related to the adoption of green economy principles in the Peruvian sector.

The sociocultural dimension was the most important factor for the green economy transition. Participants stated that the green economy transition depends on community participation, cultural preservation, and interaction between tourists and local communities. The economic dimension showed a weak to moderate correlation ($\alpha = 0.337$, $p = 0.001$); it was statistically significant, but its practical importance suggests that the relationship between local economic benefits and the green economy is relevant but not decisive due to factors such as informal employment or income inequality in Lima's tourism sector.

In the case of the environmental dimension, further analysis is required ($\rho = 0.181$, $p = 0.025$), where the p-value less than 0.05 suggests statistical significance, likely due to a sample size of $n = 153$. However, the coefficient $\rho = 0.181$ indicates a very limited practical connection with respect to established standards. In other words, while a statistically measurable relationship exists, its influence in real-world situations is minimal. This weak correlation in the environmental context could be attributed to both theoretical and environmental factors: the environment in Lima, where tourism is important, may not have a strong connection to how people act on environmental issues. This could be because people may say they care about the environment in a survey, but face practical problems that prevent them from doing so, such as high costs, lack of skills, or inadequate facilities. People may be more focused on making quick money from tourism than on investing.

To promote a green economy in Peru's tourism sector, efforts should focus on strengthening the sociocultural aspect, where ties are strongest. On the other hand, for the environmental sphere, specific measures are needed to overcome implementation difficulties, such as tax incentives, technical training, and regulations that clearly link profitability with ecological sustainability. In accordance with the general hypothesis, the correlation results obtained show a significance value of less than 0.05. Furthermore, a moderate positive correlation was observed, reaching a value of 0.01, suggesting that an increase in sustainable tourism is related to a more robust green economy.

Zhang et al. (2023) point out that a place's economy depends on how quickly its tourism industry grows and is environmentally friendly, as well as on the value of money in that place compared to others. The findings of this research align with the study conducted by Chen (2023), who indicated that a tourism-centric green economy model had a positive impact on residents, visitors, and even the ecological and heritage environment itself.

This was observed through the perceptions of tourists while on-site at the destination. According to Vrana (2023), sustainable tourism has three pillars: Environmental, which, according to Akadiri & Ozkan (2026) and Jo et al. (2026), involves the proper management of environmental resources and the protection of biodiversity to avoid harming the environment. This can be achieved through the participation of stakeholders in the tourism sector. The sociocultural factor encompasses stakeholders who must have clear tourism planning and sustainable practices. Furthermore, the traditions of local communities must be preserved, thus providing an authentic experience for tourists. Finally, a tourism-

based economy also arises when tourists' interests are understood and high-quality services are provided. This greatly benefits communities employed in the sector, generating economic returns for the community (Ingaldi & Dziuba, 2022).

Regarding the specific hypothesis, a significance value of less than 0.05 was obtained, proving that a relationship exists between the research variables. A moderate positive correlation was also found, with values of 0.181 obtained between the green economy (the variable) and the environmental dimension. Following the findings of Han & Li (2021), who highlighted the need for tourism sector activities that do not pollute the environment through energy and carbon emission controls, this should be considered in companies' cost planning. In this way, a stronger green economy could be achieved, and the environmental dimension would be enhanced by having a sustainable project to support it.

This is complemented by the research conducted by Esenarro et al. (2024) in Peru highlighted that, in order to achieve sustainable tourism and a green economy model, policies are needed that are geared towards implementing solutions to the problems facing the tourism sector, such as pollution and the lack of fair wages. Therefore, investments focused on reducing carbon emissions and energy consumption, as well as promoting equitable wage distribution, are necessary. According to López & Cisneros (2026), the World Tourism Code of Ethics emphasizes that for the development of sustainable tourism, it is essential to protect species and the natural environment that surrounds them, as well as to consider the carrying capacity of tourism so that the arrival of tourists does not negatively impact the ecosystem.

Regarding the second specific hypothesis, which states that there is a relationship between the green economy and the social dimension, a correlation coefficient of 0.560 was found, indicating a considerable positive correlation between the two parts of the hypothesis. Considering the study by Novovic et al. (2022), which indicates the relevance of implementing responsible social policies and considering the sociodemographic characteristics of workers, such as their education, for the application of green accounting practices, the social dimension of sustainability demonstrates a positive correlation with green economy practices. Furthermore, Luekveerawattana (2024) also affirms that, to achieve effective green tourism management, and therefore green economic development, it is crucial to consider the community and actively involve it in tourism activities, as well as promote the preservation of local culture.

Along the same lines (Butowski, 2021; Marques et al., 2022) mention how, in principle, tourism activity should be related to cultural heritage and the preservation of the authenticity of the culture of local communities. In addition, the tourism industry needs the participation of stakeholders with adequate planning, since in sustainable tourism practices, it is expected to provide a unique experience to tourists (Ferdian et al., 2024; Spadaro et al., 2023).

Next, regarding the final specific hypothesis, which seeks to establish a relationship between the green economy variable and the economic dimension of the sustainable tourism variable, it can be stated that there is a moderate positive correlation, as indicated by the correlation coefficient of 0.337. This is supported by the significance level of 0.001, which reaffirms the relationship between both parts of the hypothesis. Complementing this information, Xue et al. (2023) indicate how to implement economic practices that generate resilient financial benefits and fairly bifurcated compensation, while also promoting access to employment and stimulating investment activity that results in future profits. Similarly, Brel et al. (2020) expand on the topic of economic models in predominant sectors in Russia, including tourism, and explain how the use of green economy practices is indeed realistic and how their implementation could provide a solution to socioeconomic problems within the tourism industry.

Therefore, there is a positive relationship between the concept of green economy and the economic dimension, which concerns sustainable practices for improving the quality of the sector in which they are applied.

One of the main limitations of this research relates to data collection, which was restricted due to the scarcity of available information on the topic. This meant that part of the analysis focused on Peru was based on studies from previous years, as updated data were unavailable. Furthermore, due to time constraints, it was not possible to conduct field visits that would have allowed for a more in-depth and localized analysis.

From a theoretical perspective, this research contributes to understanding how sustainable tourism relates to the green economy and its environmental, sociocultural, and economic dimensions, offering a useful conceptual framework for future studies in similar contexts. In practical terms, the findings can guide museum managers and local authorities in planning inclusive infrastructure and services, promoting more accessible experiences, and fostering the active participation of communities in sustainable tourism activities.

CONCLUSIONS

The findings of this study suggest that the transition to a green economy in the Peruvian tourism sector is not a homogeneous process. While there is a clear link between sustainable practices and ecological principles, the strength of this relationship varies significantly depending on the dimension analyzed. Most importantly, the sociocultural component emerges as the main driver; community participation and the preservation of identity resonate more strongly with stakeholders in the sector than purely environmental measures. This suggests that, in the context of Lima, the social legitimacy of sustainability depends more on human interaction and culture than on the technical management of waste or energy, where a gap is perceived between intention and actual practice.

On the other hand, although the economic dimension shows a positive correlation, its impact is conditioned by the structure of the labor market and income distribution. Simply generating employment is not enough; quality and local reinvestment are crucial for the model to be perceived as truly "green." Therefore, promoting a green economy in tourism requires policies that not only incentivize ecological efficiency but also prioritize the social fabric and ensure that economic benefits effectively reach host communities. Only by balancing these three spheres, with a special emphasis on the human element, can we consolidate resilient and authentic tourism development.

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HOW CAN A SMALL DESTINATION BECOME A "RISING STAR" IN THE MODERN COMPETITIVE TOURISM MARKET? EVIDENCE FROM THE PHILIPPINES

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Abstract: This review study aims to analyze how a small island destination, exemplified by Samal in the Davao Gulf (Philippines), can achieve rapid tourism growth and transition into a competitive regional destination. It seeks to identify key drivers and strategies behind its successful development. The research examines the pathways by which a small island destination can transform into a "rising star" in the contemporary tourism market. The research employed a review-based approach combining secondary tourism data from 2015 to 2024 with a detailed case study analysis of Samal Island. The study employed a destination development framework to evaluate the impact of institutional, environmental, and socio-economic factors on growth. The findings indicate that Samal's tourism growth is driven by interconnected elements, including sustainable practices, the utilization of cultural and natural resources, and collaborative governance. These factors collectively enhanced the island's visibility and competitiveness in Southeast Asia's tourism landscape. The study concludes that even small, resource-limited destinations can reposition themselves successfully in regional tourism hierarchies through sustainable management, effective cooperation among stakeholders, and strategic leveraging of local assets. The contribution of this research lies in providing review evidence from the emerging island context of Southeast Asia, illustrating that even modestly resource-endowed destinations can successfully reposition themselves in regional tourism hierarchies when attractive resources and inclusive governance come together.

Keywords: Samal, tourism development, resources, small destination, review analysis

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INTRODUCTION

Tourism is one of the key economic branches of the global economy, with the average contribution of almost 10% to the world GDP in 2023 (UN Tourism, 2024). Tourism represents a key sector for the economic development and social cohesion in the Philippines, with its long and multilayered history which ranges from pre-colonial mobility of people, and exchange, over the colonial period and the formation of the first infrastructural basis, to the modern efforts aimed at the internationalization of the offer and sustainable development. According to Lapuz (2023), the historic reconstruction of tourism development in the Philippines points to the process where the mobility patterns, colonial policies, and local community practices shaped the tourism institutions and practices – contrary to the simplified review which connects the beginning of tourism exclusively with the post-war, mass growth. The analyses of historiography point to the existence of early forms of travels and mobility, which were later institutionalized through the state and private development of the tourism offer (Capistrano & Notorio, 2021; Capistrano & Muñoz, 2022). During the last few decades, tourism in the Philippines has changed from predominantly local and regional to the growing acceptance of international markets thanks to the combination of natural resources (attractive beaches, coral reefs, rich biodiversity), cultural heritage, solid selective types of tourism offer (Fabros et al., 2023; Valencia et al., 2022; Notorio et al., 2025) and international promotion strategic policies. However, this growth was also accompanied by challenges – from spatial and sectoral uneven development, over the poor institutional coordination and the issues of environmental degradation, to the academic criticism which advocated decolonization of tourism research and practices in order to better represent local narratives and interests. Such critical literature emphasizes the need for including the local perspectives into policy-making and tourism research (Dela Santa &

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Saporsantos, 2016; Gutierrez et al., 2021; Islam et al., 2018). The contemporary state of the sector is characterized by a strong recovery after the 2020–2021 pandemic standstill: statistical indicators and assessments point to the recovery of international arrivals and the income growth from tourism in the period 2022–2024, even though the levels in certain segments are still below the pre-pandemic (2019) trends. The national and international assessments show that the policies of opening borders, promotional campaigns, and the measures aimed at the support to the sectors of hospitality and air traffic significantly contributed to the recovery, but, at the same time, the needs for growth management, income source diversification, and strengthening destinations' resilience to external shock were highlighted (Philippine Statistics Authority, 2024). The pandemic crisis additionally changed the patterns of travelers' behavior – the importance of health safety was raised, as well as the demand for "closer" and domestic destinations, and the interest for less congested and nature-oriented products, such as eco-tourism and community-based tourism. The studies of post-pandemic tourists' behavior in the Philippines and the region of Southeast Asia point to the generation differences in the readiness to travel, as well as the higher demand for experiential, safe, and locally-based offers. These changes are both an opportunity and a demand for the reform of the destination management model (Fadlurrahman et al., 2025; Santiago et al., 2022; Zhang et al., 2021).

The perspectives of tourism development in the Philippines lie in several simultaneous directions. First, the improvement of sustainable and jointly-led models – community-based tourism (CBT) and creative forms of tourism – can enable a greater distribution of benefits, preservation of cultural and natural resources, and more resilient local development. The empirical research and evaluations of pilot-projects in the Philippines not only show the potential of CBT but also point to the need for institutional capacities, clear income mechanisms, and the support in the market positioning (Aquino, 2019; Fernandez-Abila et al., 2024; Gutierrez, 2022; Gutierrez & Vafadari, 2023). Second, the direction toward market diversification and the improvement of connections (e.g. visa-liberalization policy toward certain market sources) represents short-term measures for speeding up the income recovery, where there must be a balance with long-term sustainable planning (Quevedo et al., 2021). Third, the digitalization of services, data on visits, and strategic destination management will be crucial for the optimization of tourist flow and for minimizing the negative effects on sensitive ecosystems (Moreno & Bucoy, 2024). The research on tourism development in the Philippines requires a balanced approach which integrates historical-cultural insights, actual empirical data on tourist performance and behavior (Aquino & Porter, 2022), as well as critical perspectives which insist on local agencies and decolonization of knowledge. Such an approach enables not only the understanding of changes in the scope and structure of tourism, but also creating the policies which encourage inclusive and sustainable development of the sector.

In the Philippines, as well as in other parts of Southeast Asia, a lot of destinations rely on mass coastal tourism (for instance, the islands of Boracay, Bali, Phuket, etc.), which is why these new island destinations are forced to develop strategies of product differentiation and innovative approaches in management in order to be competitive with larger market actors (Cheer et al., 2018). In the last few years, the Island and the City of Samal, located in the Gulf of Davao in the Philippines, have been experiencing a fast development of tourism and they have often been highlighted as examples of a "rising star" destination, since they achieved significant improvements in the number of arrivals, in the income, and reputation. The aim of this paper is to analyze the key factors which have contributed to the competitive rise of Samal and to provide insights into the theoretical evidence on how small destinations can build market visibility and long-term sustainable position.

In order to achieve that, the research tasks will include the following: 1. Analysis of the historical tourism development trend of Samal (2015–2024); 2. Identification of the elements of tourism product differentiation; 3. Assessment of the impact of the improved transport accessibility on the growth in tourist arrivals and stay length; and 4. Formulation of recommendations for the implementation of good practices of Samal in the development of similar island destinations. The theoretical framework is based on the concepts of multivariate analysis of tourism in the observed destination and assessment of tourism advantages and disadvantages (Aquino & Porter, 2022; Dunets et al., 2020; Savanchiyeva et al., 2023), which show that the success of small destinations depends on a blend of comparative geographical analysis, systematic scientific methods, cartographic techniques, and expert evaluation. The previous research emphasizes the key factors of small island destination competitiveness, such as regional advantages, resources, sustainable development, and management.

MATERIALS AND METHODS

Case study of the Philippines' city and island of Samal

The sustainable development of tourism is especially important for small island destinations which possess extraordinary natural and cultural values, but which are also facing with limited resources and infrastructure, dependence on seasonality, and vulnerability to climate change (Scheyvens & Momsen, 2008). One of the representative examples is the island and the city of Samal in the Philippines. Samal is situated in the Gulf of Davao, in the south of the Philippines. The island is located in the Celebes Sea and within the province of Davao del Norte as one of the southernmost islands of the Philippine archipelago, near the southern coast of Mindanao Island (Figure 1). Samal Island has a surface area of 301 km^2, and it was inhabited by more than 120,000 people in 2020. The average arithmetic population density of the island is 395 people/km^2, and it is not one of the most densely populated islands in the Philippines. The entire island of Samal is within the city limits of the same name city (Samal). The city is divided into several districts, such as Babak, Penaplata, and Kaputian, and with additional 46 smaller settlements (Plasabas et al., 2013). Between the large island of Mindanao and Samal lies the narrow and long Pakiputan Strait. The narrowest point of this strait, between Davao City, the capital of Mindanao, and Babac Town on Samal Island, is only 900 meters wide (Nicolas et al., 2024). The largest island settlement is Samal City, which is also called "Island Garden City of Samal" or "IGACOS" (In Tagalog language: Pulong Harding Lungsod ng Samal). The city had a population of 116,638 in 2020, and it is expected that the total population of Samal city will exceed 120,000 in 2025 (Aguinaldo & Gomez, 2023).



Figure 1. The position of Samal Island in the Philippines

The average annual temperature of the city is 30 °C and the average annual rainfall is 1,297 mm. Depending on the specific location and geographical features, the annual rainfall in Samal varies between 1,200 and 1,600 mm, and short-term rains continue throughout the year. It is possible to describe the December–April period as the "dry season" since it receives the least rainfall, while the May–November period can be described as the "humid season" since it receives more rainfall. For the sea tourism purposes, the period between December and April is more convenient for visits. In Samal city, the daytime temperature averages vary between 29 °C and 31 °C throughout the year, while the nighttime temperature averages vary between 22 °C and 24 °C (Table 1). Briefly, there are no major fluctuations or major differences in both temperature and precipitation throughout the year. Before tourism began to flourish, Samal Island's economy relied primarily on coconut cultivation, large-scale agriculture, and fishing, but these industries were generally low-yielding and poverty was widespread. A wide variety of tropical fruit is produced, which is why Samal is also referred to as the "Philippines' Fruit Island". Coconuts, watermelons, avocados, pineapples, grapefruits, apples, bananas, papayas, and mangos are extensively cultivated throughout the island (Aguinaldo & Gomez, 2023).

Table 1. Monthly Average Temperature Changes in the Samal Island (Source: https://www.worldmeteo.info/en/asia/philippines/)

Months	Monthly Daytime Temperature Averages (°C)	Monthly Night Temperature Averages (°C)	Monthly Total Rainfall (mm)	Total Number of Rainy Days
January	29	22	98	16,4
February	30	22	86	14.3
March	30	22	91	16.3
April	30	22	83	18.5
May	31	23	133	25.3
June	31	24	158	25.0
July	30	24	111	23.8
August	30	24	101	21.9
September	30	24	94	20.8
October	30	24	117	24.4
November	30	23	131	24.3
December	30	22	94	18.7
Annual Average	30	23	1,297	249.7

Samal also produces the world's sweetest mango, known as the "Samal Sweet Mango". At least 2,000 hectares of land within the island's borders are planted with mangoes widely exported all around the world (Joaquin et al., 2021). The western coast of Samal Island is more densely populated and economically more developed than the eastern coast of the island. Therefore, most of the tourist facilities are found on the western coast (Fortaleza et al., 2020). To boost economic growth, the Samal Island Tourism Estate (SITE) Project was introduced, aiming to develop high-end resorts and establish the island as a secondary destination linked to Mindanao. However, initial evaluations indicated that the rural population might face significant challenges in keeping pace with rapid tourism expansion unless investments were also made in essential social infrastructure to help local communities adjust (Salman et al., 2024). With more than 2.5 million people living in the nearby city of Davao, the second largest city in the Philippines, the Samal island, one the other hand, recently became one of the main recreation centers of the metropolis. Since thousands of Davao citizens relax on the Samal Island at the weekends, the coastal parts of the island face big pressure by visitors (Dejadena et al., 2015).

Research methods

This review study examines the selected features of Samal, including economy, geography, ecology, and demographics, classifies its tourism benefits and shortcomings, and evaluates the island's tourism potential. The destination was chosen according to numerous factors (Dalagan & Sy, 2023), which distinguished it from other destinations in the Philippines.

The research was performed between January and October 2025, and it relied on the framework of the multivariate analysis of tourism in the observed destination, and tourism advantages and disadvantages were assessed. The secondary sources represent the available data from the Department of Tourism of Philippines (DOT), Philippine Statistics Authority (PSA), Samal Island City Tourism Office, for the analyzed ten-year period (2015–2024). DOT is the most representative state institution which follows the tourism flow at the national level. This study uses a systematic scientific approach, including comparative expert review method, cartographic and geographical presentations (Island Garden City of Samal — Local Tourism Development Plan, 2025). A key aim of the paper is to highlight Samal Island's resources to the academic community and encourage further research. Notably, this is the first comprehensive evaluation of the island's tourism and recreational potential, based on a two-phase study: 1. Analysis of the tourism resources on Samal Island; Examining Samal Island's accommodation capacities. The first phase involves popular tourism attractions, such as tourist parks and entertainment centers, religious centers, beaches, diving centers, historical and cultural places, etc. A detailed overview of the Island's potentials, which were not known to the academic community until now, will be presented (Table 2).

Table 2. Major Natural and Cultural Tourism Attractions of Samal City (Source: Authors, 2025)

Top 30 Natural Tourism Attractions	**Top 30 Cultural Tourism Attractions**
Giant Clam (Taklobo) Sanctuary	Aqua Water Park Samal
Kaputian Beach Park	Bandera Nature Park
Hagimit Falls	Pinta-IX Art Gallery
Sabang Cliff	ISLA Farms Highlands
Secret Blue Lagoon	Dadatan Bat Conservation Park
Canibad Beach	Floating Island Adventure
Limao Lagoon	Playa Azalea Pool
Talicud Mangrove Sanctuary	The Shoreline
Linosutan White Sand Beach	San Jose Mosque
Monfort Bat Sanctuary	St. Ignatius Spirituality Center
Uraya Beach	Japanese Cave House
Timjin's Cave	Virtu Trattoria House N Café
Sanipaan Marine Park	Kembali Samal Island by Filinvest
Pangubatan Forest Park	General Moncado White House
Coral Garden Marine Park	Aurora's Garden Resort
Malipano Islet	The Cliff Samal Oceanfront Resthouse
Quidopong Sandbar	Pearl Farm Beach Resort
Thunder Forest	Garden Breeze Inland Resort
Blue Bird Deck View	Santo Niño Parish Church
Mushroom Reef	Virgen Dolorosa Parish Church
Dayang Beach	Discovery Samal
Dapia Reef	Maxima Aqua Fun
Puting Bato	Mansud Shores
Enong Sinkhole Tidepool	Treasure Land
The Cliff Samal Oceanfront	Cafe Maañag Samal
Tagbaobo Falls	Al - Rahmaa Mosque
Vanishing Island	Virtuquest Samal Resort and Spa
Angel's Cove	Limao Lagoon Park
Cinco Engracia at Punta Pangubatan	Samal Island Park
Alorro Beach	Virtuquest Samal Resort and Spa

First, the reviewed overview will show the most famous attractions, which are key to the development of tourism through tourism attributes that Samal has. Some of them are the following: The City of Interesting Caves, The City of Magnificent Waterfalls, The City with the Puting Bato Hill, The City with the Giant Clam Sanctuary Nature Reserve, The

City with Breathtaking Views, The City with Historical Catholic Churches and Mosques, The City with Scuba Diving Centers, The City with Small Touristic Islands, The City with Historical Monuments, The City with the Talikud Island, The City with Colorful Festivals, The City with Breathtaking Beaches, and The City with the Sabang Cliff. According to the specified tourism attributes, the parameters for the assessment of the observed locations will be identified within each analyzed group, which will be supported by processing the available data from the statistical documents of the local tourism management authorities. After that, the tourism resources, sights, entertainment and recreation infrastructure will be analyzed. The obtained indicators of the evaluation criteria will be put into the unique measurement system. Then the private indicators of tourism-recreational potentials will be calculated: natural conditions and resources, cultural-historic resources, availability of tourism infrastructure, information technology provision of tourism (Jawad & Naz, 2022).

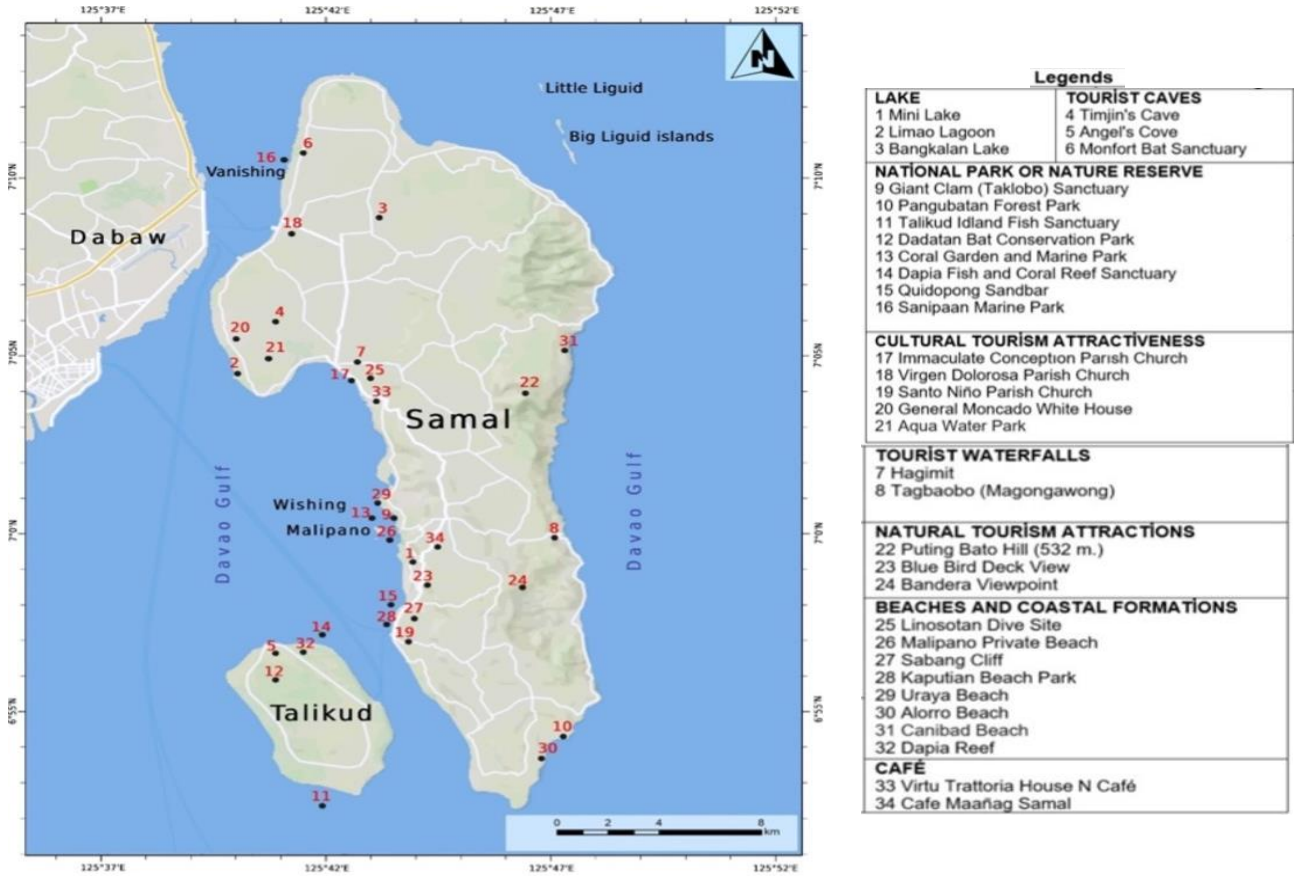


Figure 2. Map of tourist attractions "Island Garden City of Samal" (Source: Authors based on QGIS, 2025)

RESULTS AND DISCUSSION

Analysis of the tourism resources of Samal City

In terms of tourism activities, Samal has been one of the fastest growing Philippine cities of the 21st century and it also has the title of the country's largest "resort city". Samal can arguably be considered the only major Philippine city whose primary focus is tourism and recreation. Samal Island, which is only 2 km away from Davao City by ferry, is one of the most important tourist centers for travelers visiting the capital of Mindanao. This tropical island, which stands out with its pristine beaches, lush fruit orchards, and fascinating snorkeling areas, as well as luxury resorts and budget hotels, is ideal for a seaside holiday throughout the whole year. Samal city administrators organize the Samal summer festivals, which last from April to July every year. Festivals, fairs, congresses, competitions, sports and art events organized during this period attract local and foreign tourists to the city and make it possible for them to have fun. Since typhoons or severe storms are rare on the island, Samal can accommodate tourists 365 days a year. Based on this, the study aimed to create a comprehensive map (Figure 2) to present the the resources clearly and concisely. Some of the tourist features which the Garden City of Samal is famous for are its white sandy beaches and plenty of snorkeling areas, a variety of cheap seafood and fruit, quiet resorts and a wide range of accommodation options to suit every budget, fascinating caves and magnificent waterfalls, interesting marine ecosystem and unique nature reserves, colorful festivals and historical religious centers, and breathtaking diving centers and peaceful bays. Samal reveals its true nature through striking contrasts. The city generally portrays a poor rural picture, but on the other hand, it is full of modern and luxurious hotels. It has neglected suburbs and narrow streets, but also luxury villas with pools and magnificent shopping malls. Samal seems to be far from the world and civilization, but it is also only 2 kilometers away from a large and modern metropolitan city like Davao. It has untouched nature, deserted islands, and isolated shores, as well as lively tourism, noisy traffic flow, and numerous tourist facilities. Samal is a city that is both very close and very far from civilization. Those looking for a place even further from

civilization, even more untouched and more peaceful, are recommended going to the Talikud Island (Azucena & Regidor, 2023). There are many natural and cultural tourism attractions in Samal and they are quite diverse (Figure 2). The most popular tourist attractions among the foreign tourists visiting Samal are as presented in Table 3.

Table 3. The most popular tourist attractions on the Samal

1. Tourist parks and entertainment centers
"Maxima Aqua Fun", "Peñaplata Freedom Park", "Floating Island Adventure", "Playa Azalea Pool", "Precious Garden of Samal", "Aqua Water Park Samal", "Bandera Nature Park", "Aurora's Garden Resort", „Limao Lagoon Park", "Paradise Island Park and Beach Resort", "Treasure Land", "Sunset Beach Park", "Peñaplata Freedom Park", "Babak Baywalk", "Thunder Forest"
2. Tourist religious centers
"Santo Niño Parish Church", "Virgen Dolorosa Parish Church", "Immaculate Conception Parish Church", "St. Ignatius Spirituality Center", "Al - Rahmaa Mosque", "San Jose Mosque", "AL-Farouq Mosque", "Caliclic Masjid", "Mohammad Sharif Afdal Mosque", "Cogon Al Masjid "Al Azraq (The Blue Mosque)"
3. Tourist beaches
"Kaputian Beach", "Alorro Beach", "Canibad Beach", "Kembali Samal Island by Filinvest", "Samalan Camp And Sea", "Kanaan Beach", "Mansud Shores", "Coral Garden Beach Resort", "La Isla Bonita Talikud Island Beach Resort", "Isla Beach Resort", "Whean Beach Resort", "Dayang Beach", "Linosutan White Sand Beach", "La Concha Beach Resort", "Babu Santa", "Pearl Farm Beach Resort", "Babak Bamboo Beach Resort", "Vista Blanco Beach Resort", "Villa Amparo Garden Beach Resort", "Beach Ni Kapitan", "Uraya Beach Resort", "Virat Beach Resort", "Malipano Private Beach"
4. Tourist sea diving centers
"Coral Garden and Marine Park", "Dapia Fish and Coral Reef Sanctuary", "Kidopong", "Sanipaan Marine Park", "Angel's Cove", "Dapia Reef", "Coral Gardens", "Dizon Wall", "Giant Clam Sanctuary", "Linosotan Dive Site", "Babu Santa Minwall", "Mansud Wall", "Malipano Japanese Wrecks", "Talikud Idland Fish Sanctuary"
5. Tourist nature conservation areas
"Coral Garden Marine Park", "Talicud Mangrove Sanctuary", "Mahal Forest Resort", "Giant Clam Sanctuary", "Pangubatan Forest Park", "Dadatan Bat Conservation Park", "Monfort Bat Sanctuary", "Dapia Fish and Coral Reef Sanctuary", "Sanipaan Marine Park", "Linosotan Dive Site", "Babu Santa Minwall", "Mansud Wall", "Malipano Japanese Wrecks", "Talikud Idland Fish Sanctuary"
6. Tourist panorama spots
"Blue Bird View Deck", "Pacific Heights Viewing Deck", "Bandera Viewpoint", "Tañez View", "View Dekz Samal", "Fernandez Peak", "Cafe Maañag Samal", "Oasis Samal Resort", "Puting Bato Highest Peak", "View Dekz Samal", "El Samara Mount FMS", "ISLA Farms Highlands"
7. Tourist historic and cultural places
"General Moncado White House", "Japanese Cave House", "Ois Or Memorial Flight 541 Shrine", "Sinapān Heritage House", "La Vida Art Cafe", "Pinta-IX Art Gallery"
8. Tourist natural beauties
"Limao Lagoon", "Sabang Cliff", "Angel's Cove", "Coral Gardens", "Dizon Wall", "Quidopong Sandbar", "The Cliff Samal Oceanfront Resthouse", "Secret Blue Lagoon, Balet", "Caga San Jose", "Enong Sinkhole Tidepool", "Hagimit Falls", "Muni Muni Beach Resort Samal", "Aundanao", "Tagbaobo Falls", "Acantilado Aqua Farm & Resort", "Cinco Engracia at Punta Pangubatan", "La Patria Chica", "Nelmar", "Monfort Bat Sanctuary"
9. Tourist cafes, bars, and restaurants
"The Shoreline", "Virtu Trattoria House N Café", "Parola Bar", "Cafe Maañag Samal", "Samal View Cafe", "Nimfa's Secret Garden and Kitchen", "Bella italia", "Farmers V Resto & Grill", "Miami Vyce", "Haribar Lounge", "Morning Catch", "Mags Cafe", "The Limestone Brew", "Zagpa Grill and Restobar", "SIP - The Samal Island Promenade", "A Small Deli", "Kino's Bar", "Garden Breeze Inland Resort", "Kasama Coffee","Aznebo Grill & Restaurant", "Farmers V Resto & Grill", "Venus Resort Resto Bar", "Coco Loco Cafe", "Jardin de Ysabelle – Hobbiton Cafe".

Small islands, waterfalls, caves, beaches, churches and mosques, nature reserves, resorts and diving centers are the major tourist attractions in Samal. Snorkeling, trekking in tropical forests, fishing, exploring caves and waterfalls, watching Talikud coral gardens or cockfights, camping in tents, ecotourism, water sports, and beach tourism are the most popular tourist activities in Samal (Olivar et al., 2023). As a result, the destination has earned a variety of interesting epithets:

The City of Interesting Caves

Since there are about 70 caves on the island of Samal (Asdang & Schneider, 2024), speleologists from all over the world carry out scientific studies in these caves. The "Monfort Bat Sanctuary" cave system, consisting of five open caves and containing 1.8 million bats (Plasabas et al., 2013), is one of the must-see places in Samal. The cave system, situated in the northwest of the island of Samal, has been home to a large colony of Rousette fruit bats since the recorded history. More than 75% of the ceiling and walls of the caves, which are about 75 meters long, are covered with bat colonies. The "Montfort Cave System" or "Monfort Bat Sanctuary" is the largest single colony of this species according to the Guinness World Records (Asdang & Schneider, 2024). In addition to bats, the cave system is home to a variety of other animals, including snakes, lizards, and spiders. In short, this location hosts the largest single concentration of bat species in the world. "Timjin's Cave", situated northwest of the town of Penaplata, is another interesting cave formation on the island of Samal, but this small cave is not very well known to tourists and is therefore not visited very often (Joaquin et al., 2021: 33).

The City of Magnificent Waterfalls

There are 4–5 important tourist waterfalls within the borders of the "Island Garden City of Samal" that can appeal to

curious travelers. Even though these waterfalls cannot easily compete with those situated in Luzon, Mindanao, or Negros Island, they are worth seeing as well. Hagimit, Tagbaobo (Magongawong), and Sampao are the most significant of these tourist waterfalls. The famous Hagimit Waterfall, positioned in the Hagimit Valley in the central part of Samal Island, is one of the most beautiful and most popular natural tourism attractions of Samal Island (Asdang & Schneider, 2024).

The visitors can swim in the refreshing waters of the stream or simply enjoy the beauty of the waterfall from the viewing platforms. The famous Hagimit Waterfall, located southeast of the town of Penaplata, is a popular place for picnic and has plenty of benches and tables for the visitors to use. The sparkling clear waters comprise beautiful natural pools in the Hagimit valley. On sweltering hot days, the locals and children in particular go swimming and cool off in this stream. The "Virtuquest Samal Resort and Spa", "Immaculate Conception Parish Church", "Virtu Trattoria House N Café", "Peñaplata Freedom Park", "Maxima Resort Beach", situated very close to Hagimit Waterfall, are among the most interesting tourist places to visit after visiting this famous waterfall.

Tagbaobo Waterfall, also known as "Magongawong Falls", situated on the Tagbaobo River east of Anonang Town in the southeast of Samal Island, is another famous tourist attraction in Samal. The abundance of large-trunk trees in the area and the mist surrounding the waterfall create a mystical and magical atmosphere. Tagbaobo Waterfall, situated deep in the rainforest of Samal Island, is a picturesque waterfall that flows down from moss-covered rocks, creating a mesmerizing sight. Within walking distance of Tagbaobo Waterfall, places such as "Hgd View Deck", "572 Campsite Lanoy Resort", "Hgd Private Resort", "Katagbaoan Beach Farm", and "Thunder Forest" are other tourist attractions in the area that are worth seeing. There is a small but adorable waterfall called "Sofia Falls" in the southeast of Samal Island, west of Pangubatan town and just north of the "Coco Loco Cafe, Resort & Lounge" hotel. Since it is positioned very close to the Tagbaobo waterfall, it would be a good idea to visit these two waterfalls on the same day.

The City with the Puting Bato Hill

The Puting Bato Peak (532 m) is the highest point on Samal Island and offers breathtaking views of the surrounding areas. Hiking to the top is relatively easy and can be completed in less than an hour. However, the heat can be intense, so it is best to start climbing in the early morning or late afternoon. Once you reach the top, sit down and enjoy the breathtaking views of Davao Gulf and Samal Island. Puting Bato is a popular spot for both locals and tourists; therefore, make sure to visit it as early as possible in order to avoid the crowds. You can choose one of two different trails to this famous peak (Tayapoc or Guilon trail) and marvel at the combination of blue waters and lush vegetation while taking in the fresh air once you reach the highest point.

The City with the Giant Clam Sanctuary Nature Reserve

The "Giant Clam (Taklobo) Sanctuary" or "Giant Clam and Oyster Sanctuary", situated in Barangay Adecor, on the western coast of Samal Island, is a conservation area devoted to the protection and nurturing of giant clams, also known locally as "taklobo" (Plasabas et al., 2013). This colorful sanctuary, which is easily explored through a scuba diving tour, is one of the most important marine sanctuaries on the coast of Samal and also an interesting eco-tourism site. The Giant Clam Sanctuary is currently under the protection of the Davao del Norte State College. This marine area, which is home to colorful fish species and rich flora and fauna, offers fascinating mollusks to watch while snorkeling. This interesting marine sanctuary, positioned just across from the "LYR Beach Resort – Almeja Azul" hotel, is home to over 3,700 giant clams. The "Giant Clam (Taklobo) Sanctuary", occupying a marine area of approximately 14 hectares, is one of the most colorful marine sanctuaries in the Philippines.

The City with Breathtaking Views

There are many locations with fascinating scenery on both Samal Island and Talikud Island with beautiful views from the high peaks. Watching the curves of the seacoast, bays and peninsulas, beaches and forests from afar is among the favorite pastimes of every explorer tourist. "Bandera Viewpoint", "Tañez View", "Blue Bird Deck View", "View Dekz Samal", "Fernandez Peak", "Puting Bato Highest Peak", "El Samara Mount FMS", and "ISLA Farms Highlands", positioned within the borders of Samal City, are among the places with the best sea and island views. "Blue Bird Deck View" is one of the most favorite among visitors. For those who wish to watch the ocean while eating in a quality tourist place, the best choice will definitely be "Cafe Maañag Samal". This modern cafe offers delicious food, desserts, and drinks, as well as a breathtaking view of the nature. From the large balcony of "Cafe Maañag Samal", on clear days, the coast of Mindanao Island and the city of Davao is easily visible with the naked eye. Since the "Blue Bird Deck View" and "Cafe Maañag Samal" are positioned very close, both can be visited on the same day.

The City with Historical Catholic Churches and Mosques

Since the largest religious communities in Samal are Catholic Christians and Muslims, it is expected that the largest number of religious centers are churches and mosques. The first Holy Catholic Mass was held in "Santo Niño Parish" church located on Poblacion beach in Kaputian town on January 15, 1958. On May 30, 1983, St. Nino Chapel constituted a separate congregation and thus separated from the main congregation, the Immaculate Conception. This church, situated among vegetation and very close to the seashore, is one of the largest and oldest churches on the island of Samal. It would be a good idea for tourists visiting Kaputian Beach Park to see the architecture of this church. "Virgen Dolorosa Parish Church", located in the town of Babak on the northwestern coast of Samal Island, is certainly the most magnificent religious center on the island. This church, which is within walking distance from the Babak sea port, attracts visitors with

its modern architecture and peaceful, clean environment. "Immaculate Conception Parish Church", positioned in the town of Penaplata on the northwestern coast of Samal Island, is another significant religious center on the island of Samal. The church, positioned just behind "Peñaplata Freedom Park" area, is one of the favorite places for the Catholic community.

The "Al-Rahmaa Mosque" and "San Jose Mosque" are both the most popular Muslim religious centers in Samal and they are also the mosques with the most interesting architecture. The "Al-Rahmaa Mosque", situated in the village of Caliclic in the northwest of Samal Island stands out with its white, red, and green colors and magnificent appearance. This interesting place located just south of Babak Port is considered to be the largest and most modern mosque in Samal. "San Jose Mosque", found in the town of San Jose in the southwest of Samal Island is another big mosque in Samal. The most important mosques in Samal are "Masjid Darul Iman" located in the northeast of Babak town, "Al-Farouq Mosque", and "Caliclic Masjid" situated in the village of Caliclic, "Mohammad Sharif Afdal Mosque" positioned just east of the village of San Isidro, and the "Cogon Al Masjid "Al Azraq (The Blue Mosque)" located in the south of Talikud Island. It should be noted that, since the Muslim population in Samal is small, there are fewer mosques (Asdang & Schneider, 2024).

The City with Scuba Diving Centers

Samal, which is comprised of many islands, is home to many diving spots with colorful coral reefs, rich marine life, and even shipwrecks from World War II. On the west coast of Talikud Island, the most popular diving spot on the island is 150-hectare "Coral Garden and Marine Park", which is the most popular diving spot among the local and foreign tourists. This marine park area, situated off the coast of the "Coral Garden Beach Resort" hotel, has a shallow reef with depths ranging from 5 to 20 meters, offering a perfect diving experience for divers of all levels. This marine reserve is home to a variety of colorful corals such as horn coral, brain coral, and mushroom coral, as well as a variety of reef fish such as clownfish, angelfish, and butterfly fish. Divers can also explore sea turtles, octopuses, and other fascinating marine creatures here on some days. The crystal-clear water and excellent visibility make it an ideal spot for underwater photography. The 150-hectare wonderland "Coral Garden and Marine Conservation Park" is a true scuba diving paradise, home to over 50% of the Philippines' marine corals, sea grasses, and aquarium fish in one location. Other notable dive sites within the Island Garden City of Samal are "Dapia Fish and Coral Reef Sanctuary", "Angel's Cove", "Quidopong Sandbar", "Sanipaan Marine Park", "Linosotan Dive Site", "Babu Santa Minwall", "Mansud Wall", "Malipano Japanese Wrecks", "Talikud Idland Fish Sanctuary", and "Giant Clam (Taklobo) Sanctuary". The "Linosotan Dive Site" is located off the southern coast of Talikud Island. This marine reserve comes to be known for its vibrant coral gardens, diverse marine life, and underwater rock formations. Divers can explore the spectacular wall dive, which extends to depths of 30 meters, where they can see a variety of fish and other marine life. Linosotan's clear waters make it an ideal site for macro photography enthusiasts, and larger marine animals such as turtles, and reef sharks are occasionally spotted.

The "Dapia Fish and Coral Reef Sanctuary" is positioned off the northern coast of Talikud Island. Dapia is a colorful dive site with a sandy bottom and a shallow coral garden. In the Dapia sanctuary, divers can explore the reefs and encounter a variety of marine life, including clownfish, angelfish, and brood fish. The maximum depth in the Dapia sanctuary is only 10 meters, making it convenient for beginners and snorkelers. "Kidopong", situated between Talikud Island and Samal Island, is a popular dive site that offers a variety of underwater topography, including steep submarine walls, sandy slopes, and colorful coral gardens. Here, divers can explore a variety of marine life, including colorful fish, stingrays, and the occasional sea turtle. The maximum depth of "Kidopong" is 25 meters, making it suitable for divers of all levels.

The City with Small Tourist Islands

There are some small islets in the vicinity of Samal Island which contribute to the overall tourism offer. In the northeast of Samal Island, there are two small, but equally beautiful and interesting islands called Little Cruz (Little Liguid) and Big Cruz (Big Liguid). In the northern parts of Pakiputan Strait and in the northwest of Samal Island are the Arboles Island, Vanishing Island, and Sanipaan Marine Park. In the southwest of Samal Island are Talikud Island, Wiching Island, and Malipano Islands. The "Vanishing Island", "Wishing Island", "Malipano Islet" and "Big Liguid Island" are the most visited of these small coastal islets. It is possible to rent a boat from the Samal Island and visit these islands at a very reasonable price. The Vanishing Island is the first of these small tropical islets that should be visited.

This lovely tropical island is easy to reach because it only takes 5–10 minutes by boat from Barangay Tambo to go to the Vanishing Island. The area of Vanishing Island changes according to the tide. Sometimes the entire island is submerged during high tide, while a long sandy beach appears when the tide recedes. Therefore, the Vanishing Island is also called the "vanishable island" or the "coming and going island". You can easily reach this island by a small boat from the Babak Town at a low price. This interesting island, situated on the northwestern coast of Samal Island, in the Pakiputan Strait and 300–400 meters west of Babak Town, is considered one of the natural wonders of Samal.

The "Wishing Island", situated just southwest of the Giant Clam (Taklobo) Sanctuary marine reserve on the western coast of Samal Island, is another interesting tourist islet within the borders of Samal City. This islet, consisting of large rocks, is a fascinating tourist attraction with its breathtaking beauty and serene atmosphere. Plants and trees sprout from volcanic rocks and wild naturecontribute to a special charm of this small island in the middle of the sea.

This picturesque island, found just northwest of Malipano Islet, is famous for its pristine beaches and clear turquoise waters, and also stands out with its rich variety of living species for snorkeling and clear sea waters. A small, neglected water slide, a concrete-covered nature viewing terrace, and a simple picnic area are the only remarkable human elements on the island. The area of the island is so small that it is not convenient for the construction of either a restaurant or a hotel. It can be said that the Wishing Island is only suitable for daily boat tours, water sports, and picnics.

The “Malipano Islet”, situated just south of the Giant Clam (Taklobo) Sanctuary marine protection area on the western coast of Samal Island, is one of the most adorable, best-kept, cleanest, and most aristocratic coastal islets of Samal City. Long secluded beaches, mangrove forests extending along the island coast, luxury tourist facilities are the first remarkable elements of this island. This islet, situated just west of “Pearl Farm Beach Resort”, the most luxurious hotel of Samal Island, has been transformed into a recreation area for the guests of this hotel. In other words, the tourists staying at “Pearl Farm Beach Resort” Hotel generally visit Malipano Islet by boat tours. Malipano Private Beach situated on Malipano Islet is one of the most private and privileged beaches of Samal City. “Big Liguid Island” and “Little Liguid Island”, positioned off the northeastern coast of Samal Island, are deserted and lonely coastal islets. There is no settlement, no market, or tourist facility on these islands. They are islets left alone in the middle of the sea with long beaches and dense forests. Therefore, foreign tourists almost never come to these islands. Nevertheless, for those in search of peace and quiet, “Big Liguid Island” and “Little Liguid Island” are a perfect escape and a hiding place.

The City with Historical Monuments

The most anticipated and most visited architectural works of Samal Island are undoubtedly the “General Moncado White House”. The “Moncado White House”, found in the northwest of Samar Island and northwest of Penaplata Town, offers tourists a journey through time with its carefully preserved period furniture, artifacts, and memorabilia. This historical building, which offers a concrete glimpse into the lifestyle of the Moncado family and the culture of the Filipino elite, also promises the tourists a journey through Samal’s interesting history and a unique cultural experience.

The City of Talikud Island

Samal, officially known as the “Island Garden City of Samal”, has two large islands: Samal and Talikud. Samal and Talikud, positioned within the provincial borders of Davao del Norte, are like conjoined twins. The name of Talikud Island was derived from the Visayan word “licud” meaning “back” and is geographically located “right behind” or “right on the back” of Samal Island. Talikud Island has an area of approximately 28 km2 and a coastline of approximately 21.6 kilometers. The average elevation of the island above sea level is 95 meters (Asdang & Schneider, 2024).

Talikud Island, situated on the southwest coast of Samal Island, is less developed, less populated, and poorer than Samal. However, it is also quieter, more pristine, more peaceful, cleaner, and more natural than Samal. One will not find the noisy traffic and expensive resorts of Samal, nor the crowded tourist masses and urban pollution on Talikud Island.

The beaches and coastline are much more secluded and quieter, making it an ideal escape and resting place for honeymooners, romantic lovers, and families with children. Talikud Island, which lacks modern tourist facilities, has only four small rural settlements: Santa Cruz, Cogon, Linosutan, and Dadatan. Talikud Island, in comparison with Samal Island, has much fewer hotels, bars, restaurants, and tourist facilities. The main hotels on Talikud Island are: “Talikud Island Mangrove Beach Resort”, “Coral Garden Beach Resort”, “JYP Resort”, “Leticia by the Sea”, “Isla Reta”, “Garden of Eden Santa Cruz Paradise and Beach Hotel Resort”, “Pacifica-Verde Beach Resort”, “Tailkud Beach Resort”, “Pacific's Little Secret”, and “La Isla Bonita Talikud Island Beach Resort”. In reality, the total number of accommodation facilities on the island is not more than 20, and there are no luxurious five-star hotels among them. The island is more convenient for day trips and for camping in tents. However, the majority of tourists who come to Talikud Island visit this lovely island either for snorkeling or scuba diving. Water sports, diving activities, ecotourism, and marine tourism are the most popular types of tourism activities on the island. In planning and developing ecotourism, it is essential to ensure that local residents are well-informed so they can take part actively and constructively in the process (Keogh, 1990).

There are many bays, peninsulas, and beaches on the island of Talikud. Almost all of the beaches are free public beaches. The most popular beaches on the island of Talikud are: “Linosutan White Sand Beach”, “Coral Garden Beach Resort”, “Dayang Beach Resort”, “Isla Cristina Beach Resort”, “Cruz Beach”, “Mansud Shores”, “Linden Beach”, “La Isla Bonita Talikud”, “Whean Beach Resort”, “Pacific Little Secret”, “Angels Cove”, “Isla Reta Beach”, “Babu Santa”, “Vailian Precip Resort”, “Treasure Island Adventure Resort and Vacation Estates”, and “Lupa Surga”. As it is evident, the number of popular tourist beaches on the island is less than 20. The must-see tourist attractions on the Talikud Island are the “Talicud Mangrove Sanctuary”, “Dadatan Cave”, “Baga Caves”, “Coral Garden Beach Resort”, “Whean Beach Resort”, “Angels Cove”, “Linosutan White Sand Beach”, “Dadatan Bat Conservation Park”, and “Century-old Balete Tree”.

Talikud Island, in comparison with Samal Island, has much more interesting, much richer, and much more colorful diving sites. For the scuba diving enthusiasts, “Angel’s Cove”, “Dapia Reef”, “Coral Gardens”, and “Dizon Wall” are among the best diving sites. “La Isla Bonita Talikud Island Beach Resort”, “Whean Beach Resort”, “Dayang Beach”, “Linosutan White Sand Beach”, “Babu Santa”, and “Coral Garden Beach Resort” beaches also offer ideal natural environments for both snorkeling and scuba diving. Sparkling clean and warm sea waters, palm tree shadows, and white sandy beaches are the common natural features of these beaches. For those who wish to go for a swim with dense sea grass, coral gardens, and hundreds of marine creatures, the beaches listed above are the diving sites they are after.

The City with Colorful Festivals

Samal, also known as the "Island of Festivals", is a vibrant tourist destination where various unique activities, events, and festivals are celebrated throughout the year. These festivals are a testament to the rich culture and traditions of the island and offer tourists a chance to take part in the colorful festivities in person. IGACOS Festival held every March 7, Kabasan Festival held in Babak every May, the famous White Nights Festival held in Kaputian, and Hugyaw Madayaw Festival held in August (Olivar et al., 2023), are among the most colorful festivals. Indeed, during the festival periods, both the number of tourists and

the cultural and artistic activities and entertainment organizations on Samal Island tend to increase. IGACOS Festival is also known as "Samal Island Garden City Festival" as well as "Samal Island Garden City Foundation Anniversary". This three-day festival is held on the anniversary of the foundation of Samal City, every March 7. This colorful cultural festival commemorates the declaration of Samal as a city in 1998. The anniversary events include sports events, a business fair, an art workshop, cultural and sports shows, live music concerts, various exhibitions, dance competitions, an agricultural trade fair, a fireworks display, and a beauty pageant called the "Garden City of Samal". This exciting three-day festival also includes events such as sand-sculpture competition, a colorful boat river parade, beach volleyball, and a mountain bike tour (Asdang, & Schneider, 2024). Kabasan Festival, organized in May, is a week-long celebration that highlights the island's bountiful harvest. The Kabasan Festival in Babak is held during the last week of May and includes bikini beauty contests, fireworks, tourism exhibitions, street dances, street parties, and motocross events. In the Sama dialect, "kabasan" means "seashells."

Therefore, the festival was named Kabasan to celebrate the pageantry and splendor of the Island City. More importantly, Kabasan Festival is a celebration of gratitude for the bountiful produce of the sea for the people of Samal. Hugyaw Madayaw festival is organized every August and is one of the most anticipated events on Samal Island. It showcases the island's vibrant culture and heritage through street parades, cultural performances, art exhibitions, and culinary shows. Foreign tourists and visitors can watch the traditional dances, music, and costumes that provide a glimpse into the island's rich cultural fabric. Hugyaw Madayaw Festival is a three-day folk celebration filled with entertainment, games, music, dances, and presentations of the Sama tribe cultural practices, attended by the local and immigrant communities. The beauty pageant featuring folk costumes and folkloric elements is one of the most important events of this festival. Hugyaw Madayaw, organized by the Local Government Units and Municipal Authorities of Samal Island, is one of the most enthusiastic main cultural events on Samal Island. Hugyaw Madayaw Samal Festival is an attempt to sustain and preserve the Sama culture, which is gradually assimilated and on the verge of extinction. Consequently, these festivals on Samal Island are an integral part of the local identity, allowing the visitors to interact with the island's culture, traditions, and community (Olivar et al., 2023). They offer a vibrant and welcoming atmosphere, making Samal Island an even more exciting and memorable travel destination.

The City with Breathtaking Beaches

The beaches on the island of Samal can be divided into two large groups, free and fee-paying, and there are more than 70 beach areas throughout the island. Non-guests are generally charged for the beaches that belong to hotels and they are free only for hotel guests. Some of the private hotel beaches are "Pearl Farm Beach Resort", "Costa Marina Beach Resort", "Bluejaz Beach Resort and Waterpark", "Chema's by The Sea", "Samal Sands & Shores Beach Resort", and "Club Samal Resort". The public beaches that do not belong to any business or accommodation facility within the borders of Samal island are open to everyone and they are free of charge. Some of these free public beaches are: "Dalikyat Beach", "SLYap Beach", "La Concha Beach Resort", "Balet Beach", "Canibad Beach", "Isla Beach Resort", "Kanaan Beach Resort", "Joseph Beach Resort", and "Alorro Beach". In conclusion, whether fee-paying or free, the most peaceful, most beautiful and most popular beaches of Samal island are: "Babak Bamboo Beach Resort", "Vista Blanco Beach Resort", "Villa Amparo Garden Beach Resort", "Kaputian Beach", "Alorro Beach", "Canibad Beach", "Kembali Samal Island by Filinvest", "Kanaan Beach", "Pearl Farm Beach Resort", "Bluejaz Beach Resort and Waterpark", "Isla Beach Resort".

The City with the Sabang Cliff

The Sabang Cliff, found just north of Kaputian Town on the southwestern coast of Samal Island, is one of the most interesting, exciting, and magnificent tourist attractions on the island. For foreign tourists who come here, jumping into the sea from the high and steep cliffs on the Kaputian coast can be scary, but it is also incredibly exciting. When enthusiastic travelers and brave tourists jump into the sea from Sabang Cliff, they will be rewarded with a magnificent natural view and an incredible adrenaline rush. The Sabang Cliff, located just north of Kaputian Beach and Kaputian Port, is undoubtedly one of the best natural adrenaline-rush places on Samal Island.

Accommodation Potential of Samal Island

It will be appropriate to offer some tips about the hotels and beaches on Samal Island. The total length of the coast of Samal Island is 116 kilometers and there are many small coves, beaches, and capes on these coasts. Some of the beaches on the island are free public beaches and some are fee-paying hotel or private beaches. The private beach areas that belong to the "Paradise Island Park & Beach Resort" hotel in the town of Caliclic and the "Pearl Farm Beach Resort" hotel near the town of Adecor are considered the best and best-maintained beaches on Samal Island. Tourists who do not want to compromise on comfort and quality can choose to stay at these hotels. Essentially, the "Pearl Farm Beach Resort" is one of the most luxurious and most expensive accommodation facilities on Samal Island (Table 4).

The accommodation facilities on the island of Samal vary greatly in terms of both function and features, as well as in the prices and the number of stars that the hotels have. The "Maxima Aqua Fun Resort" hotel, situated just north of the town of San Jose, is a good choice for those who love water sports and entertainment. The "Chema's by The Sea" hotel is located just south of the town of Adecor on the west coast of the island of Samal. Nestled among the tropical trees and greenery, this hotel is an ideal choice for those who love romantic holidays and peaceful and quiet environment. For those who love rooms with panoramic sea views and white sandy beaches, the "Hof Gorei Beach Resort" near Caputian is a good alternative. Those who are after a more luxurious hotel can prefer the "Club Samal Resort" or "Lankenua Lodgings Samal Island". Those who wish to stay in a budget and affordable hotel with both beachfront and sea view rooms can stay at the "Red Parrot Inn" near Kaputian or "Publikhaus" boutique hotel within walking distance of "Samal Ferry Terminal".

Table 4. Main High-Price Hotels and Quality Accommodations of Samal Island (Source: Authors, 2025)

LYR Beach Resort - Almeja Azul	Pearl Farm Beach Resort	Mahan Garden Resort
Holiday Oceanview Samal Resort	Cavanico Il Mare Resort	Club Samal Resort
Fernandez Beach & Garden Resort	Camp Holiday Resort	Castle View Resort
Venus Resto Bar and Beach Resort	Q Sands Beach Hotel	Chema's by the Sea
Bluejaz Beach Resort and Waterpark	Precious Garden of Samal	Maxima Beach House
Paradise Island Park and Beach Resort	Bali-Bali Beach Resort	Kalipay sa Baybay
Lankenua Lodgings Samal Island	Castle View Hotel Samal	Secdea Beach Resort
Samal Island Garden Villa-Oakmark BnB	Seascape Inland Resort	Hana Bay Resort
Aundanao Oasis Beach Resort	Hof Gorei Beach Resort	C&C Beach Resort
Extreme Aloha Beach Resort	Villa Amparo Highlands	Lankenua Lodgings
Villa Amparo Garden Beach Resort	Kamayo Beach Resort	Beach House
Virtuquest Samal Resort and Spa	Casas Con Vıstas Resort	Swissfinity Resort
Villa Privé Samal Staycation	Almeja Azul Seaside Resort	Oceanview Residences
Mommy Mia Bed & Breakfast	Kawaii Beach Resort	Publikhaus
Mango Haven Breakfast Club Samal	Les-Angelees Apartment	Club Asiano Resort
Bakhawan Resort and Event Center	Pearl Farm Beach Resort	Q Sands Hotel
Samal Sands & Shores Beach Resort	Sonriza Beach Resort	Costa Azalea
Crusoe Cabins at Costa Azalea	Samal View Hillside Resort	Farmer's Paradise
Cocojul Resort Kubbyan İsland's & Samal Pool Swimming	Samal Ysla Beach Resort	La Celeste Samal

Table 5. Main Low-Cost Hotels and Small Accommodations of Samal Island (Source: Authors, 2025)

Pearly Mac Cabana by the Sea	Balet Beach House,	Gubat Residence
Island Hills Beach Resort For Rent	Kamayo Beach Resort	Hayahay Resort
House of Eve Samal I. Beach Resort	Canibad Point Resort	Kalinawan Resort
Pangubatan Private Beach House	Merlina Marine Resort	Balai sa Samal
Uraya Beach Resort - Olivia Sands	Kaluna Beach House	Isla Betita Resort
Albert's Place Beach Resort	Entroliso Beach Resort	Red Parrot Inn
Oceano Con Vista Highlands	Kostal Beach Resort	Samal Staycation
Punta Del Sol Beach Resort	Steve Garland Resort	La Vida Hostel
La Familia Beach Resort	JS Beach Line Cove	San Juan Beach
Caliclic Beach Resort	Kourtyard Resort Hotel	Belga Place
Island Garden Resort in Pangubatan	Samal Mango Haven	Yanai Resort
Langoy Langoy Beach Resort	Ilihan Beach Resort	Gadz Place
Residencia Mercedita Transient Home	Holy Cross Beach Resort	Balai Rajah Resort
One Greenland Beach Resort	TLSY Beach Front Resort	Sa Tabok Samal
Costa Marina Beach Resort	Jenny's Bed & Breakfast	Rosal Beach House
Golden Bay Beach Resort	Seagrass Beach Resor	Mayumi Beach
Golden Dane Heart Resort	Aundanao Oasis Beach	Island Shore Resort
Merlina Seabreeze Resort	Llanera Private Resort	Pinzgau Chalet
Zariels Private Island Resort	Sea Escape Beach Resort	Kyriedge Garden
Coco Loco Cafe, Resort & Lounge	Tiny Hauz Mini Resort	Tres Esquinas
Blue Rose Beach House Pangubatan	7 Pearls Beach House	Hideaway
Manresa Bay Private Resort	L.A. Family Beach Resort	Beach ni Kap
Samal Punta Elai Resort Hotel	Samal Casino Resort	Moms Haven
Eagle's Nest Beach Resort	Isla Betita Garden Resort	Red Parrot Inn
Pearly Mac Cabana by the Sea	Yestar Garden Resort	Probinsiya ni Inday
Segunda's Cottages on the Rocks	Vafi Hills Bed & Breakfast	Upper Island Ridge
Samal Island Staycation	Maglana Private Resort	St. Michael's Resort
Samal Family Garden Beach Resort	Island French Resort	Babox Island Hotel
Camp Holiday Private Resort 2	Seagrass Beach Resort	St. Michael's Resort
Camp Holiday Resort & Recreation Area	Georgia’s Samal Resort	White House Resort
Alta Vista Beach Resort	Mariecar Beach Resort	Mokz Travelers’ Inn
Balai Rajah Rest House by Monte Cliff	Winter Inn and Cafe Samal	Dorsita Beach Resort
Bluewaters Village and Resort	Florenda Beach Resort	Marex Beach Resort
Greatfields Forest Mountain Resort	Haze Haven Inland Resort	Bali-Bali Beach Resor
Moonstar Mountain Privacy Resort	Hof Gorei Beach Resort	Casa Playa De Ch'II
Uraya Beach Resort - Olivia Sands	Lorelei Beach Resort	Kaputian Beach Park
Isla Betita Garden Resort	Villa Nelda Beach Resort	White Sands Hostel

Those in search of a romantic and peaceful holiday in rooms with waterfall and sea view can stay at the “Virtuquest Samal Resort and Spa” holiday village next to the Hagimit waterfall. The travelers seeking for a high-quality facility surrounded by forests and not by the sea can choose the “Castle View Hotel Samal” hotel (Table 5). Today, Samal Island, which has more than 200 accommodation facilities, is regarded as the country's largest "holiday island city" with its rich tourism diversity, world-class resorts and affordable hotels (Tables 4 and 5). In 2019, before COVID-19, at least 1.9 million

tourists on average visited this tropical city annually (PSA, 2024). In general, the western coasts of Samal Island are busier, more polluted, and some parts are intertwined with port activities and industrial facilities. The eastern coasts of the island are more secluded, cleaner, and quieter. Therefore, it is recommended that those who are after a peaceful holiday should stay in the accommodation facilities found on the eastern coast of the island. There are roughly more than 100 hotels and more than 200 accommodation facilities in operation on Samal Island (Tables 4 and 5). The highest density in the number of accommodation facilities is in the Babak–Penaplata region on the northwestern coast. More than half of the accommodation facilities on Samal Island are situated in this region. Serving at European standards, the "Pearl Farm Beach Resort", "Discovery Samal", and "Club Samal Resort" are among the most luxurious accommodation facilities on the island of Samal.

CONCLUSION

The Garden City of Samal Island attracts foreign tourists with its cheerful colors of the sky, the sun shining all year round, its deserted and clean beaches, the innocence of the villagers, the deep blue and crystal sea, mysterious caves and majestic chalets, friendly and cheerful people, peaceful hidden coves, and affordable holiday opportunities. In the 21st century, tourism has been the fastest growing economic sector of this charming city (Philippine Development Plan, 2023–2028). The touristic facilities and hotels have been mushrooming on the coastal areas of the city and thousands of foreign tourists visit this beautiful tourist place every year. Foreign tourists visiting Samal Island can sunbathe on the magnificent beaches of Alorro Beach Resort or Kaputian Beach Park. They can go diving in the blue waters of Coral Garden Marine Park, explore the interesting plants and animals in Pangubatan Forest Park, swim in the cool waters of Limao Lagoon or Tagbaobo Waterfalls, and watch the sunset from the Sabang Cliff. Visitors to Samal Island should definitely visit the Davao City and Talikud Islands, which are situated nearby. The main positive factors that have designated the rapid development of the tourism sector in the Garden City of Samal Island in the last quarter century are as follows:

- The Garden City of Samal Island is located only 2 km from Davao, the capital of Mindanao and the second largest metropolitan city in the country. It is also close to the island of Mindanao and Davao international airport.
- The island has climate characteristics convenient for beach tourism all year round, as it has high temperatures during all the 12 months.
- In comparison with other parts of the Philippines, natural disasters such as earthquakes, tsunamis, volcanic eruptions, and tropical cyclones are very scarce in Samal.
- Samal Island is considered one of the safest, most peaceful, and quietest places in the Philippine Republic, with no security or terrorism problems for foreign tourists.
- The Garden City of Samal has numerous natural tourism attractions. For instance, there are about 70 caves, more than 100 beach areas, and more than 10 waterfalls in Samal.
- There are not many problems such as transportation, communication, internet, and infrastructure within the borders of the city.
- The absence of high and rugged terrain throughout the city makes it easier for individual transportation by bicycles or motorcycles.
- The city has numerous hotels and accommodation facilities that are suitable for every budget. For instance, despite its small surface area, there are more than 200 accommodation facilities, guesthouses, tourist villas, and hotels within the borders of Samal Island.

The study shows that small destinations such as Samal can become a "rising star" through a dynamic interaction between natural wealth, socio-cultural characteristics, and economic development within the theory of sustainable tourism. Theoretically, this study contributes to the wider discourse on the development of island tourism by highlighting the fact that the vicinity of urban centers, favorable climate conditions, and social stability could jointly speed up the growth in tourism in peripheral, but ecologically rich destinations. It strengthens the existing theoretical claims on the models of "location advantage" and "destination competitiveness" (Dwyer & Kim, 2003; Crouch, 2011), and, at the same time, shows that community-led hospitality and ecological attributes jointly shape the tourist experience and destination identity. From the practical point of view, the findings have significant implications for the local government, space planners, and all the stakeholders in a destination. Fast growing of accommodation capacities and tourism infrastructure highlight the economic potential of Samal as a model for balanced regional tourism development. However, this trend also requires strategic management mechanisms in order to mitigate the environmental degradation and cultural commodification. Making sure that the tourism growth is in accordance with the goals of sustainable tourism – especially through capacity management, environmental protection, and community participation – is of vital importance for preserving natural and cultural assets of the island. Nevertheless, this pathway also emphasizes the need for integrated management mechanisms in order to prevent excessive development, environmental degradation, and cultural commodification. The harmonization of tourism policies with the principles of sustainable development – such as environmental management, inclusive participation of local communities, and capacity management – remains crucial for providing long-term sustainability of the tourism sector of the island (Gössling & Hall, 2006; Hall, 2019).

Despite the comprehensive review of tourism advantages of the Island of Samal, this analysis remains with a limited scope due to the lack of empirical data on tourists' satisfaction, transportation capacity, and the impact on the environment. Moreover, socio-economic implications for the local communities and long-term sustainability results require deeper research through quantitative and qualitative methodologies. The analysis is limited to secondary sources and descriptive assessments, with no primary empirical data collected from tourists, local residents, or other key stakeholders. As a result,

important aspects such as tourists' satisfaction, transportation capacity, environmental impacts, and socio-economic effects on local communities could not be systematically measured or validated. In addition, the study adopts a cross-sectional perspective and does not include longitudinal data that would allow for the assessment of long-term sustainability outcomes of tourism growth. Environmental impacts and community perceptions are addressed conceptually rather than through field-based or quantitative evaluations. Moreover, the findings are context-specific to Samal Island, which limits their broader generalizability to other island destinations. These limitations indicate the need for future research employing mixed-method and longitudinal approaches to better understand the long-term sustainability of tourism development in the island.

Future research should examine the cross section between the tourism growth and sustainability of the Island of Samal by including longitudinal data, studies of visitors' perception, and assessment of the impact on the environment. Comparative studies with other island destinations in Southeast Asia could also enhance the theoretical understanding of tourism resilience of small islands and inform the development of adaptive management frameworks suited for similar contexts. Besides, future related studies should adopt a mixed-method approach which integrates quantitative assessments of the impact on the environment with qualitative analyses of community perception and visitors' experience. Longitudinal studies which examine the sustainability of tourism industry of the Island of Samal would additional shed light on long-term effects of tourism growth.

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MODELING VISITOR BEHAVIOR IN RELIGIOUS TOURISM: MEDIATING AND MODERATING EFFECTS IN THE CONTEXT OF CHRISTIAN PILGRIMAGE SITES IN JORDAN

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Abstract: Religious tourism has emerged as a significant sector within global tourism, influencing visitor behavior, destination development, and spiritual experiences. Jordan, which is home to several Christian holy sites recognized by the Vatican in 2000, is quite important in terms of pilgrimage, but from a practical perspective, it has still not been fully studied. Understanding the factors that affect visitors' satisfaction and their intention to revisit is crucial for the maintenance of religious tourism sites. This study aims to analyze the behavior of visitors within the scope of religious tourism at five Christian holy sites in Jordan recognized by the Vatican. Specifically, it examines the relationships between travel motivation, religious tourism experience, religious tourism potential, perceived challenges, overall satisfaction, and re-tourism intention. Data were collected from 500 visitors using a convenience sampling technique. The study employed Smart PLS 4 software to analyze the data through partial least squares–structural equation modeling (PLS-SEM). The proposed hypotheses were tested to assess direct, mediating, and moderating relationships among the study variables. The findings reveal significant relationships among the examined constructs. Visit motivation has a strong positive influence on re-tourism intention. Religious tourism experience and overall satisfaction act as significant mediators in this relationship. Furthermore, religious tourism potential and perceived challenges moderate the effect of visit motivation on re-tourism intention. The study advances religious tourism theory by integrating motivational, experiential, and contextual factors within a single framework. Practically, the findings provide valuable insights for Jordanian tourism authorities and destination stakeholders to enhance visitor experiences, address challenges, and strengthen the sustainability of religious tourism in the region.

Keywords: visit motivation, visitors' religious tourism experience, overall satisfaction, religious tourism challenges, religious tourism potential, re-tourism-intention

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INTRODUCTION

One of the most significant economic sectors worldwide is travel and tourism, offering enormous financial, sociocultural, and environmental benefits. As per WTTC (2024) with an additional $770 billion over its previous record, travel and tourism will solidify its position as a major global economic force, producing one out of every ten dollars globally. Religion is typically regarded as the earliest type of travel because it has been a primary motivator for travel from ancient times (Tsai, 2021). One of the earliest types of tourism, religious tourism, has a substantial role in the evolution of the travel industry. People who travel for spiritual or religious reasons, visit places of worship, or take part in religious festivals or events are all included in the category of religious tourism (Giușcă, 2020; Hassan et al., 2022; Hassan et al., 2024).

Holy sites, including mosques, cathedrals, and temples, are attracting more visitors from around the globe for leisure, education, and cultural reasons in addition to their spiritual significance (Ionut et al., 2024). The popularity of religious tourism continues to increase in Asia and around the globe (Shinde, 2020). The two wings of the Arab nation, one in Asia and one in Africa, are connected by the Hashemite Kingdom of Jordan, distinguished by the presence of both foreign visitors and Arab tourists who come to enjoy its breathtaking landscapes, exceptional climate, and sacred places. As a relatively stable Middle Eastern country that offers most of the conveniences of a modern Western society while maintaining its traditional roots, Jordan is an ideal destination to visit (Al-Haiaderh & Alrafaiah, 2024).

Tourism is undoubtedly the most important sector of the Jordanian economy. Jordan welcomes millions of foreign visitors yearly because of its many archaeological sites and well-preserved religious and cultural landmarks. Of the many sites that Jordan offers, the religiously motivated sites probably offer the most potential for visitors. Jordan is at the crossroads of the three great world religions. Among the three, Christianity, Judaism, and Islam, hospitality and welcoming the stranger is an essential and a religiously motivated act. Therefore, it is of great value for the development of religiously

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motivated tourism, especially in those societies that are predominantly religious in both the religious and secular spheres. Jordan's religiously motivated tourism sector has been growing since 1903, when the Hijaz Railway was built in Amman. In the 1950s and 1960s, the sector was further developed and Jerusalem was the primary destination (Bader, 2012).

The complex nature of religious tourism and its socio-cultural impacts have intrigued the interest of previous empirical studies (Singh & Bhuyan, 2024). Furthermore, studies have investigated several different facets of religious tourism (Liutikas, 2023). These studies have examined how religious tourism affects communities, destinations, and the environment, in addition to the perspectives and motivating factors of tourists(Singh & Bhuyan, 2024). Previous studies have addressed religious tourism's sociocultural and economic impacts on various destinations (Budovich, 2022; Nair & N, 2022; Yan et al., 2024). Sayfullayeva & Barotov (2024) described that religious tourism can lead to long-term sustainability through environmental conservation, social and cultural preservation, economic benefits, infrastructure, accessibility, stakeholder collaboration, education, and awareness. Jiang et al. (2024) research shows that religious tourism boosts the local economy by increasing sales of souvenirs, travel, and housing. According to Song (2025), religious tourism may result in conflicts, the commercialization of culture, and environmental degradation.

Inadequate investigation has been done on how religious tourism potential and its challenges influence behavior in religious tourism (Bhadeshiya, 2024). Overall satisfaction and repeat business might result from recognizing a destination's religious tourism potential and challenges (Cunha & Louro, 2024). By analyzing religious tourism and other forms of tourism and the issues they cause, it is possible to learn more about the preferences and behaviors of tourists, which will ultimately help to maintain sustainability in the tourism sector. Further studies can assist government and stakeholders in anticipating and managing the potential challenges of religious tourism by staying focused on visitor behavior, satisfaction, experiences, and destination management strategies (Korov et al., 2024). It has been discovered that the quantity of publications on religious tourism has grown rapidly. Most studies on religious tourism are conducted in European nations (Ohlan & Ohlan, 2024)Thus, this study expands the existing literature on religious tourism in the context of the Middle Eastern region. There is insufficient research on how visitors' attitudes are affected by their experiences and revisit intention, and the influence of potential and challenges of religious tourism on visitor behavior, and there is a need for more in-depth studies to guide sustainable development (Choe, 2024). Filling these gaps will advance theoretical understanding and guide the expansion of moral and sustainable religious tourism worldwide.

One of the most widely practiced religions worldwide is Christianity, in addition to its churches and Roman Catholic faith, which significantly impact the growth of pilgrimage destinations and the support of religious tourism. In the Catholic tradition, pilgrimage site visits are typically organized as large-scale events to commemorate important dates, anniversaries, and holy site visits. The study focuses on five Christian holy sites that the Vatican recognized as pilgrimage destinations in 2000. After the successful completion of 25 years, on the occasion of the silver jubilee, this study focuses on five religious Christian sites i.e., the Baptism Site, Mount Nebo, the Shrine of Our Lady of the Mountain, Tal Mar Elias, and Mukawir Two of these sites, Mount Nebo, and the Baptism Site, were visited by Popes John Paul II in 2000 and Benedict XVI in 2009 (Al-Zoubi & Yahaya, 2020[a]).

Given the significance and holiness of these locations, these two visits hold great significance for Jordanian religious tourism. This research adds to the current empirical and theoretical literature on religious tourism. International tourists' participation in religious tourism, the impacts of religious tourism experiences on tourists' attitudes and intentions to return to religious sites, this study examines the potential, challenges, and overall satisfaction of religious tourism as well as potential solutions for destination stakeholders.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Religious tourism is the term for adventurous travel that involves going to places of worship (Ebabey, 2024[a]). This research mainly emphasizes the variety of motivations to travel for religious tourism, satisfaction, and the potential and challenges of religious tourism. Researchers have found several factors contributing to religious tourism (O. Carvache-Franco et al., 2024). These include prayer, spiritual experience, touristic reasons, religious causes, and social reasons (Rosak Szyrocka et al., 2022). The government and tourism marketers must understand the motivations behind religious travelers' demands (Mirhoseini et al., 2025). Although religious tourism can boost host communities' economies by bringing in earnings from travel and accommodation as well as souvenir sales, it has also sparked debate about cultural commodification and authenticity (Singh & Bhuyan, 2024). To reduce the adverse effects of religious tourism and maximize its benefits, researchers prioritize sustainable management techniques and community participation (Lin, Ling et al., 2021).

Visit motivation and re-tourism intention

Visit motivation is a multifaceted stimulus (Nian et al., 2023). Several factors can influence a person's decision to travel to a particular place. He et al. (2023) highlighted relaxation, cultural exploration, spiritual enlightenment, and thrilling experiences as goals for travel. Re-tourism intention is the term used to define a visitor's intention to return (Liutikas et al., 2024). There is empirical evidence establishing a connection between the purpose and intent of returning to a study site. Numerous researchers have shown a relationship between these two factors, indicating that if people have strong motivations to visit a place, they are more likely to go there (Hussain, 2021; Çıkı & Akgöz, 2025). Visitors were more inclined to return if they had unique and engaging experiences (Sthapit et al., 2024). Their motivation greatly influences the likelihood of a visitor returning to a site (Rasoolimanesh et al., 2022). This hypothesis clarifies visitor behavior by combining a theoretical framework with empirical evidence on visit motive. Therefore, we hypothesize:

H1. Visit motivation significantly affects tourists' re-tourism intention.

Visit motivation and visitors' religious tourism experience

Religious visitors are drawn to the destination due to their innate spiritual needs, including a desire to fulfil their curiosity and express their practice and faith. Their experiences were mostly noted for their religious (spiritual) involvement rather than their secular (tourist) activities (Rebuya et al., 2020; Lopes et al., 2025). As per Liutikas (2021) the desire to have a religious experience rather than having contact with a deity or engaging in spiritual activities, is more frequently the driving force for pilgrimage site visits, authentic, transcendental religious tourism (Wang et al., 2024) supernatural (Haller & Haller, 2022) or to achieve a lasting and beneficial positive impact (Van Iwaarden & Nawijn, 2024; Brogni et al., 2024). The relationship between visit motivation and religious tourism experience plays an integral role in why people go to places of worship in today's secular world (Raj, 2012). Following the above discussion, therefore, we hypothesize:

H2. Visit motivation significantly affects visitors' religious tourism experience.

Visitors' religious tourism experience and re-tourism intention

Re-tourism intention has been recognized as a critical research topic in the tourism literature (Lin, Chang, et al., 2021). Researchers generally agree that returning visitors are happier, spend more money on consumptive activities, stay longer, create positive word-of-mouth, and require much lower marketing costs than first-time tourists (Suhartanto et al., 2020). A visitor's intention to return to the same area is greatly influenced by their experience during religious tourism (Nguyen-Viet et al., 2025). Positive experiences play a vital role in getting visitors to visit the same site again. A visitor's intention to return to a similar area is greatly influenced by their experience during religious tourism. Numerous studies in the literature confirm that destination culture, historical significance, overall experience, and amenities have an impact on the intention to return (Tien et al., 2021; Pujiastuti et al., 2022; Rasoolimanesh et al., 2023). Following the above discussion, we hypothesize:

H3. Visitors' religious tourism experience significantly affects re-tourism intention

Visit motivation and overall satisfaction

Recently, several significant research studies (e.g. Nanggong et al., 2022; Ribeiro et al., 2022; Hamdy et al., 2024) have confirmed the relationship between visit motivation and overall satisfaction. Esubalew & Singh (2020) supported the valuable impact of visit motivation on overall satisfaction. Kim & Chen (2021) suggested that the visitors' activities had minimal impact on the overall experience or the advantages they received. The most reliable indicator of the visit motivation was the sensation of connecting spiritually and emotionally, ultimately resulting in a shift in visitors' devotion to pilgrimage experiences and overall satisfaction (Jyotsna & Sai, 2022; Hendar et al., 2025). Following the above discussion, therefore, we hypothesize:

H4. Visit motivation significantly affects overall satisfaction.

Overall satisfaction and re-tourism intention

According to previous research, re-tourism intention is significantly influenced by overall satisfaction (Baghirov et al., 2023; Lim et al., 2024). It appears to directly influence behavioral intentions, and visitor satisfaction with the event and destination is crucial for a favorable outcome and an indicator of intention to return (Al-Dweik, 2020). Visitor satisfaction is a predictor of revisit intention (Khoo, 2022; Hari & Mohan, 2025). Following the above discussion, we hypothesize:

H5. Overall satisfaction significantly affects re-tourism intention

Prior empirical studies have examined the intricate relationship between visitors' travel motivation, religious tourism experiences, and re-tourism intention (Rasoolimanesh et al., 2022). Parthenis et al. (2023) religious tourism experiences affect how visitors behave and how much they like a place. Thowayeb Hassan et al. (2022) discovered that a positive religious tourism experience positively contributes to the re-tourism intention of visitors. Hassan et al. (2024) research indicates that visitors' religious tourism experience acts as a mediator between visit motivation and revisit intention. Religious and spiritual people are more likely to seek out life-changing experiences in places of worship (Johnmeyer et al., 2025). Additional investigation is required to ascertain whether the visitor's religious tourism experience works as a mediator between visit motivation and re-tourism intention (Huddin et al., 2024). This hypothesis examines how tourists behave in religious tourism environments by using their experiences as a mediator. It also provides insight into re-tourism intention. The mediation model demonstrates how visit motivation, religious tourism experience, and re-tourism intention are interconnected. Therefore, we hypothesize:

H6. Visitors' religious tourism experience significantly mediates the relationship between visit motivation and re-tourism intention.

It has been discovered that the intention to revisit a place and visit motivation are significantly mediated by overall tourist satisfaction (Torabi et al., 2022; Ningsih & Muslichah, 2025). Visitor satisfaction increases the likelihood that they will return to a destination (Kumar & Bhinder, 2024). Nguyen-Van (2021) also verified that overall satisfaction mediates the link between visit motivation and re-tourism intention. Therefore, we hypothesize:

H7. Overall satisfaction significantly mediates the relationship between visit motivation and re-tourism intention.

Moderating effects of the religious tourism potential

Research regularly demonstrates that there is a considerable correlation between people's motivation for visiting a religious site and their willingness to return (Kayal, 2023;M. Carvache-Franco et al., 2024). Perceived value, infrastructure, and attractiveness as a destination for religious tourism are collectively referred to as the "religious tourism potential" of a place. This notion may strengthen or weaken the association between visit motivation and revisit intention, which can function as a moderator (M. Carvache-Franco et al., 2024[b]; Yuliviona et al., 2025). Re-tourism intention can be influenced by religious tourism potential (Choe, 2024). Nguyen Viet et al. (2020) outlined a gap in tourism potential that can serve as a

strong moderator between satisfaction and re-tourism intention. The suggested moderation model clarifies the connection between the visit motive, religious tourism potential, and the re-tourism intention. Therefore, we hypothesize:

H8. Religious tourism potential moderates the relationship between visit motivation and re-tourism intention.

The relationship might be weakened or strengthened by religious tourism challenges (Benmehdi, 2025). Relationships can be disrupted if a pilgrim feels insecure at a temple. Even if they were initially inspired by faith, they may be less inclined to return. Relationships will be reinforced (Varo & Emiroğlu, 2025). For example, a pilgrim may feel more accomplished and more motivated to return after overcoming a challenging journey to a sacred destination (Huang & Pearce, 2019). Religious tourism challenges can affect both individual experiences and the broader expansion of religious tourism destinations by influencing visit motivation and the intention to return (Choe, 2024). Religious tourism challenges can adversely affect revisit intention (Hasan et al., 2017). The suggested moderation model clarifies the connection between the visit motive, religious tourism challenges, and the re-tourism intention. Therefore, we hypothesize

H9. Religious tourism challenges moderate the relationship between visit motivation and re-tourism intention

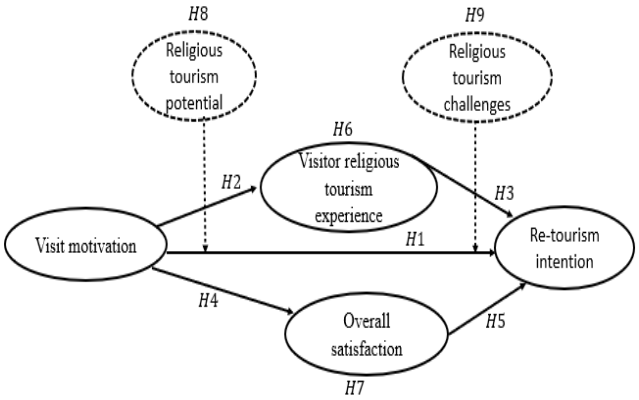


Figure 1. Proposed conceptual model

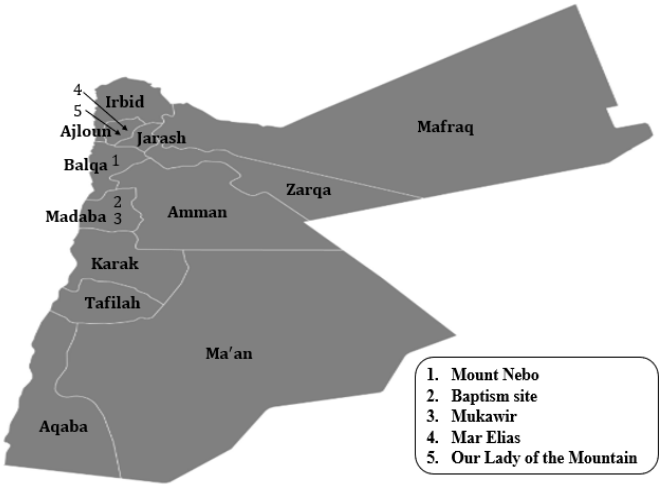


Figure 2. Location map of the study area (Jordan Map)

RESEARCH METHODOLOGY

Study Area

The study focuses on five Christian holy sites approved by the Vatican in 2000 as pilgrimage destinations. Following the successful completion of 25 years, on the silver jubilee, this study focuses on five Christian religious sites in Jordan, namely the Baptism Site, Mount Nebo, the Shrine of Our Lady of the Mountain, Tal Mar Elias, and Mukawir. The study area's location map is shown in Figure 2. Two of these sites, Mount Nebo and the Baptism Site, were visited by Popes Benedict XVI in 2009 and John Paul II in 2000 (Al-Zoubi & Yahaya, 2020[b]). As the 25th anniversary approaches, His Beatitude Cardinal Pierbattista Pizzaballa, the Latin Patriarch of Jerusalem, Rasmi Al-Khazaleh, urge people to travel to Jordan and experience its profound holiness (Jordan News Agency, 2025).

Sampling and data collection

As per MOTA (2024) Mount Nebo received 1,63,830 international visitors, the Baptism site received 67,198, and the Tal Mar Elias received 11,243. The Shrine of Our Lady of the Mountain and Mukawir also received thousands of visitors in 2024. A survey was conducted at every location for the entire 30 days from 1st February to 2nd March 2025 to obtain a representative sample. Due to the large number of visitors at certain sites, the researcher administered 100 questionnaires at each site and ensured 100 valid responses to confirm a substantial level of confidence.

Data collected from 500 visitors. Five postgraduate students and two faculty members made up the research team; they were employed to collect the data from international visitors and received training for the survey. Visitors were informed of the study's aim during data collection, and those who agreed to participate were requested to complete the questionnaire. Data collected from visitors after attending religious sites at the exit point/parking area. Fieldwork was carried out on weekdays and weekends. The questionnaire was filled out using a convenience sample technique.

A copy of the questionnaire, which took around ten minutes to complete, was delivered to those who granted their approval. To minimize non-response bias, the researcher asked the subsequent visitor to complete the questionnaire after the first one declined. To prevent response biases, researchers chose various times for data collection each day.

Questionnaire design

This study created a questionnaire based on its hypothesis and research framework. To confirm content validity, the survey questions were adapted from literature reviews. All the items in the data collection instrument were taken from scales of existing literature. The constructs were assessed using a seven-point Likert scale, with 1 denoting "strongly disagree" and 7 denoting "strongly agree." To ensure respondents understood the questionnaire items, the researchers administered a pretest in a small group of 40 foreign visitors to Mount Nebo. Before using the questionnaire in the official survey, the researchers made additional changes to enhance its readability and reliability based on the pretest results. Using exploratory factor analysis, the

study specifically tried to remove items that did not load on a factor sufficiently and items with low adjusted item-to-total correlation values to purify the instrument. There were thirty items in the completed questionnaire. As shown in Table 1, which includes six constructs: VM (5 items), RI (3 items), VRTE (6 items), OS (5 items), RTP (4 items), and RTC (6 items).

Common method bias: As per Vomberg & Klarmann (2022) simple questionnaire instructions are vital for letting respondents know that there is no right or incorrect response and that all answers will be kept anonymous. This is a quick and easy way to lessen common method bias (CMB). As a result, the authors assured respondents during the data collection process that there would be no right or incorrect answers and that their identities would not be revealed. The CMB of the data was also confirmed using the Harman single-factor test (Harman, 1976).

Analytical methods

Once the respondents' attributes have been described using descriptive statistics, exploratory and confirmatory factor analysis, as well as the validity and reliability of the measurement model, and the structural model (path analysis) were analyzed using structural equation modeling (SEM) with the partial least squares (PLS) algorithm in SmartPLS 4.0, that has gained popularity and interest among researchers in recent years (Silaban et al., 2023; Vafaei-zadeh., 2024).

The study assessed the structural model's explanatory ability using common evaluation metrics, including R^2, F^2, and statistical significance of path coefficients. PLS-SEM is a practical approach that may be used to model latent constructs in non-normality situations and has few limitations on measurement scales (Chang et al., 2016).

The study was required to confirm the measurement model's reliability and validity for ordinary least squares regression (PLS-SEM), and structural model linkages for the latent and manifest variables in a non-iterative manner. Finally, the study assessed the statistical importance of the bootstrap resampling technique for the structural routes.

Table 1. Questionnaire items and their sources

Visit motivation (VM): source: Rybina & Lee (2021)	
VM1	I do like visiting religious sites because it allows me to reach my full spiritual potential.
VM2	I experience a sense of intimacy and connection with something sacred when I visit religious sites.
VM3	My present scenario gets replaced by a new one when I visit religious sites.
VM4	I may show my love and respect for God by going to holy places.
VM5	I constantly pray in the religious site.
Re-tourism intention (RI): source: Bhatti & Alawad (2023)	
RI1	I plan to visit Jordan's religious Christian sites in the near future.
RI2	I would recommend Jordan's religious Christian sites to friends or family members.
RI3	In the future, I would like to prioritize visiting Jordan's religious Christian sites over other travel destinations.
Visitors' religious tourism experience (VRTE): source: Rebuya et al. (2020)	
VRTE1	My love and reverence for God are expressed through my religious travel.
VRTE2	A visit to a spiritual location provides me with a sense of forgiveness.
VRTE3	I get closer to God when I visit religious sites.
VRTE4	Religious sites help me to recognize the region's historical significance.
VRTE5	The religious attraction/activity broadens my understanding by showcasing historical and cultural significance.
VRTE6	The religious site is in harmony with the local environment.
VRTE7	The hospitality of the local people is good
Overall satisfaction (OS) : source: Hughes et al. (2013)	
OS1	I deemed the visit to be worthwhile.
OS2	The visit was just as excellent as I had expected.
OS3	I was enchanted by everything I read, heard, and saw.
OS4	I discovered the information to be fascinating.
OS5	I believe I benefited from being here today.
Religious tourism potential (RTP): source: Rivera et al. (2009)	
RTP1	I found good facilities and infrastructure (access, cleanliness, facilities, physical layout)
RTP2	I found Jordan's religious Christian sites' economic (price of admission, price of food)
RTP3	I found good sensory stimulants (use of technology and exhibits)
RTP4	I found sufficient site-specific attributes (Christian themes, spiritual activities, information about the Bible, and inspirational experience)
Religious tourism challenges (RTC): source: Kumar & Rao (2022); Ebabey (2024)	
RTC1	Convenient and trustworthy transportation choices are available to religious sites.
RTC2	Signage to religious sites is well-marked and informative.
RTC3	There is sufficient institutional or governmental assistance for religious tourism.
RTC4	Religious sites have adequate security measures in place.
RTC5	The staff and guides at the religious site are informed and supportive.
RTC6	I feel safe while visiting Jordan, despite the ongoing cross-border conflicts.

RESULTS

Demographics

Table 2 presents the demographic aspects of 500 respondents. The sample's general gender distribution was (59.2%) male and (40.8%) female, in contrast to previous studies that suggested older ages were more interested in religious tourism, with respondents aged 31 to 50 making up the majority (72% of the entire survey). Most visitors were European (37.6%), followed by North Americans (23.4%), With a share of (37.6%), It needs to be noted that European tourists are

more interested in visiting Jordanian Christian sites, and ove[r] half of the sample was highly educated (61.4%), with bachelor's degrees or more. However, over two-thirds of the respondents were regarded as upper middle class, with (63.2%) earning between (31,000 and 70,000 $), while (50.8%) were employed and (34.6%) were businessperson.

Table 2. Demographic profile
(Source: Author's calculation)

Demographics(n=500)	Frequency (Responses)	Respondents' percentage (%)
Gender		
Male	296	59.2
Female	204	40.8
Age		
18-30	24	4.8
31-40	191	38.2
41-50	169	33.8
51-60	96	19.2
61+	20	4.0
Education		
Secondary education or less	45	9.0
Diploma/advanced diploma	148	29.6
Bachelor degree	181	36.2
Post-graduation degree	107	21.4
PhD.	19	3.8
Occupation		
Student	18	3.6
Employee	254	50.8
Businessperson	173	34.6
Unemployed	29	5.8
Retired	26	5.2
Household income (US$)		
Below 10000	29	5.8
11000-30000	136	27.2
31000-50000	247	49.4
51000-70000	69	13.8
71000 or more	19	3.8
Nationality		
Europe	188	37.6
North America	117	23.4
South America	56	11.2
Southeast Asia	59	11.8
Africa	33	6.6
Australia	47	9.4

Table 3. Reliability and Validity for constructs (Source: Author's creation)

Construct	Factor loading	CR	AVE	Cronbach's alpha (α)
Visit Motivation (VM)		0.959	0.826	0.936
VM1	0.857			
VM2	0.912			
VM3	0.865			
VM4	0.814			
VM5	0.823			
Re-tourism intention (RI)		0.927	0.854	0.865
RI1	0.863			
RI2	0.874			
RI3	0.854			
Visitors' religious tourism experience (VRTE)		0.963	0.796	0.743
VRTE1	0.898			
VRTE2	0.912			
VRTE3	0.813			
VRTE4	0.845			
VRTE5	0.967			
VRTE6	0.876			
VRTE7	0.843			
Overall satisfaction (OS)		0.956	0.812	0.916
OS1	0.876			
OS2	0.858			
OS3	0.832			
OS4	0.842			
OS5	0.812			
Religious tourism potential (RTP)		0.943	0.865	0.954
RTP1	0.843			
RTP2	0.812			
RTP3	0.832			
RTP4	0.871			
Religious tourism challenges (RTC):		0.916	0.781	0.797
RTC1	0.945			
RTC2	0.832			
RTC3	0.854			
RTC4	0.821			
RTC5	0.846			
RTC6	0.833			

Notes: Note = CR=composite reliability; AVE=average variance extracted; VM = visit motivation; RI = re-tourism intention; VRTE = visitors' religious tourism experience; OS = overall satisfaction; RTP = religious tourism potential; RTC = religious tourism challenges

Table 4. Discriminant validity – Fornell-Larcker criterion (Source: Author's calculation)

Constructs	VM	RI	VRTE	OS	RTP	RTC
VM	0.903					
RI	0.542**	0.897				
VRTE	0.654**	0.639**	0.943			
OS	0.621**	0.532**	0.639**	0.840		
RTP	0.598**	0.540**	0.589**	0.625**	0.901	
RTC	0.609**	0.528**	0.513**	0.539**	0.662*	0.882

Notes: Significant at two-tailed *p<0.05 and **p<0.01. The square root of the average variance extracted (AVE) for each construct is displayed by the diagonal numbers in italics; VM = visit motivation; RI = re-tourism intention; VRTE = visitors' religious tourism experience; OS = overall satisfaction; RTP = religious tourism potential; RTC = religious tourism challenges

Measurement model

The convergent validity of each construct was demonstrated by the average variance extracted (AVE) values above the 0.50 threshold (Fornell & Larcker, 1981). The inter-consistency reliability was assessed by computing Cronbach's alpha and composite reliability values for each construct. The analysis's findings revealed that Cronbach's values were higher than the cutoff point of 0.70, as specified by Taber (2018). The items in each construct group have a high level of internal consistency, as indicated by the respective values for each construct, which were 0.959, 0.927, 0.963, 0.956, 0.943, and 0.916, respectively, and appropriate factor loadings as displayed in Table 3. Additionally, the suggested cutoff limit of 0.70 was exceeded by the CR readings. Tables 3 and 4 illustrate that the discriminant validity is sufficient, as per Garver & Mentzer (1999), as the

correlation coefficients for each component were less than the average variance extracted (AVE) square root. This implies that every construct is distinct from the others and does not strongly correlate with others (Fornell & Larcker, 1981).

Table 5. The PLS method's coefficient of determination (Source: Author's calculation)

Constructs	R-square	R-square adjusted	Q^2 predict
RI	0.381	0.367	0.316
VRTE	0.314	0.287	0.277
OS	0.558	0.561	0.543

Table 6. The structural equations model's results (Source: Author's calculation)

Hypotheses	Relationship among constructs	β	Sample mean	S. D	T values	F square	P values	LLCI 2.5%	ULCI 97.5%	Remarks
Direct Effect										
H1	VM--> RI	0.538	0.540	0.034	14.904	0.398	0.000	0.471	0.602	Accepted
H2	VM--> VRTE	0.118	0.114	0.023	4.398	0.069	0.000	0.056	0.155	Accepted
H3	VRTE--> RI	0.267	0.268	0.048	5.388	0.041	0.000	0.178	0.361	Accepted
H4	VM--> OS	0.489	0.491	0.039	2.066	1.251	0.000	0.049	0.276	Accepted
H5	OS--> RI	0.243	0.244	0.044	2.126	0.446	0.000	0.168	0.283	Accepted
Indirect Effects Mediating Effect										
H6	VM-->VRTE-->RI	0.031	0.032	0.011	3.213		0.000	0.015	0.054	Accepted
H7	VM -->OS-->RI	0.028	0.142	0.023	4.765		0.000	0.072	0.179	Accepted
Moderation Analysis										
H8	RTP x VM--> RI	0.025	0.024	0.033	4.389		0.000	− 0.118	− 0.033	Accepted
H9	RTC x VM--> RI	0.078	0.076	0.022	0.787		0.000	− 0.042	0.096	Accepted

Notes: VM = visit motivation; RI = re-tourism intention; VRTE = visitors' religious tourism experience; OS = overall satisfaction; RTP = religious tourism potential; RTC = religious tourism challenges

Structural Model

Once the measurement model had been evaluated, the structural model, also known as the inner model, was the focus of the next investigation. The R^2 value was first computed to assess the variation explained by the constructs associated with the (endogenous) dependent variables. Ozili (2023) show that, depending on the research environment, the R^2 evaluation results fall into three categories: 0.09 (poor), 0.13 (moderate), and 0.26 (high). The inner model graphically represents the interdependencies between the elements in the conceptual model. The R^2 values for the study's (endogenous) dependent variable show that the direct impact model accounts for 55.8% of the variation in OS and 31.4% of the variation in VRTE. These findings imply that changes in these parameters can be predicted by VM and moderated variables. Additionally, an investigation shows that the computed coefficient of determination (R^2) for the RI is 0.381. Thus, about 38.1% of the variation in RI may be explained by the variables VRTE, VM, RTC, RTP, and second, the predictive relevance (Q^2) by cross-validation redundancy was computed to quantify the conceptual model's assessed significance.

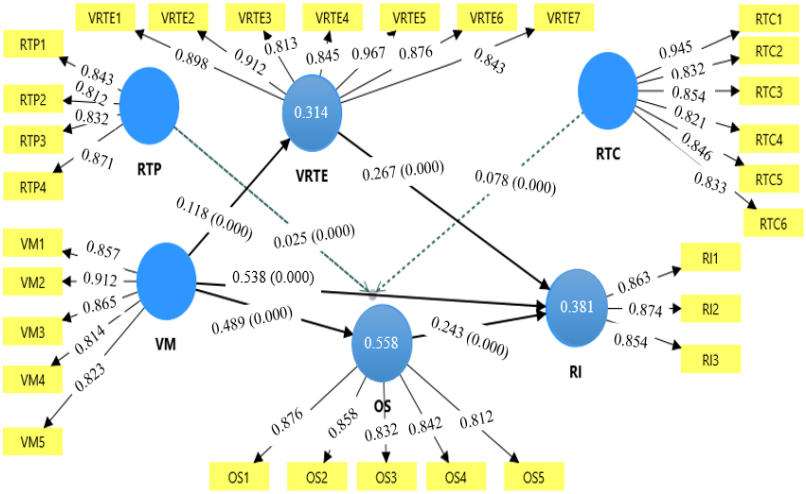


Figure 3. PLS-Path analysis based on 5000 bootstrapped samples

The direct effect model has sufficient predictive significance, as demonstrated by Table 5, where all endogenous latent variables have Q^2 values greater than zero (Q^2 = 0.277 for the direct VM and VRTE, Q^2 = 0.543 for the VM and OS, and Q^2 = 0.316 for the indirect impact of VM on RI). As per Table 6 and Figure 3. Hypotheses from H1 to H5 were accepted because VM had a positive and statistically significant direct effect on RI (β = 0.538, t = 14.904, p < 0.05), similarly comparable substantial positive impact for VM on VRTE (β = 0.118, t = 4.398, p < 0.05), VRTE on RI (β = 0.267, t =

5.388, $p < 0.05$), VM on OS ($\beta = 0.489$, $t = 2.066$, $p < 0.05$), and OS on RI ($\beta = 0.243$, $t = 2.126$, $p < 0.05$). The relation between VM and RI is mediated by VRTE, according to the study. Similarly, OS mediates the relationship between VM and RI. The indirect impact of VM on RI through VRTI was significant ($\beta = 0.031$, $t = 3.213$, $p < 0.05$).

Moreover, there was a substantial indirect effect of VM on RI through OS ($\beta = 0.028$, $t = 4.765$, $p < 0.05$).H6 and H7 were thus also approved. Furthermore, the relationship between VM and RI was shown to be significantly moderated by RTP ($\beta = 0.025$, $t = 4.389$, $p < 0.05$). The association between VM and RI was also significantly moderated by RTC ($\beta = 0.078$, $t = 0.787$, $p < 0.05$). Therefore, H8 and H9 were also accepted.

DISCUSSION

The study explores the dynamics of visitor behavior in locations related to religious tourism and the outcomes of applying concepts pertinent to the study's framework. By examining the relationships between visitors, travel motivations, religious tourism experiences, potential, challenges, and intention to return, the study investigates the complex relationships that foster destination loyalty and intention to return. The study uses both empirical data and a theoretical framework to clarify the complex features of religious tourism. For those in destination management looking to enhance their plans and initiatives for sustainable tourism growth.

First, it was hypothesized that re-tourism intention is significantly impacted by visit motivation. The current study's findings suggest that motives for the visit have a significant effect on re-tourism intention. If their initial travel goals were satisfied, tourists are more inclined to return to a place. Most researchers reported a sound relationship between their re-tourism intention and visit motivation (Esubalew & Singh, 2020; Ayoub et al., 2024). As per Mishra & Maheshwari (2025), to create individualized visitor experiences and marketing strategies, it is necessary to understand the motivations of visitors, which may include spiritual enrichment or learning about the host culture.

Secondly, it was hypothesized and study findings suggest that visit motivation significantly affects visitors' religious tourism experience. As per Lachlali et al. (2019), at a religious site, different motives result in different behaviors, expectations, and overall experiences. Religious tourists travel for a variety of motives, including cultural immersion, spiritual growth, sightseeing, and personal development. Therefore, to improve the religious tourism experience, destination stakeholders should concentrate on genuine and interesting linkages with religious heritage and traditions.

Third, it was hypothesized that visitors' religious tourism experience significantly affects overall satisfaction. The study's findings aligned with the body of existing literature. Previous research has demonstrated that religious tourism experiences have a positive effect on re-tourism intention (Rehman et al., 2022). A study by Bhandari et al. (2024) found a strong, favorable relationship between tourists' religious tourism experiences and their inclination to return. Fourth, it was hypothesized that visit motivation significantly affects overall satisfaction. Results aligned with the earlier findings. Previous research has revealed that travel motivations have been demonstrated to be significant indicators of overall satisfaction (Esubalew & Singh, 2020). Similarly, previous studies have mostly focused on the relationship between overall satisfaction and several variables associated with visit motivation, such as push and pull factors.

Fifth, it was hypothesized that overall satisfaction significantly affects re-tourism intention. By the study's findings, M. Lin (2024) satisfied tourists are more likely to make plans to return. Studies repeatedly demonstrate that there is a positive correlation between satisfaction and the intention to return. Sixth, it was hypothesized that visitors' religious tourism experience significantly mediates the association between visit motivation and re-tourism intention. By providing unique experiences, tourism destinations may increase visitor engagement. Because of this, visitors are urged to come back and recommend the location. Travelers' experiences, motivation, and desire to return are all intertwined in religious tourism (Carvache-Franco et al., 2024).The results emphasize how essential it is for destination stakeholders to manage the destination holistically. Prior research conducted by Bhatti & Alawad (2023) confirmed that visitors' religious tourism experience significantly mediates the association between visit motivation and intention to return.

Seventh, it was hypothesized that overall satisfaction significantly mediates the association between visit motivation and re-tourism intention. The reason for traveling is known as the motive of the visit. Researchers have suggested that understanding visit motivation could be the key to overall satisfaction and re-tourism intention. Research continuously demonstrates that visit motivations and re-tourism intention are significantly mediated by overall tourist satisfaction (Esubalew & Singh, 2020). Further, between the initial motivation for the visit and the ultimate decision to return, satisfaction acts as a connection. The essential aspect that turns motivation into a desire to return is the satisfaction gained from the experience, not because motivation only results in the intention to return.

Eighth, it was hypothesized that religious tourism potential would be a moderator between visit motivation and re-tourism intention. In line with the results of the Rehman et al. (2022) study, which showed that the perceived religious tourism potential of a place might affect the degree of the association between an individual's motivation for visiting that location and their intention to return. For the ninth hypothesis, it needs to be noted that religious tourism challenges have a significant moderating effect on the relationship between visit motivation and re-tourism intention, which supports the research Zhou et al. (2023) that found that religious tourism challenge is a favorable moderator between visit motivation and re-tourism intention. Different challenges at destinations may deter visitors from visiting. Overtourism, inadequate infrastructure, and disturbances to nearby populations are a few examples of these difficulties (Rybina & Lee, 2021).

CONCLUSION

This study contributes to the understanding of religious tourism by examining the relationships among visit motivation, religious tourism experience, overall satisfaction, destination potential, destination challenges, and re-tourism intention in

the context of Christian pilgrimage sites in Jordan. The findings confirm that visit motivation directly and indirectly influences re-tourism intention through the mediating roles of religious tourism experience and overall satisfaction. Furthermore, destination potential and destination challenges significantly moderate these relationships, demonstrating that visitors' behavioural intentions depend not only on their motivations but also on the quality and management of the destination. These findings extend the theoretical understanding of religious tourism by providing empirical evidence of the sequential mechanisms through which motivation is transformed into future behavioural intentions. From a practical perspective, the results offer valuable guidance for destination managers, policymakers, and tourism marketers in developing effective strategies to strengthen pilgrimage destinations. Improving destination infrastructure, reducing operational challenges, enhancing interpretation services, and adopting digital tools such as mobile applications and virtual guides can enrich visitors' experiences and increase satisfaction and revisit intentions. Regular monitoring of visitor motivations, experiences, and satisfaction through surveys and digital feedback systems will support evidence-based destination management. Overall, this study provides a comprehensive framework for promoting the sustainable development and long-term competitiveness of religious tourism destinations in Jordan and similar pilgrimage contexts.

Limitations and Future Research

Every investigation has inherent limitations, and every study offers opportunities for improvement. The current study also has several shortcomings. Only five Christian worship sites recognized by the Vatican in 2000 were the focus of this study; more research should focus on other sites that are also connected to Christianity in Jordan. Second, while the current study was cross-sectional, future research should concentrate on a variety of data collection techniques, such as longitudinal studies, mixed methods, and interview-based investigations. Third, to consider stratified sampling in future research to guarantee wider representativeness and address the drawbacks of convenience sampling (such as overrepresenting visitor groups). The sample and conditions of the study may restrict generalizability. Future studies may examine the effects of sustainable tourism practices on visitor preferences and destination competitiveness in the context of religious tourism as sustainability becomes popular. Studying religious tourism and other niche tourism categories like wellness tourism and volunteer travel can be the way to investigate the relationship between visitor experiences and motivations. Future research can fill these gaps and investigate new aspects of religious tourism to sustain religious tourism destinations worldwide and improve theoretical and practical understanding.

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DEVELOPING LOCAL WISDOM–BASED TOURISM PRODUCTS IN BIREUEN REGENCY, ACEH PROVINCE: INTEGRATING CULTURAL HERITAGE, COMMUNITY EMPOWERMENT, AND SUSTAINABLE TOURISM STRATEGIES

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Abstract: Local wisdom-based tourism is increasingly seen as a strategic approach to achieving sustainable, inclusive, and competitive destination development, particularly in areas with rich cultural heritage and vibrant traditional social systems. Bireuen Regency, Aceh, boasts tourism potential stemming from relatively well-preserved natural resources and deeply embedded sociocultural values within its communities. This study explores the development of local wisdom based tourism products in Bireuen Regency, using the something to see, something to do, and something to buy framework integrated with sustainable tourism strategies. This research method uses an exploratory qualitative approach. Data were collected through in-depth interviews with key informants, including tourism site managers and members of indigenous communities, selected using snowball sampling. Additional data were obtained through observation and documentation. Data analysis involved systematic stages of data reduction, data display, interpretation, and conclusion drawing. Results of the reseach reveal that Bireuen Regency possesses diverse local wisdom-based tourism potentials encompassing natural landscapes, tangible and intangible cultural heritage, and traditional social systems. Cultural traditions such as *Meugang*, *Khanduri Laôt*, and *Khanduri Blang* emerge as authentic cultural tourism attractions. Local knowledge and community social practices support the development of experiential and educational tourism. Furthermore, local crafts and culinary products including *plik u*, *purun* weaving, crafts from coconut powder, *sate matang*, *kuah beulangong*, and Acehnese noodles contribute significantly to community-based economic empowerment. A SWOT analysis positions tourism development in Quadrant I, indicating strong internal strengths and external opportunities, thereby supporting an aggressive development strategy centered on cultural preservation and digital promotion.

Keywords: local wisdom, sustainable tourism, tourism product development, cultural heritage

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INTRODUCTION

Tourism is a service-based sector characterized by extensive horizontal and vertical linkages across multiple economic and social domains. Owing to these interconnections, tourism plays a strategic role in development agendas, as it is expected to generate significant contributions to economic growth at both national and regional levels while simultaneously enhancing community well-being (Cong et al., 2021). Beyond its economic significance, tourism also contributes to cultural preservation and the reinforcement of local identity, positioning it as a multidimensional development instrument. In the Indonesian context, the discourse on local wisdom–based tourism development has gained increasing prominence alongside growing awareness of the importance of cultural values in strengthening destination competitiveness. Local wisdom is no longer understood merely as inherited traditions; rather, it encompasses a broader system of values, knowledge, and social practices that underpin community life and guide collective behavior.

This perspective aligns with contemporary approaches to sustainable and community-based tourism, which emphasize cultural integrity, social inclusivity, and local participation. In Aceh Province, local wisdom constitutes a central element shaping the cultural character of society, as reflected in diverse traditions, customary practices, and religious expressions that are deeply embedded in everyday life. These socio-cultural foundations offer a distinctive context for tourism development that is both culturally grounded and socially meaningful.

Within this regional setting, Bireuen Regency demonstrates considerable potential for the development of tourism rooted in local cultural resources. The presence of tangible and intangible cultural heritage that has been identified as a potential cultural tourism asset indicates that Bireuen possesses valuable cultural capital that can be strategically

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developed as an authentic tourism attraction (Novalita et al., 2023). Beyond its cultural potential, Bireuen Regency also possesses natural tourism resources that serve as prominent destinations for local communities. On the other hand, Aceh is widely recognized as a region that applies the concept of halal tourism by integrating customary and religious values into tourism practices. This approach not only strengthens cultural identity but also enhances destination competitiveness in a global tourism market that increasingly demands unique, authentic, and sustainable experiences.

Accordingly, the development of local wisdom–based tourism products in Bireuen is strategically important, as it integrates cultural values, natural potential, and the principles of halal tourism that have become a defining characteristic of Aceh. Despite its considerable potential, tourism development in Bireuen Regency faces several challenges. Strategies for tourism product development that utilize local culture have not yet been optimally integrated.

Community participation in tourism management and promotion remains limited, while innovation in branding and marketing of local tourism products has not been maximized. In addition, cultural and environmental preservation has not been fully addressed, creating risks of cultural commodification. Furthermore, policies and regulatory frameworks that support the development of local wisdom–based tourism remain limited.

The development of local wisdom–based tourism has become a central focus in sustainable destination development, as it integrates cultural preservation, community empowerment, and enhanced destination competitiveness. Scholarly attention to the role of local wisdom in tourism management has continued to grow, with emerging trends emphasizing ecotourism, community-based tourism, and cultural heritage conservation as key thematic areas (Judijanto, 2025).

Local wisdom–based tourism development strategies further highlight the importance of integrating cultural values into tourism product design, whereby cultural and natural assets function as primary attractions while simultaneously contributing to local community welfare (Oematan et al., 2022). Destination differentiation strategies that foreground local values have been shown to enhance tourist experiences and strengthen destination appeal (Gai et al., 2024).

In this regard, local wisdom serves as an essential medium for cultural preservation and the empowerment of community-based cultural values. Consequently, tourism development should be grounded in region-specific potential, the authenticity of village-based products, the reinforcement of local culture, and efforts to maintain environmental sustainability (Yusri & Hajar, 2025).

Effective tourism development should be grounded in regional potential, the authenticity of village-based products, the strengthening of local culture, and the protection of environmental sustainability. In line with this perspective, sustainable tourism or ecotourism emphasizes the responsible use of resources, respect for local traditions, and the implementation of sustainable practices across all tourism sectors. Sustainable tourism prioritizes social equity, economic viability, and environmental responsibility, while actively involving local communities to generate economic opportunities and support cultural preservation (Litheko, 2022). A holistic approach to destination management is also essential. This approach underscores the need for comprehensive destination planning, sustainable development, and effective governance to ensure that the benefits of tourism can be sustained over the long term (Kalaitan et al., 2021).

In the tourism industry, a product is understood as a set of interrelated elements whose utilization occurs simultaneously. More broadly, tourism products encompass a combination of tangible goods and intangible services or facilities that can be accessed, experienced, and enjoyed by tourists throughout their journeys. The tourist travel process is designed to create meaningful experiences, beginning with departure from the place of origin, engagement at the destination, and concluding with the return journey. Tourism products are commonly classified into primary and secondary products. Primary products constitute the main attractions that motivate tourists to visit a destination, whereas secondary products support the travel experience but do not serve as the primary reason for visitation, such as accommodation and catering services. These secondary products exhibit a complex character, as they involve interactions between tangible and intangible elements and encompass broader geographical and thematic scopes (Benur & Bramwell, 2015). The development of sustainable tourism products emphasizes the responsible use of resources, respect for local traditions and culture, and the implementation of sustainable practices to ensure benefits for communities without generating negative impacts (World Tourism Organization, 2016; Mishra, 2025). One of the key strategies in this approach is the utilization of local wisdom, which encompasses unique values embedded in community life and shapes patterns of thinking, attitudes, and behaviors that are harmonious with the environment (Magdalena et al., 2021).

These cultural values influence how community express emotions and interact with their surroundings, serving as life guidelines that encompass both material and immaterial dimensions (Miller, 2012). The integration of local wisdom into sustainable tourism product development enables the creation of destinations that are authentic, attractive, and capable of empowering local communities. Tourism is highly dependent on the socio-cultural dimensions of society.

Furthermore, tourism development drives changes in destination characteristics, resulting in complex socio-cultural implications (Artal-Tur, 2018; Mkhize & Hlengwa, 2024; Zhuang et al., 2019). Cultural heritage provides crucial support to various development efforts, particularly in driving social and economic growth in many rural areas (Mashele et al., 2025). The social and cultural impacts of tourism activities emphasize the importance of preserving local traditions and cultural heritage. Therefore, responsible tourism development that respects local values deserves continued support.

This step aims to prevent overexploitation of culture and the erosion of traditional lifestyles and community wisdom (Ferdos et al., 2026). Therefore, community-based tourism development requires an effective strategy to ensure maximum benefits in sustainable development in the tourism industry (Durrah et al., 2026). Based on this background, this study aims to explore the development of local wisdom–based tourism products in Bireuen Regency, Aceh, through the integration of cultural heritage, community empowerment, and sustainable tourism strategies.

MATERIALS AND METHODS

This study employed an exploratory qualitative research method. A qualitative approach was adopted to obtain in-depth information through naturalistic inquiry, in which the researcher served as the primary instrument for data collection and analysis. In addition, the use of an exploratory approach aimed to achieve a comprehensive understanding of the phenomena under investigation. Figure 1 presents the overall research framework employed in this study. The research was conducted in four main stages: formulation of research objectives, application of research methods, data analysis, and formulation of research outputs. Based on Figure 1 exploratory research seeks to examine the underlying causes of a phenomenon rather than to describe variables, symptoms, or conditions contextually. Nevertheless, this approach facilitates the development of comprehensive data through observation, surveys, interviews, policy studies, and documentation. The analysis was conducted based on observations gathered from various activities across several tourist attractions within the geographical area of Bireuen Regency. Data sources consisted of primary data derived from field research and secondary data obtained through library research. Data collection was carried out through several stages: (a) observation, involving direct and spontaneous observation of tourism objects in Bireuen Regency using both on-site field notes and pre-prepared observation checklists; (b) interviews with key informants, namely indigenous community members and tourism site managers in Bireuen Regency, Aceh Province selected using a snowball sampling technique; and (c) documentation studies derived from field activities. Data trustworthiness was ensured through credibility, transferability, dependability, and confirmability. Data analysis techniques included data reduction, data display, SWOT analysis, and conclusion drawing (Kotler, 2002). Furthermore, the variables examined in the SWOT analysis comprised strengths, weaknesses, opportunities, and threats.

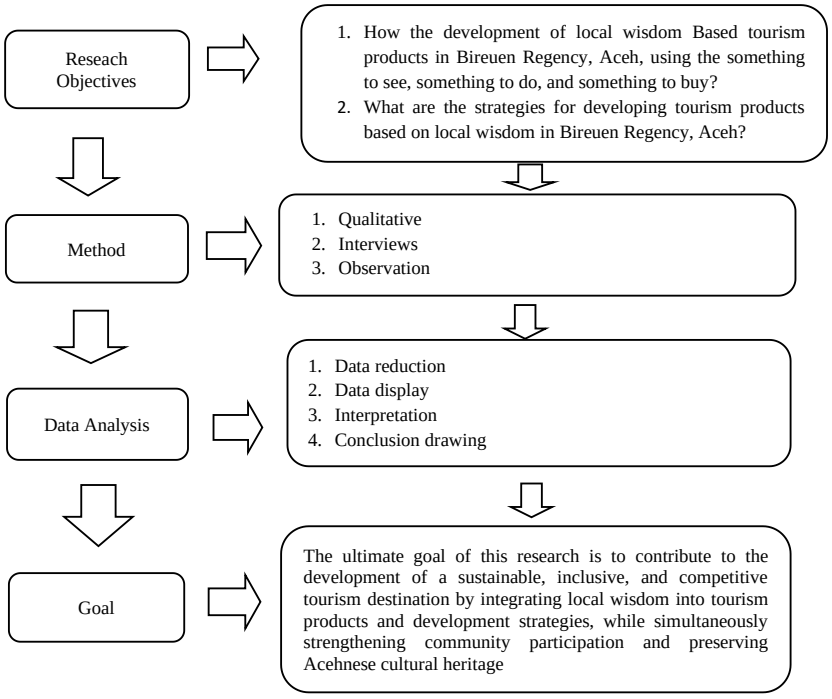


Figure 1. Research Methodology Steps (Source; Reseachers, 2025)

RESULTS

This study was successfully conducted as planned. The following results focus on exploring the development of local wisdom–based tourism products in Bireuen Regency, Aceh Province, viewed through the dimensions of something to see, something to do, and something to buy, as well as the strategies for developing local wisdom–based tourism products. The research findings are presented as follows.

Something to See in Bireuen Regency. Attractions

Bireuen Regency is well known for its coastal natural beauty and local culture, which constitute the primary capital for the development of its tourism attractions. Its coastal landscape is characterized by scenic beaches complemented by rows of coastal pine trees that enhance the visual appeal of the area. Bireuen Regency possesses a variety of tourism attractions. In general, tourism objects and attractions in Bireuen Regency are classified into three main categories, as outlined below.

Natural Tourism Attractions

In general, nature-based tourism refers to recreational and tourism activities that utilize natural potential to appreciate environmental aesthetics, whether in relatively pristine conditions or areas that have undergone cultivation or management processes, with the expectation of attracting tourist visits. The distribution of various types of natural tourism attractions found in Bireuen Regency is presented in Figure 2. Based on Figure 2, which presents the map distribution of natural tourism attractions in Bireuen Regency, it can be concluded that Bireuen Regency possesses highly diverse natural tourism

potential that is distributed across almost all subdistricts. The dominant types of tourism attractions include coastal tourism, natural bathing sites, waterfalls, wetlands (*paya*), as well as hilly landscapes and ecotourism areas. Coastal tourism attractions are predominantly found in subdistricts located along the coastline, such as Samalanga, Simpang Mamplam, Jeumpa, Kuala, Pandrah, Gandapura, Jangka, and Peudada. This distribution indicates that Bireuen's coastal areas hold significant potential for the development of marine and coastal tourism. Meanwhile, freshwater-based tourism attractions, including river bathing sites, wetlands, and waterfalls, are distributed across central and inland subdistricts such as Juli, Peusangan, Peusangan Siblah Krueng, Kota Juang, and Gandapura. Subdistricts such as Samalanga, Simpang Mamplam, Juli, and Gandapura are recorded as having a relatively higher number of natural tourism attractions compared to other areas, suggesting their potential to serve as centers for priority tourism development. The presence of diverse tourism attractions, ranging from coastal tourism to ecotourism and white-water rafting, indicates that Bireuen Regency possesses rich natural resources that can be developed in a sustainable manner. Overall, the distribution of natural tourism attractions in Bireuen Regency demonstrates substantial potential to support regional tourism development, enhance local economic activity, and function as an attraction for both local and regional tourists, provided that these resources are managed effectively.

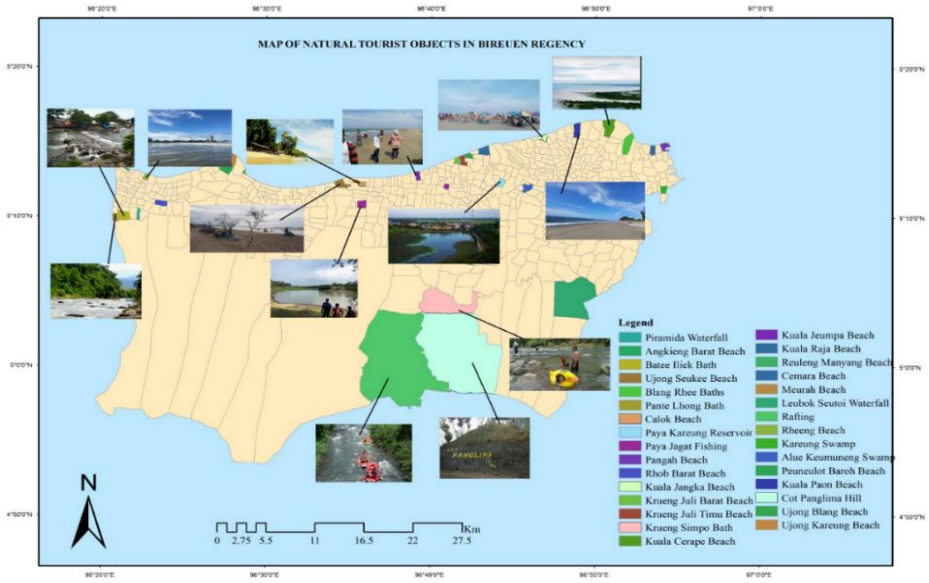


Figure 2. Map Natural Tourist Objects in Bireuen Regency (Source: Data Processing, 2025)

Cultural Tourism Attractions

Cultural heritage tourism, which involves visits to historical sites, cultural attractions, and locations of cultural significance, is an effective way to learn about the history and development of a destination (Khoa et al., 2025). Bireuen Regency possesses considerable potential in cultural tourism attractions. This is evident from the presence of various historical sites and heritage remains distributed across subdistricts throughout Bireuen Regency. Figure 3 illustrates the spatial distribution of cultural tourism attractions in Bireuen Regency.

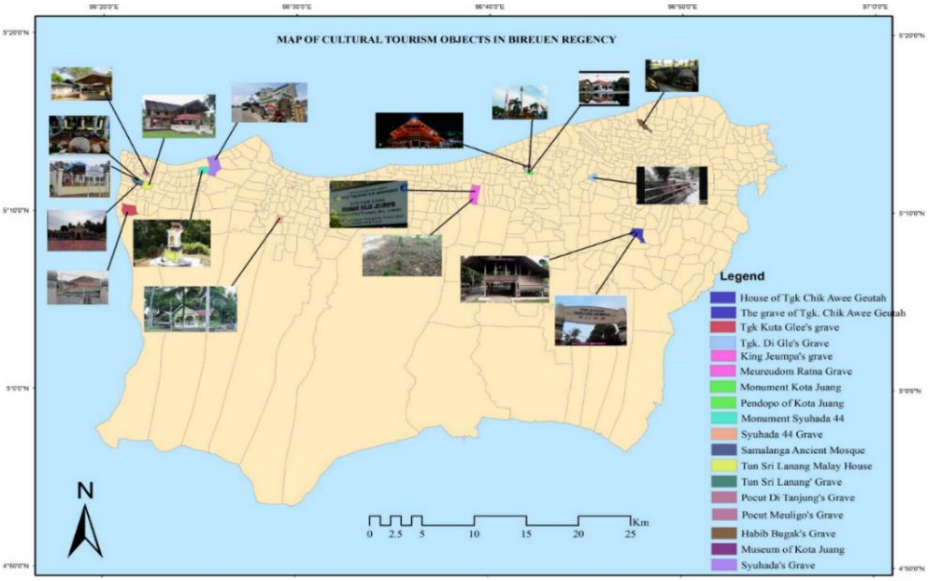


Figure 3. Map Cultural Tourism Objects in Bireuen Regency (Source: Data Processing, 2025)

Based on Figure 3, which presents the map distribution of cultural tourism attractions in Bireuen Regency, it can be concluded that Bireuen Regency possesses a rich cultural tourism heritage with high historical value, characterized by an almost even distribution of attractions across various subdistricts. The majority of cultural tourism sites consist of the graves of historical figures, religious scholars, and heroes, as well as commemorative monuments, reflecting the historical trajectory, struggles, and the development of Islam in the Bireuen region. Samalanga Subdistrict stands out as a central hub of cultural tourism, as it hosts the highest number of cultural attractions, including the graves of prominent figures, an ancient mosque, and the Tun Sri Lanang cultural house. This distribution highlights Samalanga's historical role as one of Aceh's centers of civilization, religious life, and intellectual activity in the past. In addition, other subdistricts, such as Kota Juang, also feature important cultural tourism sites in the form of monuments, museums, and the regent's official residence, which represent the region's governmental history and local struggles. Cultural tourism attractions associated with themes of struggle and heroism are found in subdistricts such as Simpang Mamplam, Pandrah, Jeunib, and Jangka, as indicated by the presence of martyrs' graves and commemorative monuments. Meanwhile, cultural and religious values are also reflected in subdistricts including Jeumpa, Peusangan, Peusangan Siblah Krueng, and Kuta Blang through the graves of kings and religious scholars, as well as traditional Acehnese houses. Overall, the distribution of cultural tourism attractions in Bireuen Regency demonstrates substantial potential for the development of historical, religious, and cultural educational tourism. If managed and promoted optimally, these cultural tourism assets can strengthen regional identity, preserve historical values, and serve as tourism attractions that support sustainable tourism development in Bireuen Regency.

Man-Made Tourism Attractions

In addition to natural and cultural tourism attractions, Bireuen Regency also possesses man-made tourism attractions. These man-made attractions are distributed across various subdistricts in Bireuen Regency. For further details, the spatial distribution of man-made tourism attractions in Bireuen Regency is illustrated in Figure 4. Based on Figure 4, which presents the map distribution of man-made tourism attractions in Bireuen Regency, it can be concluded that man-made tourism attractions in Bireuen Regency are distributed across several subdistricts and are generally associated with water infrastructure as well as fisheries and recreational activities. The dominant types of man-made tourism attractions include dams, reservoirs, irrigation systems, and fishing facilities, which serve dual functions as infrastructure supporting local livelihoods and as recreational tourism sites. Jeumpa Subdistrict has the highest number of man-made tourism attractions, primarily in the form of dams and freshwater fish cages, indicating the productive utilization of water resources with potential for development as educational and recreational tourism. Meanwhile, Peusangan Subdistrict is also notable for the presence of dams and reservoirs that can be utilized as water-based tourism and fishing destinations. Although the number of man-made tourism attractions in other subdistricts such as Jeunib, Peudada, Kota Juang, and Juli is relatively limited, these sites continue to play an important role as local tourism destinations, particularly for surrounding communities. The presence of fishing areas and reservoirs provides accessible and relatively affordable family-oriented tourism alternatives. Overall, the distribution of man-made tourism attractions in Bireuen Regency demonstrates potential for the development of infrastructure-based and water recreation tourism. With appropriate spatial planning, improved facilities, and effective promotion, these man-made attractions can complement natural and cultural tourism, thereby enriching the diversity of tourism destinations in Bireuen Regency.



Figure 4. Map of Artificial Tourist Attractions in Bireuen Regency (Source: Data Processing, 2025)

Local Culture

Local communities have ample opportunities to participate in ecotourism development. This role is crucial because the success of community-based tourism depends on the commitment and readiness of local residents to actively participate, as well as their understanding of the importance of preserving cultural values and environmental sustainability in their areas (Nizamiev et al., 2025). Developing cultural tourism in traditional villages generally involves utilizing local knowledge that has been passed down through generations. This knowledge is not only a vital part of a valuable cultural heritage but also serves as a foundation for implementing sustainable tourism practices that are in harmony with the environment and the lives of local communities (Sumarmi et al., 2026). One of the most prominent traditions that embodies the depth of local cultural meaning in Bireuen Regency is the *Meugang* tradition, along with *Khanduri Laot* and *Khanduri Blang*. The *Meugang* tradition is a distinctive Acehnese cultural celebration held two to three days before major Islamic holidays, particularly *Ramadan***,** Eid al-Fitr, and *Eid al-Adha*. During this period, traditional markets become vibrant centers of community activity as residents purchase beef and buffalo meat to prepare traditional Acehnese dishes, such as *kuah beulangong* and Acehnese rendang. Beyond its culinary significance, Meugang serves as a powerful expression of gratitude, togetherness, and social solidarity. Communities gather to prepare, share, and enjoy traditional meals, reinforcing family relationships, strengthening mutual cooperation, and preserving cultural values that have been passed down through generations. For visitors, *Meugang* offers an authentic cultural tourism experience through opportunities to observe local culinary traditions, participate in communal celebrations, and interact directly with the friendly local community. In Bireuen Regency, *Meugang* is not only an important element of Acehnese cultural heritage that deserves preservation but also a valuable cultural tourism asset with significant potential to attract both domestic and international tourists while promoting community-based tourism and the preservation of local cultural traditions.

The *Khanduri Laot* tradition is a cultural practice of coastal communities. *Khanduri Laot* represents a ritual through which coastal community express gratitude to Allah SWT. This communal feast serves as a form of thanksgiving by fishermen for the marine harvests they have obtained over time. In addition, it functions as a forum for social bonding aimed at fostering shared awareness of the importance of preserving marine life so that ecosystems and habitats remain protected (Figure 5). *Khanduri Laot* is typically held once a year at a time agreed upon by the *Panglima Laot*, traditional leaders who regulate customary maritime law in Aceh. On the day of the ceremony, community members gather along the coastline or at river estuaries, bringing various dishes, marine products, and a goat or cow to be sacrificed. The ritual begins with a collective prayer led by a religious figure, seeking safety for fishermen and blessings for future catches. Following the ritual, the community shares a communal feast along the seashore. For tourists, *Khanduri Laot* in Bireuen Regency offers an authentic cultural experience rich in ecological meaning. This tradition not only enriches Aceh's cultural heritage but also conveys important values related to environmental conservation, social solidarity, and the spiritual life of coastal communities.



Figure 5. Community Gathering During the *Meugang* Celebration Reflecting the Values of Gratitude, Togetherness, and Social Solidarity (Source: Data Analysis, 2025)



Figure 6. Preparation of Traditional Communal Meals During the *Khanduri Laot* Celebration Reflecting Gratitude, Social Solidarity, and the Preservation of Coastal Cultural Heritage (Source: Data Analysis, 2025)

In addition, the *Khanduri Blang* tradition refers to a communal meal accompanied by collective prayers held prior to the commencement of rice field plowing activities. *Khanduri Blang* is performed before farmers begin cultivating their rice fields. The ceremony is led by a *keujruen blang*, an individual or elder appointed as the leader among farmers. The *keujruen blang* is responsible for regulating all activities conducted in the rice field area, including the organization of customary rituals. During *Khanduri Blang*, a sheep or buffalo is typically sacrificed. The ritual begins with *samadiah* or collective prayers, followed by *peusijuek* rituals for the rice seeds to be planted and for the *lueng ie* (water gate). Agricultural tools used for plowing are also required to undergo the *peusijuek* ritual. The ceremony then continues with a communal meal involving all members of the community (Figure 6). Following the implementation of *Khanduri Blang*, *samadiah* or collective prayers are held in the evening for a period ranging from three to seven nights. On the seventh day after *Khanduri Blang* is conducted, farmers may begin cultivating the rice fields. When the rice plants start to turn green a stage locally referred to by the Bireuen community as *padèe ka dara* another ritual known as *Khanduri Ie Bu* is performed. *Khanduri Ie Bu* symbolizes a process of overseeing the rice crops as they enter the pre-harvest stage (Figure 7).



Figure 7. Community Gathering During the *Khanduri Blang* Tradition Symbolizing Gratitude, Communal Prayer, and Social Solidarity before the Rice Planting Season (Source: Data Analysis, 2025)

Something to Do in Bireuen Regency

Local Knowledge - Intangible cultural heritage refers to the various practices, representations and knowledge systems that are passed down from generation to generation and maintained in the lives of people, thus contributing to the formation of cultural identity and sustainability (Zhang, 2026). In social life, the people of Bireuen Regency highly uphold the values of mutual cooperation (*gotong royong*) and deliberation. The tradition of *peumulia jamee* (honoring guests) forms an integral part of community identity. This value is reflected in various customary activities such as *khanduri*, *meugang*, and *khanduri laot*, in which all community members actively participate regardless of social status. Local knowledge is also evident in the traditional Acehnese house architecture commonly found in rural areas. These stilt houses are constructed using natural materials such as wood and are designed to be resilient to earthquakes and floods while ensuring adequate tropical air circulation. The underlying philosophy emphasizes a balance between comfort, safety, and aesthetic harmony.

In the field of traditional medicine, the people of Bireuen Regency utilize herbal remedies derived from plants such as betel leaves, turmeric, and tree roots to treat minor illnesses. This practice reflects a deep understanding of the surrounding natural environment and its prudent use. In addition, local communities possess knowledge related to seasonal patterns known as *keunong* or *keuneunong*. *Keunong* refers to seasonal conditions determined by the alignment of the Kala star and the moon in the sky. Furthermore, the community maintains extensive knowledge of various fish species, including *Sure*, *Kareueng*, *Geurape*, *Yee*, *Bawai Itam*, *Bawai Puteh*, *Paroe*, *Sisek*, *Bileh*, *Blaneuk*, *Turok*, *Jeunara*, *Lameukan*, *Udeueng Tima*, *Udang Wat*, *Noh*, *Bieng*, *Bieng Laot*, *Kreueng*, and *Tirom.*

Local Social Processes - The community of Bireuen Regency maintains a social system deeply rooted in the value of *ukhuwah* (brotherhood). Centers of social interaction are typically located in the *meunasah*, a multifunctional building that serves as a place of worship, deliberation, religious study, and social activities. The *meunasah* functions as a symbol of social unity, where community members engage in discussion, collectively resolve issues, and strengthen interpersonal relationships. Bireuen society is characterized by a distinctive social organizational system known as the *gampong* structure. The *gampong* is led by a *keuchik* and supported by *tuha peut* (the customary deliberative council) and the *imam meunasah*. This structure reflects a combination of formal governance systems and Acehnese customary values.

In everyday life, social organization in Bireuen Regency also includes informal groups such as fishermen associations, farmer groups, religious study groups, and youth organizations. These groups serve as platforms for interaction, cooperation, and the maintenance of social harmony. The social system of Acehnese society is inseparable from the values of Islamic law (*syariat Islam*), which function as moral and legal guidelines in community life. Principles such as deliberation and consensus (*musyawarah mufakat*), justice, and mutual cooperation are applied in social decision-making processes. In Bireuen society, social conflicts are generally resolved through customary mechanisms and deliberation. Customary institutions such as the *tuha peut* and *keuchik* play an important role as mediators. Conflict resolution is conducted through a familial approach that prioritizes peace and the preservation of harmonious relationships among community members, in accordance with the principle of *peusijuek* (a ritual symbolizing reconciliation and blessing).

Something to Buy in Bireuen Regency

Local Skills -Local skills and traditional products constitute important tourism resources in Bireuen Regency. Handicrafts hold a special appeal for tourists because they are often purchased as souvenirs with symbolic value, serving as lasting reminders of their travel experiences. In addition to preserving local cultural heritage, handicraft production creates employment opportunities for local artisans and contributes to community income (Ahmad et al., 2026) (Figure 8).

The people of Bireuen Regency produce a variety of traditional handicrafts made from coconut leaves, coconut fiber, and *purun*, including *bleut* (woven mats used for seating or drying agricultural products). The region is also well known for its distinctive local products, such as *pliek U* (fermented coconut paste), *boh giri Matang* (Matang citrus), banana chips, and *Sate Matang*, a traditional Acehnese-style satay that has become one of Bireuen's culinary icons. These handicrafts and

local products not only preserve Acehnese cultural identity but also provide economic benefits for local communities while enhancing the attractiveness of Bireuen Regency as a destination for cultural and gastronomic tourism (Figure 9).



Figure 8. Community Members Producing Traditional Handicrafts from Coconut Fiber and Other Local. These Handicrafts Reflect Local Creativity, Preserve Cultural Heritage, and Contribute to Sustainable Livelihoods and Community-Based Tourism (Source: Data Analysis, 2025)



Figure 9. *Pliek U*, a traditional fermented coconut product representing local culinary heritage and a value-added product that supports community-based tourism and the local economy (Source: Data Analysis, 2025)

Overall, the local handicrafts, traditional culinary products, and agricultural specialties of Bireuen Regency represent valuable cultural assets that strengthen community-based tourism. Handicrafts made from coconut fiber and natural materials, together with distinctive local products such as *pliek U*, *boh giri Matang*, and *Sate Matang*, not only preserve Acehnese cultural heritage but also create sustainable livelihood opportunities for local communities. By promoting these authentic local products, Bireuen Regency can enhance its appeal as a cultural and gastronomic tourism destination while supporting local economic development and the long-term sustainability of its cultural traditions (Figure 10 and 11).



Figure 10. *Sate Matang*, a traditional culinary specialty of Bireuen Regency, Aceh, representing the region's gastronomic heritage and a popular attraction for domestic and international visitors (Source: Data Analysis, 2025)



Figure 11. *Boh Giri Matang* (*Matang* citrus), a distinctive local agricultural product sold by local vendors contributing to community livelihoods and the region's tourism appeal (Source: Data Analysis, 2025)

Strategy for Developing Local Wisdom Based Tourism Products in Aceh

The development of tourism products based on local wisdom has strong potential as a tourism attraction, as it embodies cultural values and unique characteristics inherent in Acehnese society. The importance of developing Aceh's local wisdom–based tourism products lie in ensuring that tourism in Aceh remains sustainable through the continued existence of tourism products rooted in local wisdom. Based on the Cartesian diagram mapping constructed using weighted scores for each factor, the results of the SWOT analysis indicate that the selected strategy is the SO strategy, or an aggressive strategy. Accordingly, the following section presents the formulation of strategies for developing local wisdom–based tourism products in Aceh. Based on the Table 1, the total internal analysis score is 2.92 (1.77 + 1.15), indicating that strengths outweigh weaknesses to a considerable extent.

Table 1. Internal Factors Analysis (IFAS): Strengths and Weakness (Source: Researcher, 2025)

No.	Internal Factors	Weight	Rating	Score
Strengths				
1	Strong Acehnese local wisdom (customs, language, culture, Islamic values)	0.08	4.0	0.31
2	Diverse and attractive natural tourism resources (beaches, mountains, natural bathing sites, tourism villages)	0.08	4.0	0.31
3	Local wisdom–based products with potential to enrich national cultural heritage	0.08	3.5	0.27
4	Openness of local communities toward visitors	0.08	3.5	0.27
5	Tourism products containing local cultural values (culinary products, handicrafts, traditions)	0.08	4.0	0.31
6	Strong Acehnese cultural identity suitable for tourism branding	0.08	4.0	0.31
Subtotal Strengths		**0.46**		**1.77**
Weaknesses				
1	Low level of community awareness regarding the preservation of local wisdom	0.08	2.5	0.19
2	Limited human resources related to local wisdom–based tourism information	0.08	2.0	0.15
3	Bireuen Regency has not yet become a national or international tourism activity center	0.08	2.5	0.19
4	Limited data and information on Acehnese local wisdom	0.08	2.0	0.15
5	Lack of detailed planning for local wisdom–based tourism development	0.08	2.0	0.15
6	Inadequate tourism facilities	0.08	2.0	0.15
7	Limited accessibility to rural tourism destinations	0.08	2.0	0.15
Subtotal Weaknesses		**0.54**		**1.15**
Total Internal Factors		**1.00**		**2.92**

Table 1 presents the Internal Factor Analysis Summary (IFAS), matrix, which identifies the strengths and weaknesses influencing the development of local wisdom-based tourism in Bireuen Regency. The analysis produced a total internal factor score of 2.92, indicating that the internal condition of tourism development is moderately strong and provides a favorable basis for future development. The main strengths include the strong Acehnese local wisdom reflected in customs, language, culture, and Islamic values; the diversity of natural tourism resources; tourism products containing local cultural values; and a strong cultural identity that can be utilized as a destination branding strategy.

In addition, the openness of local communities toward visitors and the availability of local wisdom-based products further increase the attractiveness of tourism destinations. However, several internal weaknesses remain, including limited community awareness of preserving local wisdom, inadequate human resources with expertise in local wisdom-based tourism, insufficient tourism facilities and accessibility, limited documentation of Acehnese local wisdom, and the absence of comprehensive planning for tourism development. These findings indicate that while Bireuen Regency possesses considerable cultural and natural assets, strengthening institutional capacity, infrastructure, and human resources is essential to maximize the potential of sustainable tourism development.

Table 2. External Factors Analysis (EFAS): Opportunities and Threats (Source: Researcher, 2025)

No.	External Factors	Weight	Rating	Score
Opportunities				
1	Global tourism trends favoring authenticity and local culture	0.11	4.0	0.44
2	Growth of halal tourism at national and international levels	0.11	3.5	0.39
3	Advances in digital technology and platforms	0.11	4.0	0.44
4	Opportunities to develop various special-interest tourism packages	0.11	4.0	0.44
5	Potential collaboration with travel agencies, influencers, and arts and cultural communities	0.11	3.5	0.39
Subtotal Opportunities		**0.56**		**2.11**
Threats				
1	Competition with local wisdom–based tourism products from other regions	0.11	2.5	0.28
2	Decline of local wisdom–based tourism products due to environmental degradation	0.11	2.5	0.28
3	Loss of local cultural identity due to foreign cultural influences through tourism	0.11	2.5	0.28
4	Insufficient regulation or supervision of mass tourism that may damage natural and cultural resources	0.11	2.0	0.22
Subtotal Threats		**0.44**		**1.06**
Total External Factors		**1.00**		**3.17**

Table 2 presents the External Factor Analysis Summary (EFAS), which identifies the external opportunities and threats influencing the development of local wisdom-based tourism in Bireuen Regency. The analysis produced a total external factor score of 3.17**,** indicating that the external environment provides substantial opportunities for tourism development despite the existence of several challenges. The most significant opportunities include the growing global demand for authentic cultural experiences, the rapid expansion of halal tourism at both national and international levels, advances in digital technology and online tourism platforms, opportunities to develop special-interest tourism packages, and the potential for collaboration with travel agencies, social media influencers, and cultural communities. These opportunities create favorable conditions for promoting Bireuen Regency as a destination that emphasizes Acehnese local wisdom and cultural heritage. However, several external threats must also be considered, including increasing competition from other regions offering similar local wisdom-based tourism products, environmental degradation that may reduce the quality of tourism resources, the erosion of local cultural identity due to globalization and foreign cultural influences, and inadequate regulations or supervision of mass tourism that may negatively affect natural and cultural assets. Overall, the relatively high EFAS score suggests that Bireuen Regency is well positioned to capitalize on external opportunities while implementing appropriate strategies to mitigate potential threats and achieve sustainable tourism development.

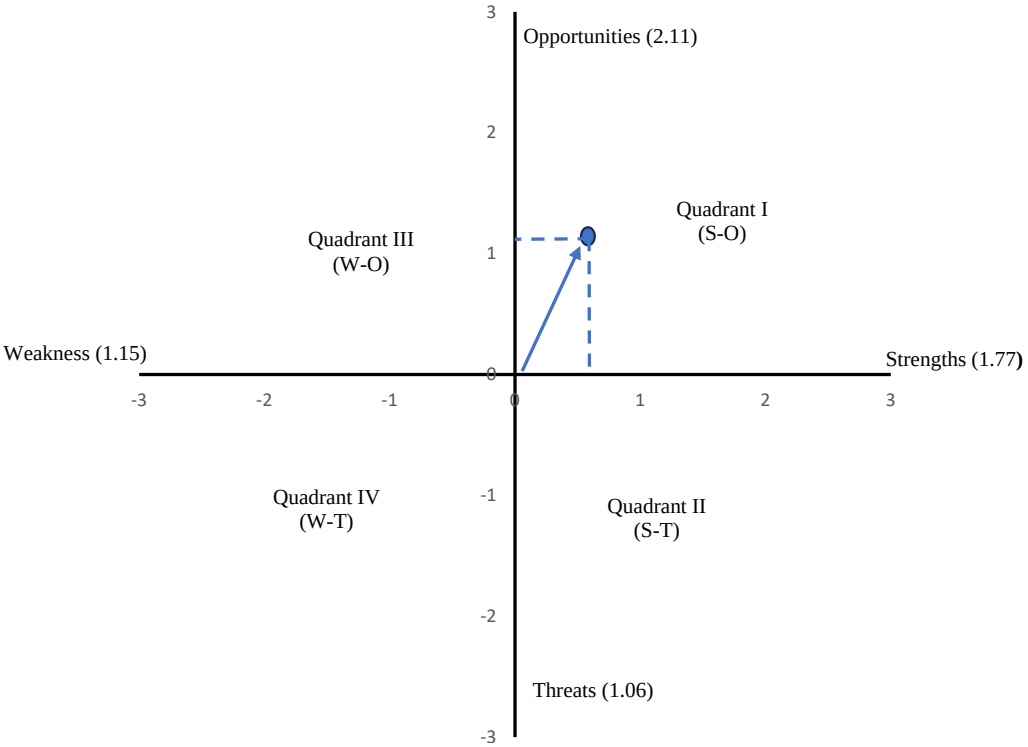


Figure 12. Cartesian Diagram of SWOT Strategic Positioning (Source: Data Analysis, 2025)

Figure 12 illustrates the strategic position of local wisdom-based tourism development in Bireuen Regency based on the SWOT analysis. The Internal Factor Evaluation (IFE) produced a total score of 2.92**,** consisting of strengths **(**1.77) and weaknesses **(**1.15**),** while the External Factor Evaluation (EFE) yielded a total score of 3.17**,** consisting of opportunities **(**2.11**)** and threats **(**1.06**).** Based on these results, the SWOT coordinates are calculated as X = 0.62 (Strengths − Weaknesses) and Y = 1.05 (Opportunities − Threats), placing the strategic position in Quadrant I (Strengths–Opportunities)**.** This quadrant indicates that Bireuen Regency possesses strong internal resources and favorable external opportunities to support tourism development. Therefore, an aggressive growth strategy is recommended by maximizing the region's cultural heritage, Acehnese local wisdom, natural tourism attractions, and community participation to strengthen destination competitiveness. Strategic priorities include diversifying local wisdom-based tourism products, enhancing destination branding, improving tourism infrastructure and accessibility, strengthening the capacity of local communities and tourism stakeholders, and fostering collaborative governance to ensure sustainable tourism development.

Rangkuti (2016) explains that strategy fundamentally serves as a set of tools used to achieve organizational objectives. He categorizes strategy into three main types: managerial strategy, investment strategy, and business strategy.

Managerial strategy is typically formulated by decision-makers at the macro level and encompasses aspects such as product development, pricing decisions, market expansion, and financial management. Meanwhile, investment strategy focuses on capital investment initiatives aimed at promoting more aggressive growth.

Business strategy, or functional strategy, involves operational activities such as distribution, marketing, strengthening organizational structures, and improving production processes. Based on the analysis of internal and external conditions, these various types of strategies can be employed as a foundation for formulating the strategic direction of local wisdom–based tourism product development in Bireuen Regency, Aceh, as presented in Table 3.

Table 3. SWOT Matrix for the Development Strategy of Local Wisdom–Based Tourism Products in Bireuen Regency, Aceh (Source: Data Analysis, 2025)

No.	SO Strategy (Strength–Opportunity)	ST Strategy (Strength–Threat)	WO Strategy (Weakness–Opportunity)	WT Strategy (Weakness–Threat)
1	Developing integrated tourism packages (nature, culture, and culinary tourism) based on Acehnese local wisdom	Strengthening regulations and service quality standards for local wisdom–based tourism to address competition from other regions	Improving tourism infrastructure (access, public facilities, cultural information signage) through government support and investment	Establishing destination management standards to prevent unpreparedness in facing sudden increases in tourist arrivals
2	Positioning Acehnese local wisdom as the core destination branding of Bireuen tourism	Preserving local culture through regular festivals to prevent cultural erosion due to globalization	Providing professional training for tourism actors who lack knowledge of modern tourism management	Providing assistance to cultural MSMEs to enhance their competitiveness against external products
3	Strengthening the local creative economy through cultural products such as traditional cuisine, handi-crafts, and performing arts	Establishing local wisdom–based tourism attractions as competitive advantages that are difficult for other regions to replicate	Developing Aceh cultural information centers to address limited information on local wisdom for tourists	Reorganizing poorly managed destinations to prevent environmental degradation or damage caused by tourism exploitation
4	Collaborating with travel agencies, influencers, and national and international tourism platforms to expand promotion	Developing environmentally friendly tourism management systems to mitigate the risk of environmental degradation due to increased tourist activity	Designing training curricula for local tour guides focusing on history, culture, and foreign language skills	Enhancing community literacy regarding the importance of cultural preservation amid modernization
5	Enhancing community capacity in cultural tourism services and homestay management	Strengthening Acehnese cultural identity as a distinctive hallmark to remain relevant amid global tourism trends	Expanding marketing efforts through digital platforms to compensate for previously suboptimal promotion	Formulating clear regulations for the protection of local culture and destination ecosystems
6	Developing integrated tourism zones that highlight local cultural values	—	Establishing academic collaborations with universities for research and development of local culture as a tourism attraction	—
7	Optimizing digital promotion (websites and social media) to showcase local wisdom–based attractions	—	—	—

DISCUSSION

The development of local wisdom–based tourism products in Bireuen Regency, Aceh, as demonstrated by the findings of this study, reflects a sustainable tourism approach that places culture, nature, and local communities at the core of destination development. The results indicate that Bireuen's tourism potential is derived not only from its rich natural resources but also from the continuity of socio-cultural practices that remain active and functional in the everyday lives of local communities. These living cultural practices contribute to the authenticity and distinctiveness of the destination. This finding aligns with the global paradigm of sustainable tourism, which emphasizes that the future competitiveness of tourism destinations is largely determined by their capacity to preserve cultural authenticity while simultaneously empowering local communities (World Tourism Organization, 2016). In this context, the integration of local wisdom into tourism product development in Bireuen represents not merely a cultural asset but a strategic foundation for sustainable destination development.

Something to See: Tourism Attractions as Representations of Local Identity

From the *something to see* perspective, the findings of this study indicate that Bireuen Regency possesses a complex and layered tourism landscape comprising natural, cultural, and man-made attractions. The presence of coastal areas, rivers, waterfalls, wetlands (*paya*), and hilly landscapes reflects the richness of ecosystems that remain relatively well preserved. In contemporary tourism literature, such natural attractions are commonly conceptualized as nature-based tourism, which holds high value due to its capacity to offer visual appeal, tranquility, and emotional connections with nature (Buckley, 2020). Modern tourists increasingly avoid mass tourism destinations and tend to seek spaces that provide calmness, authenticity, and ecological sustainability. Beyond natural attractions, the findings further demonstrate that cultural tourism attractions in Bireuen Regency possess strong historical and symbolic significance. The existence of the graves of religious scholars and traditional leaders, historical struggle sites, traditional Acehnese houses, and museums indicates that tourism spaces in Bireuen function as sites of collective memory. Cultural tourism rooted in local history can strengthen place identity and foster emotional bonds between tourists and destinations. Accordingly, cultural tourism attractions in Bireuen serve not merely as objects to be observed but as narrative media through which Acehnese history and identity are articulated and sustained.

Local traditions such as *Meugang*, *Khanduri Laot*, and *Khanduri Blang* enrich the *something to see* dimension through their embodiment of intangible cultural heritage. These traditions illustrate how spiritual values, social solidarity, and human nature relationships are harmoniously integrated within everyday cultural practices. Qiu et al. (2022) emphasize that

tourists are increasingly attracted to destinations that offer experiences of living culture rather than artificially staged cultural performances. In this regard, Acehnese traditions practiced in Bireuen demonstrate substantial potential as authentic and sustainable cultural tourism attractions. Culture has evolved into one of the core products in the international tourism market, with tourists participating in cultural activities accounting for approximately 40% of total international arrivals in 2016 (World Tourism Organization, 2016). Consequently, many destinations leverage their cultural assets to adapt and enrich tourism offerings in response to growing visitor interest in cultural attractions. Furthermore, local potential and local wisdom can be utilized in the development of geotourism as part of the tourism sector, contributing to economic growth, strengthening regional image, and enhancing the welfare of local communities (Hasmira et al., 2023).

The development of cultural tourism functions not only as a medium for showcasing local cultural richness but also as a crucial mechanism for safeguarding its continuity. By presenting traditions, arts, culinary practices, and local knowledge to visitors, communities are encouraged to continuously practice and preserve their ancestral heritage, thereby fostering cultural pride and strengthening awareness of the importance of preservation. At the same time, cultural tourism development must be grounded in principles of mutual respect and appreciation of diversity, ensuring that interactions between tourists and local communities enrich cultural experiences, cultivate harmonious relationships, promote tolerance, and reinforce diversity as a shared asset. The success and sustainability of culture-based tourism are largely determined by the involvement and collaboration of multiple stakeholders. These include government actors responsible for policy formulation, infrastructure provision, and destination promotion; tourism businesses that deliver supporting services; local communities as the primary custodians of cultural heritage and beneficiaries of economic gains; academics and non-governmental organizations that contribute through research, capacity building, and sustainable policy development; and tourists as consumers who drive demand for cultural products. Such stakeholder synergy not only enhances economic outcomes but also ensures the protection of cultural heritage for future generations. Accordingly, strengthening customary institutions, improving collaboration, developing tourism attractions, upgrading the physical condition of traditional elements, and establishing community-based groups become essential components of sustainable cultural tourism development (Fattah et al., 2025). Furthermore, cultural tourism development is closely interconnected with the reconfiguration of public spaces, with each reinforcing the other. Development processes within a particular area should therefore contribute meaningfully to the overall quality of surrounding spaces. Tourism activities, events, or programs as cultural products can only function optimally when supported by conducive environmental and contextual conditions. In this regard, the atmosphere and character of space constitute integral elements of attraction that play a decisive role in the success of cultural tourism initiatives (Hornyák et al., 2025).

Something to Do: Tourism Experiences and Social Participation

The *something to do* dimension in this study demonstrates that Bireuen Regency offers a rich array of tourism experiences grounded in local knowledge and community social processes. Values such as mutual cooperation (*gotong royong*), *peumulia jamee* (honoring guests), deliberation (*musyawarah*), and the role of the *meunasah* as a center of social activity reflect an inclusive and participatory social system. In the tourism context, these elements closely align with the concept of experiential tourism, in which visitors are not merely passive observers but actively engage in the social and cultural activities of local communities (Pine & Gilmore, 2020). Local knowledge practices including seasonal calendrical systems (*keunong*), knowledge of fish species, traditional medicine, and Acehnese vernacular architecture indicate the presence of valuable local ecological knowledge. Tourism based on such local knowledge has the potential to generate meaningful learning experiences for visitors while simultaneously encouraging the preservation of traditional knowledge that is increasingly at risk of decline. Accordingly, tourism activities in Bireuen can be developed in the form of educational tourism, cultural tourism, and special-interest tourism that positions local communities as the primary holders and transmitters of knowledge.

Local social processes rooted in the *gampong* structure, along with the roles of the *keuchik*, *tuha peut*, and *imam meunasah*, indicate that communities in Bireuen Regency possess strong institutional capacity. This finding supports the concept of community-based tourism (CBT), in which the success of tourism development is largely determined by the level of local community participation and control (Goodwin & Santilli, 2021). The use of customary mechanisms and deliberation (*musyawarah*) for conflict resolution further demonstrates the presence of strong social capital, which is essential for maintaining tourism sustainability and preventing social conflicts arising from tourism activities. Moreover, community-based tourism emphasizes the involvement of local communities in tourism planning and management, including resource conservation, economic development, and project ownership. This approach encompasses three main dimensions: community involvement through ownership, power and control over tourism management, and outcomes that support community self-reliance and sustainability (Mayaka et al., 2019). The effectiveness of this model ultimately depends on the capacity of local communities to acquire and apply the skills required for tourism business operations (Khunnikom et al., 2022).

Something to Buy: Local Products and Culture-Based Creative Economy

Within the framework of sustainable tourism, the development of cultural heritage can be classified into three main components: cultural heritage itself, cultural artifacts, and efforts to protect cultural assets (Ginting et al., 2024). The attractiveness of a tourism destination is shaped by the integration of multiple interrelated factors and conditions that collectively sustain visitor interest and enhance the competitiveness of a particular destination or location (Kadyrbekova et al., 2024). From the something to buy perspective, the findings of this study demonstrate that the local skills of communities in Bireuen Regency possess substantial potential to support the development of a tourism-based creative

economy. Handicrafts such as weaving, coconut-based products including *pliek* and coconut oil, traditional culinary products, as well as local fisheries and agricultural products reflect a close interconnection between culture and economic activities. These products embody cultural meanings while simultaneously serving as sources of livelihood for local communities. The level of cultural development within a society is closely associated with the increasing diversity of food types, the complexity of processing techniques, and the precision of presentation methods (Harsana et al., 2019). Culinary activities can therefore be regarded as an important indicator of a community's cultural advancement (Rijal et al., 2020). Traditional local gastronomy has a very important role in understanding and preserving intangible cultural heritage (Phrammanachot et al., 2026). In this context, Acehnese ethnic cuisine refers to a variety of traditional foods prepared using distinctive techniques and ingredients that represent the cultural identity of the Acehnese people. Consequently, local culinary and craft products in Bireuen not only function as commodities for tourist consumption but also act as cultural expressions that reinforce local identity within the tourism experience.

To date, Acehnese communities continue to maintain the consumption of a wide range of traditional dishes, including *pliek*, *pulut ijo*, *thimpan*, *sate Matang*, *kuah beulangong*, and *mie Aceh*. Within the socio-cultural context, Acehnese ethnic culinary traditions are commonly practiced during customary events as a form of honoring guests through practices known as *khanduri*, namely communal dining activities aimed at strengthening togetherness, unity, and social harmony. The advancement of cultural tourism plays a crucial role in increasing awareness of a region's existence while simultaneously supporting the preservation of its cultural heritage.

Culture also functions as a tourism attraction that can enhance income generation and create employment opportunities for local communities (Patabang et al., 2023). Culinary tourism, or gastronomy tourism, has emerged as one of the most dynamic sectors within the global tourism industry (Rivza et al., 2025). This form of tourism encompasses visits to food producers or restaurants, participation in culinary festivals, and the experience of tasting or enjoying local food, which often serves as a primary motivation for tourists (Hall & Sharples, 2003).

More broadly, gastronomic tourism can be understood as any tourism experience that enables individuals to learn about, appreciate, or consume distinctive local cuisine (Smith & Honggen, 2008). Gastronomic tourism places particular emphasis on food and tourists' dining experiences (Marine-Roig et al., 2019) and highlights the close relationship between cuisine and local culture, a linkage that has been widely examined in tourism studies (Ghanem, 2019; Fusté-Forné, 2022). Traditional gastronomy plays an important role in sustaining cultural traditions and values, while the relationship between food and tourism destinations has become a central issue in contemporary culinary tourism research (Raji et al., 2020). Cultural heritage in the field of gastronomy can serve as a significant driver of regional tourism when managed effectively through an experience-based economic approach.

One of the main advantages of gastronomic tourism lies in its capacity to deliver multisensory experiences that extend beyond taste and aroma to include sound and the unique atmosphere of tourism locations, thereby deepening tourists' engagement with local cultural heritage (Rivza et al., 2022).

Development Strategy: SWOT Analysis and Its Implications

The results of the SWOT analysis indicate that the development of local wisdom–based tourism products in Bireuen Regency, Aceh, is positioned in Quadrant I, reflecting relatively strong internal and external conditions. The SO strategy, or aggressive strategy, is therefore considered an appropriate choice, as it enables the optimization of internal strengths to capitalize on external opportunities, including the growing demand for authentic tourism experiences, the expansion of halal tourism, and advances in digital technology. This finding is consistent with Ruhanen et al. (2022), who argue that culture-based destinations need to adopt proactive strategies to maintain competitiveness amid the dynamic global tourism landscape. Nevertheless, several weaknesses such as limited human resources, low awareness of cultural preservation, inadequate facilities, and accessibility constraints suggest that tourism development in Bireuen requires a well-planned and sustainable approach. Scheyvens et al. (2021) emphasize that without community capacity building and careful planning, local wisdom–based tourism risks cultural commodification and the erosion of local values. In this regard, the advancement of cultural tourism is essential not only to increase awareness of a region's presence but also to safeguard its cultural heritage. Moreover, culture can function as a tourism attraction that contributes to income generation and job creation for local communities (Patabang et al., 2023).

Based on the SWOT matrix, the development strategy for local wisdom–based tourism in Bireuen Regency, Aceh, emphasizes the importance of leveraging regional strengths and opportunities to create sustainable tourism competitiveness while simultaneously minimizing existing weaknesses and threats. The integration of natural, cultural, and culinary tourism potentials into integrated tourism packages, along with the reinforcement of local wisdom as a core identity and destination branding, emerges as a key strategy for attracting tourist interest. The development of the local creative economy, enhancement of community capacity, and optimization of digital promotion and multi-stakeholder collaboration further strengthen Bireuen's tourism position at both regional and national levels. At the same time, defensive strategies are directed toward strengthening regulatory frameworks, improving service quality standards, promoting environmentally friendly destination management, and safeguarding cultural heritage and ecosystems to address competition and the adverse effects of globalization and modernization. Efforts to improve infrastructure, enhance human resource capacity through training, provide support for cultural MSMEs, and develop cultural information and research centers are also critical in addressing internal limitations. Overall, the success of these strategies is highly dependent on synergy among government institutions, local communities, tourism businesses, academics, and other stakeholders to ensure that local wisdom–based

tourism development not only contributes to regional economic growth but also sustains Acehnese cultural heritage in the long term. Accordingly, the economic, social, and environmental impacts of tourism influence community quality of life, which in turn shapes public perceptions and levels of support for tourism development (Halim, 2022).

CONCLUSION

Based on the findings of this study, it can be concluded that the development of local wisdom–based tourism products in Bireuen Regency, Aceh, demonstrates strong potential to be directed toward a sustainable tourism model. This potential is derived not only from relatively well-preserved natural resources such as coastal areas, rivers, wetlands, and hilly landscapes but also from the continuity of social and cultural values that remain embedded in the everyday lives of local communities. Tourism attractions in Bireuen represent an authentic local identity through natural tourism, historical sites, customary traditions, and cultural practices that function as spaces of collective memory and expressions of living culture. Local traditions, the presence of traditional houses, the graves of religious figures, and various customary rituals further reinforce Bireuen's position as a destination that offers not only visual appeal but also rich historical narratives and profound cultural meanings.

Beyond visible attractions, tourism development in Bireuen is also supported by a wealth of activities and experiences rooted in community social participation. Values such as mutual cooperation, hospitality toward guests, the role of customary institutions, and local knowledge related to nature, seasonal cycles, fisheries, traditional medicine, and architecture demonstrate the capacity of local communities to act as primary agents of tourism development.

These conditions create opportunities for the development of educational tourism, cultural tourism, and community-based tourism that position local communities as subjects rather than mere objects of development.

At the same time, local products including handicrafts, traditional cuisine, and agricultural and fisheries outputs—reflect the close interrelationship between culture and economic activity, thereby offering significant potential to strengthen the local creative economy and enhance community welfare through tourism.

The strategic analysis further indicates that the internal and external conditions of Bireuen Regency are relatively supportive of the development of local wisdom–based tourism, thereby necessitating an aggressive and proactive development strategy. Nevertheless, challenges related to limited human resources, inadequate facilities, accessibility constraints, and low awareness of cultural preservation must be addressed through integrated and sustainable planning. Overall, this study confirms that the integration of tourism attractions, tourism experiences, and local products provides a strong foundation for Bireuen's tourism development as a competitive and inclusive destination capable of safeguarding Acehnese local wisdom amid the dynamics of modern tourism.

In summary, the findings reaffirm that the development of local wisdom–based tourism products in Bireuen Regency, Aceh, is underpinned by a robust foundation for sustainable destination development. The integration of something to see, something to do, and something to buy demonstrates that tourism in Bireuen extends beyond visual consumption to encompass experiential engagement, learning processes, and community empowerment. These findings contribute to the tourism literature by providing empirical evidence that Acehnese local wisdom can serve as an effective strategy for building destinations that are competitive, inclusive, and sustainable.

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A DYNAMIC CAUSAL MODELLING FRAMEWORK FOR PRIORITISING GREENHOUSE GAS EMISSION REDUCTION STRATEGIES IN AGRO-TOURISM LAND USE AND SUSTAINABLE TERRITORIAL DEVELOPMENT IN THAILAND

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Abstract: This research aims to examine the priority order of the influence of causal factors affecting the formulation of future greenhouse gas emission management strategies arising from land use for agritourism in Thailand. The study develops an advanced model called the Path Analysis based on Probit Government Model (PA-Probit-G model), which is an enhanced model derived from previous models by incorporating their key strengths to serve as an important tool for formulating national management strategies toward sustainability, given that agritourism is one of Thailand's leading sources of income. The research findings reveal new insights that enable the prioritization of causal factors in determining strategies to reduce greenhouse gas emissions from land use for agritourism in Thailand. The socio-cultural sector is identified as the most influential factor, with indicators used as new scenario policies including the urban culture rate and stakeholder acceptance rate, alongside the government sector, which must urgently and concretely promote renewable energy development in the future. These indicators are considered critically important for reducing greenhouse gas emissions resulting from the promotion and expansion of agritourism as a main source of income for Thailand and for achieving the green economy target by 2050. Furthermore, the results demonstrate that the new scenario policies proposed in this study can continuously drive greenhouse gas emissions to levels below the carrying capacity, thereby contributing to the long-term success of Thailand's national management plan.

Keywords: agrotourism, socio-cultural sector, BCG economy, urban culture, sustainability, stakeholder acceptance

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INTRODUCTION

Thailand, together with 193 United Nations member states, has endorsed the 2030 Agenda for Sustainable Development, which serves as a global framework for achieving sustainable social, economic, and environmental development while leaving no one behind (The World Bank: Energy Use (Kg of Oil Equivalent Per Capita) Home Page, 2026; Office of the National Economic and Social Development Council (NESDB, 2026). According to recent Sustainable Development Reports, Thailand ranks 43rd out of 166 countries assessed worldwide (National Statistical Office Ministry of Information and Communication Technology, 2026). Thailand has pursued sustainable development continuously from the past to the present (1992–2025), with a strong commitment to enhancing efficiency across all dimensions of development (NESDB, 2026; Hasanein & Ayad, 2025). In particular, economic development has demonstrated clear and consistent growth, as Thailand's economic system has expanded steadily over time (Ahmed et al., 2025; Muna et al., 2025).

Although certain years have presented significant obstacles to economic progress, the government has remained steadfast in promoting economic growth while continuously seeking new export markets, resulting in substantial inflows of capital into the country (Salama et al., 2025; ONEP, 2026). In addition, Thailand has persistently promoted tourism in various forms for both domestic and international visitors. This is reflected in the highly developed tourism management system, which has positioned tourism as one of the leading sources of national revenue through increased employment across regions (Office of Natural Resources and Environmental Policy and Planning (DEDE), 2026). Notably, ecotourism has emerged as the most popular form of tourism and has been designated by the government as a key national policy priority (Thailand Greenhouse Gas Management Organization (Public Organization), 2026). In addition, investment in

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various industries, particularly policies that encourage foreign direct investment, has been a core and continuous strategy in Thailand's national administration (OECD, 2026; Junsiri et al., 2024). From a social perspective, Thailand has experienced substantial development in the socio-cultural sector, leading to profound transformations of traditional Thai societies across regions. Urbanization has gradually expanded, resulting in the erosion of long-standing social and cultural practices to the extent that, by 2025, very little of the traditional way of life remains visible (Sutthichaimethee et al., 2025).

Across the country, the general population has gained greater access to higher levels of education, improved living standards, and comprehensive healthcare, while unemployment rates remain relatively low (Energy Policy and Planning Office, 2026). Although agriculture continues to be a primary occupation in Thailand, significant changes have occurred in agricultural livelihoods, cultural practices, and operational methods (Ministry of Natural Resources and Environment, 2026; Winyuchakrit et al., 2021). Land use for agriculture has been transformed dramatically from the past to the present, leaving almost no trace of its original patterns (Xiao et al., 2025). In response, the government has sought to implement a wide range of important measures, particularly those promoting sustainable agricultural land use and climate-smart agricultural practices**.** These measures emphasize the adoption of clean technologies and efficient resource management to support environmental sustainability**.** Such changes have also influenced agricultural practices and local livelihoods as communities throughout Thailand continue to undergo social and economic transformation (Sutthichaimethee et al., 2025).

However, regardless of the extent to which Thai society has transformed into an urbanized society, it is essential to preserve cultural values and traditional ways of life as much as possible (Sutthichaimethee et al., 2025). The rapid changes experienced in the past have not been particularly beneficial to the livelihoods and occupations of Thai farmers; instead, they have led to increasingly negative impacts (Waiyasusri et al., 2024). People have developed more self-centered values and cultural attitudes, especially with regard to environmental conservation, which is often neglected because it is perceived as not being personal property. Individuals compete for opportunities and continue to consume and exploit resources without restraint, causing significant harm to ecosystems (ONEP, 2026). This is evident in the continuous rise in wastewater pollution in communities, the sharp increase in household solid waste, and the substantial growth in plastic bag consumption, among other issues. Although the government has actively promoted environmental campaigns, these efforts have not succeeded in fostering a culture of social responsibility or a sense of collective stewardship within communities, as originally intended under sustainable development policies. From a social perspective, this indicates that government implementation has not yet achieved its intended outcomes. Furthermore, from an environmental standpoint, greenhouse gas emissions have continued to increase steadily from the past to the present (NESDB, 2026).

In particular, greenhouse gas emissions generated from agricultural occupations and businesses have risen at one of the highest rates nationwide, especially within the agritourism sector. This is largely due to the extensive use of land converted for agritourism activities, which has caused substantial changes to local communities. Large-scale land-use transformation aimed at attracting foreign revenue has resulted in immediate and direct damage to ecosystems (DEDE, 2026).

Once agritourism operations are established, both domestic and international population flows increase significantly, and the associated activities further intensify direct ecological impacts (NESDB, 2026). As a consequence, traditional Thai communities have undergone profound transformations, to the extent that authentic traditional communities have nearly disappeared. At the same time, urban expansion has encroached upon rural areas, exacerbating environmental degradation nationwide. Data from all relevant agencies responsible for greenhouse gas emission management in Thailand indicate that agritourism ranks among the leading contributors to environmental loss and degradation. As tourism becomes increasingly popular, the tourism industry continues to expand, driven by both domestic growth and foreign investment, leading to deeper and more irreversible damage. Land-use changes for agritourism have altered the country's geographical and spatial systems beyond recognition, while traditional ways of life have been fundamentally transformed (NESDB, 2026; ONEP, 2026). Moreover, these developments have continuously increased greenhouse gas emissions, despite ongoing governmental efforts to implement preventive measures and policies aimed at reducing emissions from agritourism activities. Nevertheless, such measures have failed to curb the rising trend of emissions. For these reasons, this research was conducted in response to the researcher's recognition of Thailand's persistent environmental problems arising from land use for agriculture and agritourism. The study therefore develops an integrated dynamic model under a sustainability policy framework to identify effective approaches for reducing future greenhouse gas emissions to levels below the carrying capacity, thereby supporting Thailand's long-term success. This research fundamentally differs from previous studies by adopting a comprehensive analytical approach that examines all relevant components simultaneously, allowing for a true prioritization of causal factors and enabling more precise and effective policy solutions.

MATERIALS AND METHODS

In this research, an advanced smart model was developed. The model construction was adapted from previous models by identifying their weaknesses and integrating the strengths of each in order to achieve the highest analytical efficiency. The proposed model is called the Path Analysis based on Probit Government Model (PA-Probit-G model). This model consists of a structural model and measurement equations for constructing the variables used in the analysis.

In general research practice, measurement scales are typically constructed from sets of statements or questionnaire items related to the variable of interest. These items are quantified and summed to produce a composite score for the measurement scale. Although such scales may demonstrate construct validity, directly summing the items implicitly assumes that each item carries equal weight (Bentler & Chou, 1987). A key conceptual difference between the proposed model and previous models lies in the treatment of core variables (which may function as either independent or dependent

variables). These core variables are latent variables that cannot be directly observed or measured. Therefore, they must be represented by manifest variables (Kline, 2015). Consequently, solving the model equations requires an analysis of the causal influences and relationships among the manifest variables associated with each latent construct. Since latent variables cannot be directly measured, their values are inferred from the corresponding manifest variables, which serve as indicators of the latent constructs (Bentler & Chou, 1987; Kline, 2015). The PA-Probit-G model is particularly suitable for analyzing strategies aimed at reducing carbon dioxide emissions in the future. In addition, the model can effectively assess changes following increases or decreases in energy consumption, as well as variations in other factors included in the model. The causal relationships among the factors within the PA-Probit-G model are illustrated as follows (Baltagi, 2021).

$$L_i = \beta_1 + \beta_2 X_i \quad (1)$$

From Equation (1), let X_i denote an observed variable, which can be measured to determine whether a particular action or decision is undertaken. This decision is revealed when the value of an underlying index i ncreases and reaches a critical threshold, denoted by L_i^*, which represents the critical index value. If $L_i > L_i^*$, this indicates that a policy is implemented. Conversely, if $L_i < L_i^*$, it implies that the policy is not implemented at all. The variable L_i itself is not directly observable; however, it is directly related to probability. Therefore, the probability of the occurrence of a given event can be expressed in the form of a cumulative distribution function, as follows (Harvey, 1980).

$$P_i = P(Y = 1|X) = P(L_i \geq L_i^*) = P(Z_i \leq L_i) = F(L_i) \quad (2)$$

From Equation (2), let Z_i be an observed variable in the model, which follows a standard normal distribution, $Z \sim N(0,1)$. Let F denote the cumulative distribution function, which defines the probability of the occurrence of the case $Y = 1$, as expressed below (Hoyle, 1995).

$$F(L_i) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{L_i} e^{\frac{-Z^2}{2}} dz \quad (3)$$

$$F(L_i) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\beta_1 + \beta_2 X_i} e^{\frac{-Z^2}{2}} dz \quad (4)$$

From Equations (3)–(4), the value of L_i can be calculated using the inverse function of Equation (4).

$$L_i = F^{-1}(L_i) = F^{-1}(P_i) = \beta_1 + \beta_2 X_i \quad (5)$$

From Equation (5), the relationship can be expressed in the form of a general equation as follows.

$$Y^* = \beta X_i' + \varepsilon \quad (6)$$

From Equation (6), let X_i' denote the vector of observed variables, β the coefficients of the observed variables**,** and ε the error term, which follows a normal distribution with mean μ and variance σ^2 , $\varepsilon \sim N(\mu, \sigma^2)$. The outcome variable is defined such that $Y = 1$ if $Y^* > 0$, and $Y = 0$ when $Y^* \leq 0$. Therefore, the probability of the event occurring ($Y = 1$) can be written as follows.

$$P(Y = 1|X_i) = P(Y^* > 0|X_i) = P(\varepsilon > -\beta|X_i) \quad (7)$$

From Equation (7), the distribution is normal and symmetric, which leads to the following formulation.

$$P(Y = 1|X_i) = P(Y^* > 0|X_i) = P(\varepsilon > -\beta|X_i) = \emptyset(\beta X_i') \quad (8)$$

From Equation (8), $P(Y = 1|X_i)$ represents the probability that the event occurs, which is determined by X_i , and $\emptyset(\beta X_i')$ denotes the standard normal cumulative distribution function**,** referred to as the Probit Government Model, as expressed below (Byrne, 2001).

$$P(Y = 1|X_i) = \int_{-\infty}^{\beta X_i'} \emptyset(t)dt = \emptyset(\beta X_i') \quad (9)$$

$$P(Y = 1|X_i) = \int_{-\infty}^{\beta X_i'} \frac{1}{\sqrt{2\pi}} e^{\frac{-t^2}{2\sigma^2}} dt \quad (10)$$

From Equation (10), by assuming that $\varepsilon \sim N(\mu, \sigma^2)$ substituting $\mu = 0, \sigma^2 = 1$ into Equation (10), the following expression is obtained (MacKinnon, 1991).

$$P(Y = 1|X_i) = -\frac{1}{\sqrt{2\pi}} \left(\frac{-e^{\frac{-(\beta X_i')^2}{2}}}{\beta X_i'} \right) \quad (11)$$

From Equation (11), it can be observed that the probability function is nonlinear. Therefore, the analysis must be conducted under a path analysis framework to appropriately specify the equations and to avoid potential problems arising from the proposed model, including autocorrelation, multicollinearity, and heteroskedasticity. Accordingly, an estimation approach is employed in which $F(\beta X_i')$ represents the probability that the event occurs, with a joint probability density function, as follows (Dickey & Fuller, 1981; Byrne, 2001).

$$Pr(Y_1 = y_1, Y_2 = y_2, \ldots, Y_n = y_n|X_i) = L = \Pi_{y_i=0}(1 - F(\beta X_i')) \Pi_{y_i=1}(F(\beta X_i')) \quad (12)$$

From Equation (12), the complete and revised formulation can be expressed as follows.

$$lnL = \sum_{y_i=0} \ln(\ 1 - \emptyset(\beta X_i') + \sum_{y_i=1} \ln(\emptyset(\beta X_i') \qquad (13)$$

A review of relevant domestic and international literature reveals that no previous study has developed an integrated model employing advanced statistical techniques in this manner for the purpose of formulating national management strategies to achieve sustainable development in the future. Existing studies have generally failed to conduct fully integrated analyses across all sectors, making it difficult to adequately capture interconnections, as well as direct and indirect effects among them. Moreover, insufficient attention has been given to the relative importance of individual indicators that truly drive these influences. As a result, scenario models have not been accurately specified, limiting their applicability for policy formulation and national planning in Thailand.

In this study, the researcher develops a comprehensive model capable of simultaneously prioritizing both direct and indirect relationships across all sectors. This approach provides significant advantages for advancing sustainable development in line with the long-term objective of achieving a green economy by 2050. Considering all sectors concurrently offers substantial benefits for national policy and planning, as it enables a clearer understanding of how new policy scenarios should be formulated in the future and how they differ from past approaches that were implemented but did not achieve full success. This, in turn, facilitates effective learning and appropriate integration across sectors. The following section presents the research methodology and procedural steps undertaken in this study.

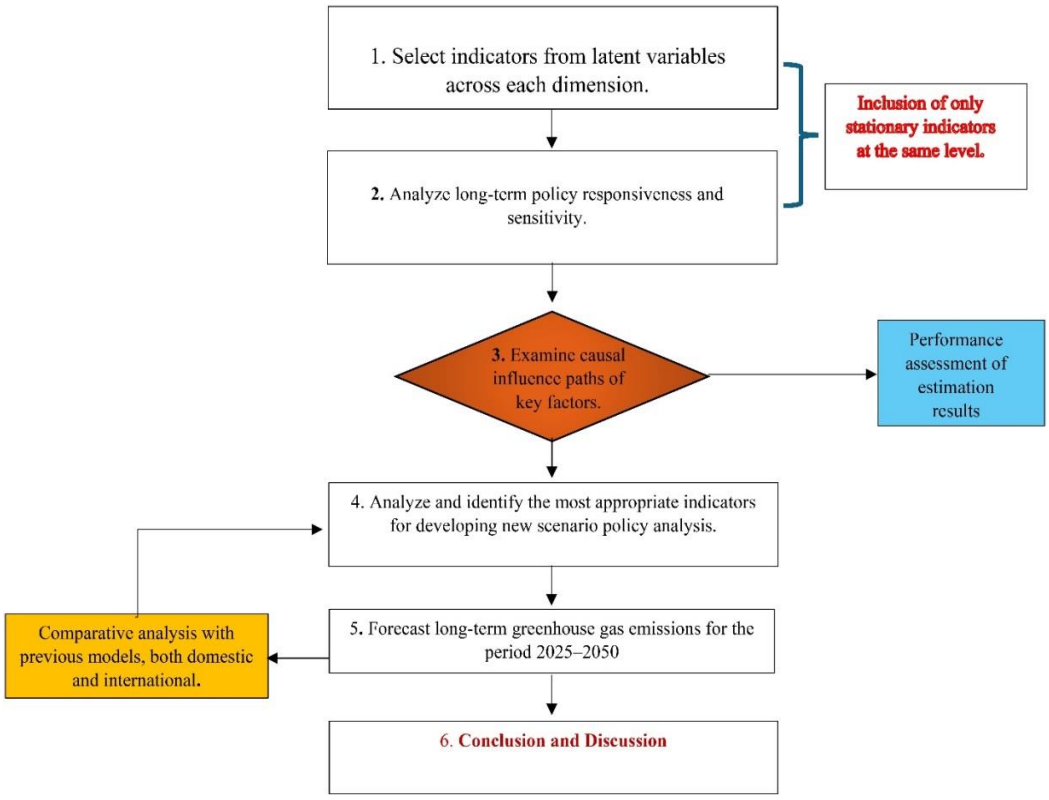


Figure 1. Research Methodology Framework

Figure 1 illustrates the research procedures employed to analyze the influence of causal factors affecting changes in the socio-cultural, economic, environmental, and government sectors arising from transformations in agricultural land use toward Thailand's future sustainability.

RESULTS

Selection of Observed Variables Based on Model Diagnostic Criteria

The findings of this study employ the PA-Probit-G model, which is designed to analyze the pathways of influence among four latent variables: the socio-cultural sector, economic sector, environmental sector, and government sector. The researcher utilizes observed variables derived from indicators that meet all required statistical properties.

All indicators included in the analysis are those that Thailand has consistently used in national development planning and are obtained as secondary data from the relevant responsible agencies, namely the National Economic and Social Development Council (NESDC), the Office of Natural Resources and Environmental Policy and Planning (ONEP), and the Ministry of Agriculture and Cooperatives (MOAC). These data sources are therefore considered appropriate and reliable for the purposes of this analysis. In total, 26 observed variables are included in the model, such as Political Stability (P_1), Solar cell rate (P_2), Biomass energy rate (P_3), renewable energy rate (P_4), green material rate (P_5),

waste biomass rate (P_6), Biofuel oil consumption rate (P_7), Biofertilizers rate (P_8), electric vehicle rate (P_9), Smart grid rate (P_{10}), Drying & Storage Agricultural Products (P_{11}), industrial structure rate (L_1), foreign investment rate (L_2), Ecotourism rate (L_3) Infrastructure (L_4), BCG rate (L_5), Health and wellness rate (A_1) Public participation rate (A_2), Education rate (A_3), Income distribution rate (A_4), Protection rate (A_5), Urban culture rate (A_6), Energy intensity rate (N_1), Carbon dioxide emissions (N_2), Methane emission (N_3), and Nitrous oxide emission N_4). The results of the statistical tests are presented as follows.

Table 1. The results of the selection of observed variables that exhibit no unit root

Tau Test				MacKinnon Critical Value		
Variables	Level I(0) Value	Variables	First Difference I(1) Value	1%	5%	10%
$ln(P_1)$	−2.77	$\Delta ln(P_1)$	−4.10***	−4.05	−3.25	−2.15
$ln(P_2)$	−2.53	$\Delta ln(P_2)$	−4.15***	−4.05	−3.25	−2.15
$ln(P_3)$	−2.19	$\Delta ln(P_3)$	−4.19***	−4.05	−3.25	−2.15
$ln(P_4)$	−3.79	$\Delta ln(P_4)$	−5.77***	−4.05	−3.25	−2.15
$ln(P_5)$	−3.11	$\Delta ln(P_5)$	−4.10***	−4.05	−3.25	−2.15
$ln(P_6)$	−3.05	$\Delta ln(P_6)$	−4.50***	−4.05	−3.25	−2.15
$ln(P_7)$	−3.10	$\Delta ln(P_7)$	−4.61***	−4.05	−3.25	−2.15
$ln(P_8)$	−3.20	$\Delta ln(P_8)$	−4.07***	−4.05	−3.25	−2.15
$ln(P_9)$	−-3.03	$\Delta ln(P_9)$	−4.31***	−4.05	−3.25	−2.15
$ln(P_{10})$	−3.29	$\Delta ln(P_{10})$	−4.39***	−4.05	−3.25	−2.15
$ln(P_{11})$	−3.15	$\Delta ln(P_{11})$	−4.97***	−4.05	−3.25	−2.15
$ln(L_1)$	−3.01	$\Delta ln(L_1)$	−4.33***	−4.05	−3.25	−2.15
$ln(L_2)$	−3.15	$\Delta ln(L_2)$	−4.50***	−4.05	−3.25	−2.15
$ln(L_3)$	-3.10	$\Delta ln(L_3)$	-4.55***	−4.05	−3.25	−2.15
$ln(L_4)$	-2.97	$\Delta ln(L_4)$	-4.95***	−4.05	−3.25	−2.15
$ln(L_5)$	−3.57	$\Delta ln(L_5)$	−5.70***	−4.05	−3.25	−2.15
$ln(A_1)$	−3.60	$\Delta ln(A_1)$	−5.61***	−4.05	−3.25	−2.15
$ln(A_2)$	−3.20	$\Delta ln(A_2)$	−4.99***	−4.05	−3.25	−2.15
$ln(A_3)$	−3.41	$\Delta ln(A_3)$	−4.47***	−4.05	−3.25	−2.15
$ln(A_4)$	−-3.05	$\Delta ln(A_4)$	−4.31***	−4.05	−3.25	−2.15
$ln(A_5)$	−3.11	$\Delta ln(A_5)$	−4.39***	−4.05	−3.25	−2.15
$ln(A_6)$	−3.69	$\Delta ln(A_6)$	−4.95***	−4.05	−3.25	−2.15
$ln(N_1)$	−3.01	$\Delta ln(N_1)$	−4.67***	−4.05	−3.25	−2.15
$ln(N_2)$	−3.50	$\Delta ln(N_2)$	−4.50***	−4.05	−3.25	−2.15
$ln(N_3)$	-3.55	$\Delta ln(N_3)$	-4.45***	−4.05	−3.25	−2.15
$ln(N_4)$	-3.75	$\Delta ln(N_4)$	-5.50***	−4.05	−3.25	−2.15

Table 1 presents the results of the selection of observed variables with no unit root. The findings indicate that all observed variables are free from unit roots at the first-difference level, demonstrating statistical significance at the 99% confidence level. This confirms that all observed variables are stationary, with constant means and covariances that do not change in response to irregular fluctuations or external shocks. Consequently, the researcher incorporates all of these observed variables into the PA-Probit-G model to further analyze the pathways of causal influence among the factors under investigation.

Results of Path Analysis of Causal Factors

This section presents the results of the path analysis of causal factors. In this study, four causal dimensions are specified: the socio-cultural sector, economic sector, environmental sector, and government sector. The PA-Probit-G model is employed to analyze the causal pathways among these factors, allowing the direction of relationships to be clearly identified. At the same time, the model enables the assessment of sensitivity through sensitivity analysis, which is used to prioritize policy options and to formulate future new scenario policies. The results are presented as follows.

Table 2. The results of the path analysis of causal factors based on the PA-Probit-G model

Dependent Variable	**Type of effect**	**Independent Variable**			
		Socio-cultural sector	**Economic sector**	**Environmental sector**	**Government sector**
Socio-cultural sector	DE	-	0.52***	0.76***	0.51***
	IE	-	0.12***	-	-
Economic sector	DE	-	-	-	0.40***
	IE	0.10***	-	-	-
Environmental sector	DE	0.12***	0.64***	-	0.12***
	IE	0.81***	0.09***	-	0.09***
Government sector	DE	0.43***	-	-	-
	IE	-	0.19***	-	-

Note: *** denotes significance α = 0.01, DE is direct effect and IE is indirect effect

Based on Table 2, the results of the path analysis of causal factors derived from the PA-Probit-G model indicate that each causal dimension exhibits both direct and indirect effects. The model satisfies all measurement and goodness-of-fit criteria, with a Chi-square statistic of 2.79, Root Mean Squared Residual (RMSR) of 0.05, Root Mean Square Error of Approximation (RMSEA) of 0.09, Standardized Root Mean Square Residual (SRMR) of 0.01, Normal Fit Index (NFI) of 0.95, Non-Normed Fit Index (NNFI) of 0.95, Comparative Fit Index (CFI) of 0.99, and Adjusted Goodness-of-Fit Index (AGFI) of 0.90. In addition, white noise diagnostic tests reveal no problems of autocorrelation, multicollinearity, or heteroscedasticity, indicating the robustness and novelty of the proposed model. The results further show that, at a statistical significance level of α = 0.01, the government sector exerts direct effects on changes in the socio-cultural, economic, and environmental sectors. At the same time, the socio-cultural sector also has a direct influence on changes in the government sector in the same direction, reflecting a reciprocal causal relationship.

Importantly, this study identifies a novel finding that differs from previous research and past national governance approaches: the socio-cultural sector has a direct effect on changes in the environmental sector, with the highest magnitude at 0.81% in the same direction. This effect is substantially stronger than that of the economic sector, which also has a direct effect on changes in the environmental sector but at a lower magnitude. Moreover, the economic sector has a direct effect on changes in the socio-cultural sector at 0.54% in the same direction, indicating that economic growth directly contributes to the development of the socio-cultural sector. The economic sector also influences changes in the environmental sector indirectly, operating through the socio-cultural sector. These findings imply that if the government intends to formulate effective policy measures, priority should be given to interventions in the socio-cultural sector, as this sector exhibits the strongest influence on changes in the environmental sector and simultaneously transmits indirect effects to the economic sector. Such an approach is therefore both cost-effective and highly appropriate for achieving maximum efficiency and effectiveness in policy implementation.

In this study, once the influence relationships have been clearly identified, the next analytical step involves ranking the relative importance of these influences to determine which indicators the government should address first in order to achieve the greatest policy impact. Accordingly, sensitivity analysis based on the PA-Probit-G model is conducted, and the results are presented in the following section.

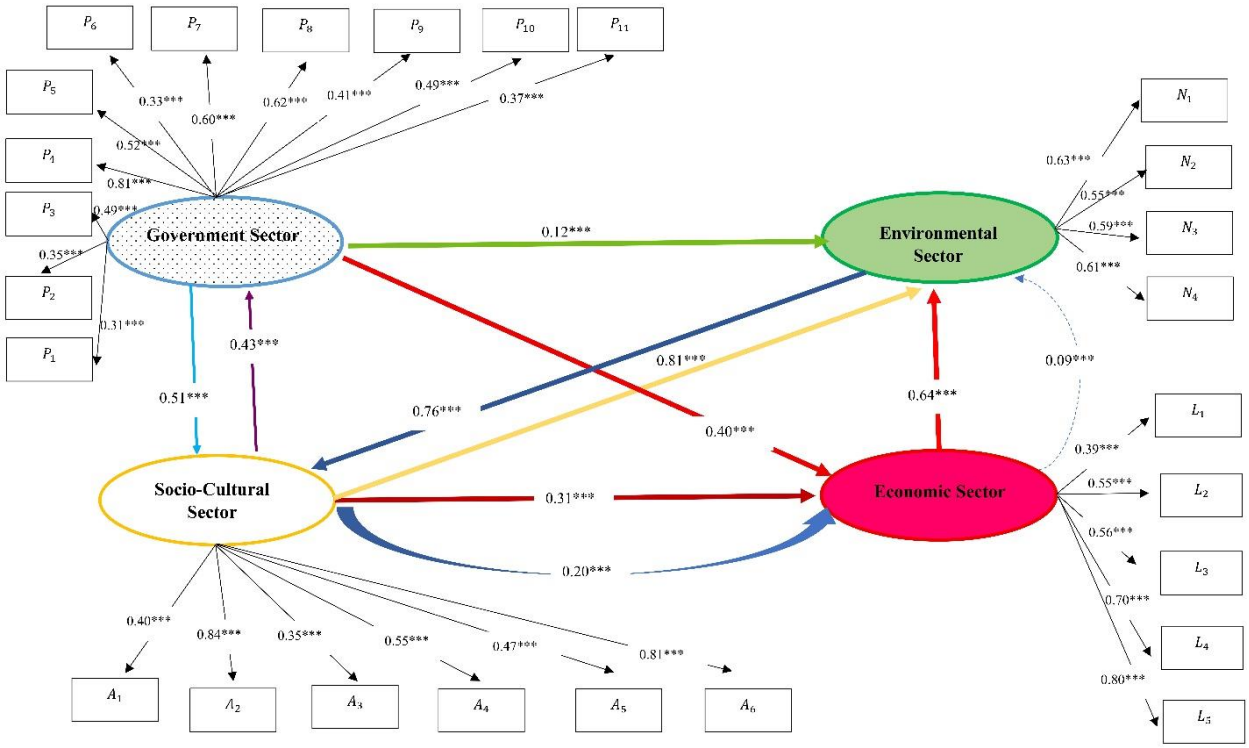


Figure 2. The results of the sensitivity analysis conducted to identify new scenario policies based on the PA-Probit-G model

As shown in Figure 2, the PA-Probit-G model effectively demonstrates the outcomes of the sensitivity analysis used to identify new scenario policies from the observed variables. The results indicate that the sensitivity of government policy related to the adoption of renewable energy is the highest, at 81%. In addition, within the sensitivity range of 80-100%, two other observed variables exhibit similarly high sensitivity levels: the urban culture rate and the stakeholder acceptance rate. These findings suggest that although the government has implemented numerous measures within the government sector to reduce greenhouse gas emissions, a lack of comprehensive and detailed consideration may obscure the importance of certain key indicators. Therefore, prioritizing indicators based on their relative influence on change is critically important and should be carried out on a continuous basis in order to achieve long-term success in line with the green economy

objective. Furthermore, despite the government's continued emphasis on the Bio-Circular-Green (BCG) economic model, the results of the analysis demonstrate that the influence of changes in the economic sector on the environmental sector is weaker than the influence exerted by changes in the socio-cultural sector.

Long-Term Forecasting Results of Greenhouse Gas Emissions (2025–2050) from Agricultural Land Use

In this study, the performance of the PA-Probit-G model is evaluated by comparing it with conventional models used in previous research. The evaluation employs Mean Absolute Percentage Error (MAPE) and Root Mean Square Error (RMSE) as statistical measures to assess the model's capability for long-term forecasting of greenhouse gas emissions resulting from agricultural land use over the period 2025-2050, which corresponds to Thailand's green economy target. The results are presented as follows.

Table 3. The comparison of the performance of the PA-Probit-G model with traditional models (Source: Author's Estimate (2026)

Forecasting Model	MAPE (%)	RMSE (%)
OLS model	10.45	11.99
CNN model	5.10	5.37
ANN model	5.05	5.25
Fuzzy model	4.05	4.77
LSTM model	3.80	4.00
ANIF model	3.75	3.92
ARIMAX model	3.55	3.75
PA-Probit-G model	1.05	1.57

Based on Table 3, the researcher compares the PA-Probit-G model with conventional models previously used in Thailand as well as in international studies, including the Autoregressive Integrated Moving Average with Exogenous Variables (ARIMAX) model, Adaptive Neuro-Fuzzy Inference System (ANFIS) model, Long Short-Term Memory (LSTM) model, Fuzzy model, Artificial Neural Network (ANN) model, Convolutional Neural Network (CNN) model, and Ordinary Least Squares (OLS) model. The test results indicate that the PA-Probit-G model demonstrates the highest forecasting performance, with MAPE and RMSE values of 1.05% and 1.57%, respectively. The ARIMAX model ranks second, with MAPE and RMSE values of 3.55% and 3.75%, respectively, followed by the ANFIS model (MAPE = 3.75%, RMSE = 3.92%), the LSTM model (MAPE = 3.80%, RMSE = 4.00%), the Fuzzy model (MAPE = 4.05%, RMSE = 4.77%), the ANN model (MAPE = 5.05%, RMSE = 5.25%), the CNN model (MAPE = 5.10%, RMSE = 5.37%), and the OLS model, which exhibits the lowest performance (MAPE = 10.45%, RMSE = 11.99%). Accordingly, the PA-Probit-G model is the most appropriate model for long-term forecasting of greenhouse gas emissions over the study period.

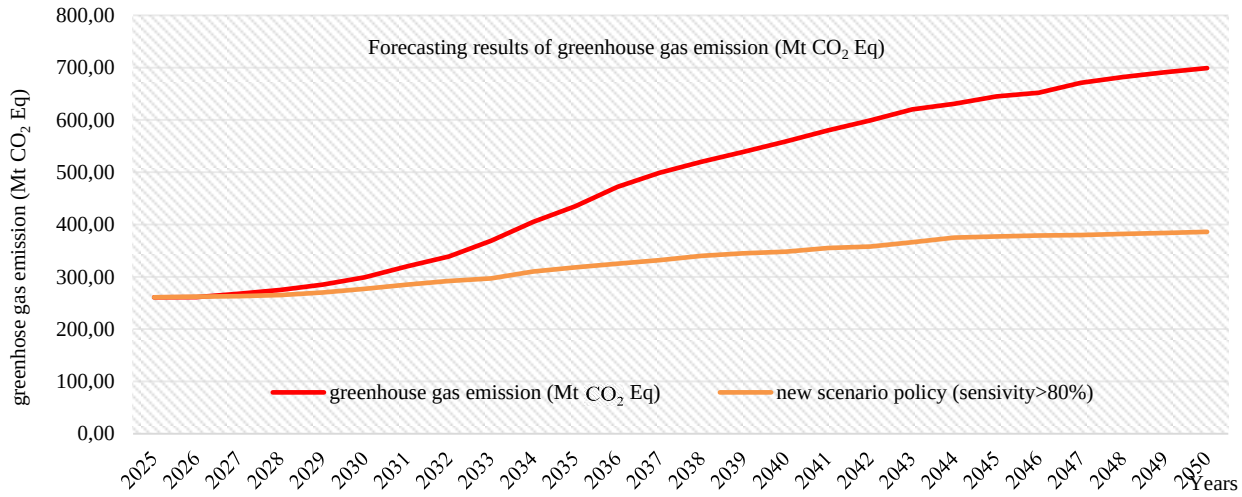


Figure 3. Long-term forecasting results of greenhouse gas emissions from 2025 to 2050 using the PA-Probit-G model

Figure 3 illustrates the projected greenhouse gas emissions over the period 2025-2050. The results indicate that agricultural land use leads to a continuous increase in greenhouse gas emissions throughout this period. Despite Thailand's long-standing implementation of sustainable development policies from 1992 to 2025, these measures have not been sufficient to curb the steadily rising growth rate of emissions. The analysis shows that greenhouse gas emissions are projected to increase to 396 Mt CO_2 eq by 2050, a level that poses significant risks to ecosystems because it exceeds the defined carrying capacity of 350.50 Mt CO_2 eq. However, this study develops the PA-Probit-G model and identifies a new scenario policy centered on renewable energy as the highest-priority policy requiring concrete government action. This policy must be implemented in parallel with improvements in the urban culture rate and stakeholder acceptance rate in order to safeguard the environmental sector, stabilize its growth trajectory, and reduce greenhouse gas emissions to the greatest extent possible without exceeding the established carrying capacity.

Under the new scenario policy, the forecasting results indicate that by 2050 greenhouse gas emissions would increase at a substantially lower level, reaching approximately 275 Mt CO_2 eq, representing a growth rate of only 75.09% and remaining below the carrying capacity threshold of 350.50 Mt CO_2 eq. Nevertheless, to sustain economic and socio-cultural development, the government should continue to advance the Bio-Circular-Green (BCG) economy framework, which remains essential for supporting Thailand's long-term national development strategy.

Despite the government's long-standing implementation of sustainability policies up to the present, final energy consumption has continued to increase at a steady and substantial rate, reaching a growth rate of 65.4%, which exceeds the government's target ceiling of 40%. However, when the new scenario policy, comprising the solar cell adoption rate, biomass utilization rate, and public participation rate, is applied using the GMM-PAXi model, the growth rate of final energy consumption declines to only 31.75%. This level falls within a range that makes progress toward the net-zero emissions target by 2065 feasible. These results demonstrate that the formulation of appropriate new scenario policies, together with the selection of a suitable analytical model, can effectively guide strategic planning toward the intended long-term goals. Accordingly, the researcher proceeds to forecast greenhouse gas emissions over the period 2025-2065.

DISCUSSION

The development of Thailand's agricultural sector toward sustainability is critically important for the country's long-term development. Agriculture has been an integral part of Thai society from ancestral times to the present, with a large proportion of the population engaged in agricultural occupations and most of the country's land area devoted to agricultural use. Therefore, if Thailand is to achieve sustainable national development in line with established targets, the agricultural sector should be prioritized as the first and most fundamental sector. Under Thailand's green economy goals within its sustainability policy framework, sustainability is intended to be achieved across all sectors simultaneously. Nevertheless, the agricultural sector remains the most essential sector for the Thai population, even as urbanization continues to expand across the country. Despite this urban expansion, agriculture continues to serve as the primary livelihood for much of the population. Consequently, environmental conservation and protection constitute an urgent, spatially grounded priority that must be addressed in both the short and long term to ensure the successful and sustainable achievement of national goals, while also preserving the environment as a legacy for future generations. However, although Thailand has implemented sustainable development policies continuously from 1992 to 2025, these efforts have not effectively reduced greenhouse gas emissions.

Furthermore, the designation of agritourism as a national agenda has intensified land use, altered geographical conditions, and significantly increased consumption levels among both domestic populations and international tourists. These dynamics have led to profound transformations within the socio-cultural and environmental sectors, accelerating urbanization across nearly all regions of the country. As a result, traditional Thai culture and indigenous ways of life have gradually diminished, while ecosystems have become increasingly degraded and have exceeded established environmental thresholds. The research findings further indicate that, if current trends persist, greenhouse gas emissions are projected to continue rising beyond the carrying capacity, directly contradicting the government's declaration of the green economy as a national agenda. This agenda seeks to achieve its targets 15 years ahead of the original timeline, with completion by 2050, at which point greenhouse gas emissions are expected to be reduced and balanced by absorption rates to achieve net-zero emissions. Nevertheless, it is now evident that these plans have not only failed to achieve their stated targets but have also been unable to constrain greenhouse gas emission growth to levels below the carrying capacity. This persistent trend poses escalating risks to ecological systems and will continue to adversely affect biodiversity, human well-being, and other living organisms in the future.

In managing Thailand's agricultural sector, the government has undertaken extensive efforts to achieve national objectives by introducing key measures, most notably the Alternate Wetting and Drying (AWD) rice cultivation policy. This policy aims to reduce greenhouse gas emissions by lowering methane CH_4 emissions by up to 30% through controlled water management that alternates between flooded and dry conditions, allowing oxygen to penetrate the soil and inhibit methane-producing bacteria. In addition to mitigating emissions, AWD reduces water consumption, fertilizer and chemical use, lowers production costs, and generates additional income through carbon credits, while aligning with the Bio–Circular–Green (BCG) economic strategy, a core national development framework. However, the rapid expansion of land use for agritourism, driven by growing international demand, has exacerbated ecosystem degradation, intensifying environmental pressures beyond those generated by domestic agricultural activities alone.

Agritourism development has accelerated land-use transformation at a much greater scale, amplifying ecological disruption and increasing the severity of environmental impacts over time. Despite the government's strong commitment and intensive implementation of these policies in accordance with established targets and plans, greenhouse gas emissions have not declined to the levels specified in national objectives. This shortfall is primarily attributed to limitations in existing governance and planning models, which lack sufficient accuracy and integration to effectively support sustainable national management. In response, this study develops an improved model that enables research findings to be more effectively applied to government decision-making processes in the long term.

The results further demonstrate that the formulation and implementation of government policies, whether domestically designed or adopted from international frameworks, will fail to achieve their intended goals if they do not account for indicators that genuinely and significantly influence outcomes. This study therefore finds that while the implementation of BCG economic measures has generated substantial benefits in terms of economic growth, such growth alone is insufficient to ensure reductions in greenhouse gas emissions without alignment with the most influential causal indicators.

Nevertheless, one critical measure that has not been prioritized by the government in policy formulation is the promotion of renewable energy, which constitutes a highly significant, and indeed the most crucial, measure for the agricultural sector in reducing greenhouse gas emissions. This measure must be implemented in parallel with two indicators that require immediate and urgent action: the urban culture rate and the stakeholder acceptance rate.

This urgency arises because Thai society has historically not embedded environmental conservation as a core cultural value. Across generations, the environment has largely been perceived as a public good that anyone may use, with greater individual use often viewed as yielding greater personal benefit, rather than as a shared resource that must be protected and preserved for future generations. Therefore, to maximize policy effectiveness, all sectors, public, private, and civil society, must undergo a cultural transformation that emphasizes environmental stewardship, collective responsibility, and the sustainable use of natural resources. Consequently, the urban culture rate and stakeholder acceptance rate are essential factors in advancing Thailand's sustainable development and in enabling the country to transition toward a green economy by 2050 in a durable and effective manner. The findings of this study are consistent with those of several prior studies, including Waiyasusri et al. (2024), Hasanein & Ayad (2025), Ahmed et al. (2025), Salama et al. (2025), and Salama et al. (2025). However, the implementation of renewable energy is well suited to Thai society and Thailand, particularly when considering spatial analysis within the agricultural sector. Nevertheless, the long-standing cultural characteristics of Thai society and the continuous process of urbanization are likely to influence future transitions. Cultural change among the population cannot be achieved through coercive measures alone; rather, it requires proactive incentive-based policies that encourage shifts in mindsets and lifestyles. Environmental conservation must be positioned as a primary priority in daily life, which inherently requires time and sustained government support. If current approaches are maintained without significant adaptation, Thailand is unlikely to achieve its long-term objectives, including the green economy target by 2050, and it will certainly fall short of attaining the net-zero emissions goal by 2065.

Recommendation

Based on the findings of this study, the researcher identifies several significant insights that are highly beneficial to the public interest. This research successfully identifies a new scenario-based policy that differs from government policies implemented from the past to the present and demonstrates the potential to reduce greenhouse gas emissions to levels below the carrying capacity. Accordingly, the following recommendations are proposed for public and policy relevance:

1) With regard to land use for the development of agritourism, it is crucial for the government to prioritize infrastructure factors, as infrastructure constitutes a core foundation for national development toward sustainability and is among the most influential factors demonstrating the relationships that drive various forms of change. If infrastructure development is implemented appropriately, negative spillover effects on other sectors can be avoided, thereby preventing further damage to ecosystems. To date, land use for agritourism has already imposed substantial pressure on land resources; consequently, inadequate or poorly planned infrastructure would accelerate ecological degradation and lead to more rapid ecosystem deterioration than previously experienced.

2) Support measures to address fine particulate pollution caused by biomass burning in forest areas: Air pollution has emerged as a critical environmental issue, particularly during periods of forest fires, haze, and smog in northern Thailand. During the severe haze crisis in early 2023, concentrations of fine particulate matter (PM2.5) were found to increase continuously each year. More than 100,000 accumulated hotspots were detected, with the majority located in forested areas. Of these, approximately 48% were found in protected forest areas, followed by 37.99% in national reserved forests, and 14.23% in agricultural areas and land reform zones (Sor Por Kor), along with other land-use categories. Given these circumstances, effective prevention and mitigation strategies in forest areas are essential. These should include strengthening area-based mechanisms, enhancing coordination and collaboration with local communities and surrounding areas, improving fuel management and combustion efficiency, developing and deploying more effective technologies, and expanding the use of monitoring, surveillance, and hotspot-tracking technologies to enable timely intervention and long-term environmental management.

3) Enhance local capacity for water planning and management: Water resource management has become increasingly challenging due to rising water demand, climate variability, and changes in rainfall patterns and distribution that are difficult to predict. Surface water sources have been encroached upon, altered, and degraded over time. Moreover, the occurrence of more severe and prolonged El Niño events is likely to significantly affect water availability, thereby constraining the ability to manage water resources in a manner that equitably meets diverse demands. Accordingly, there is an urgent need to strengthen capacity for water planning and management at the community and local levels, particularly in areas vulnerable to flooding and drought. This should be achieved through comprehensive capacity-building initiatives that enhance knowledge and skills in the application of information and communication technologies (ICTs) for water resource management, enabling more accurate water forecasting and more effective, adaptive decision-making.

4**)** Support urban green space assessment and planning: Rapid urban expansion, together with a continuous increase in the registered urban population, the presence of transient populations, tourists, and visitors, has led to the replacement of natural green spaces with built structures and infrastructure. This transformation has adversely affected urban temperatures, water retention capacity, biodiversity, and the availability of recreational spaces. Therefore, it is recommended that municipalities at all administrative levels be supported in conducting systematic surveys and developing area-based urban green space management plans that align with national public green space targets and established operational guidelines for advancing sustainable urban green space management.

5) Study environmental changes and impacts on cultural and artistic heritage sites: A well-preserved cultural and artistic environment enhances the aesthetic value and significance of heritage sites. However, ongoing urban expansion and transformation, both physical and social, along with tourism pressures and natural hazards, increasingly threaten the environmental context and intrinsic value of cultural and artistic heritage. Consequently, in-depth studies and impact assessments are needed to analyze environmental changes affecting these sites, particularly historic urban areas, in order to safeguard cultural and artistic heritage as a vital national legacy for future generations.

Limitations of the Research

This study is based exclusively on quantitative research methods, which constitutes a limitation in terms of the absence of complementary qualitative analysis. Qualitative data, particularly from practitioners directly involved in policy implementation, may be subject to incomplete reporting, bias, or constraints in providing fully accurate information. Such limitations could potentially lead to errors in analysis and interpretation. For this reason, the researcher deliberately chose not to incorporate qualitative methods in this study. Integrating biased or incomplete qualitative information into the analysis could result in misguided interpretations and, if applied to national governance and policy formulation, could generate adverse consequences for Thailand's development trajectory.

Reliance on unverified beliefs or non-informational inputs may distort strategic decision-making and lead to policy directions that contradict national objectives. Accordingly, the quantitative approach employed in this research is considered sufficient and appropriate for informing long-term national strategic planning and governance decisions.

CONCLUSIONS

This study, entitled "A Dynamic Causal Modelling Framework for Prioritising Greenhouse Gas Emission Reduction Strategies in Agro-tourism Land Use and Sustainable Territorial Development in Thailand," examined the priority order of the causal factors influencing the formulation of future greenhouse gas emission management strategies arising from agro-tourism land use in Thailand. To achieve this objective, the study developed the Path Analysis based on the Probit Government Model (PA-Probit-G model), an enhanced analytical framework derived from integrating the principal strengths of previous models. The model enables the simultaneous examination of direct and indirect relationships among the socio-cultural, economic, environmental, and government sectors, while also identifying the indicators that should be prioritized in future national management strategies.

The findings demonstrate that the socio-cultural sector is the most influential factor affecting changes in the environmental sector. In particular, the urban culture rate and stakeholder acceptance rate are identified as critically important indicators for formulating new scenario policies. These indicators should be implemented in parallel with concrete government measures to accelerate renewable energy development. The results therefore confirm that the effective management of greenhouse gas emissions from agritourism land use cannot depend exclusively on economic development or technological interventions. Rather, it requires the integration of renewable energy policies with socio-cultural transformation, environmental stewardship, and stakeholder acceptance.

The forecasting results further demonstrate that continuing existing policy conditions would cause greenhouse gas emissions to exceed the established carrying capacity by 2050. In contrast, implementing the proposed new scenario policies can maintain greenhouse gas emissions below the carrying capacity throughout the forecasting period. These policies are therefore essential for mitigating the environmental impacts associated with the promotion and expansion of agritourism, while supporting Thailand's green economy target by 2050. Accordingly, the PA-Probit-G model provides an effective evidence-based instrument for prioritizing causal factors, formulating national greenhouse gas emission management strategies, and supporting sustainable territorial development. Integrating renewable energy development, the urban culture rate, and the stakeholder acceptance rate will strengthen Thailand's capacity to balance agritourism-based economic development with socio-cultural continuity and environmental protection. The application of this framework can therefore contribute to the long-term success of Thailand's national management plan and its transition toward sustainable development.

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A QUANTITATIVE ASSESSMENT OF GEOSITES IN ARUSHA NATIONAL GEOPARK, TANZANIA

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Abstract: Geodiversity underpins geoheritage, yet systematic and quantitative assessments of geosites remain unevenly distributed globally, with Africa particularly underrepresented despite its exceptional geological diversity. This limits both effective geoconservation and the development of geoparks seeking international recognition. Here we present a comprehensive quantitative assessment of seven geosites within the Arusha National Geopark, Northern Tanzania, using a standardized evaluation framework. We assess the scientific, educational, and touristic value, together with degradation risk, of seven representative geosites. The selected geosites, which include Ngurdoto Crater, Momella Debris Avalanche Deposit (DAD), Momella Lakes, Mt. Meru Ash Cone, Little Meru, Socialist Peak, and Tephra Fallout Deposits, were evaluated. Results show that all geosites possess moderate to high scientific value, reflecting their geological significance in illustrating volcanic, geomorphological, and sedimentary processes linked to the evolution of Mount Meru. Degradation risk varies, with Little Meru and Socialist Peak showing low vulnerability, while Momella Lakes and Tephra Fallout Deposits exhibit moderate to high risk due to erosion, weathering, and human activity. Ngurdoto Crater and Momella DAD demonstrate the highest educational and touristic potential, supporting their prioritization for geotourism development and outreach initiatives. The findings highlight the importance of strategic geoconservation planning to protect fragile geosites while enhancing their value for scientific research, education, and sustainable tourism. This assessment contributes to ongoing efforts to strengthen the geopark's geosite inventory and supports the development of Arusha National Geopark toward meeting UNESCO Global Geopark designation standards. More broadly, our results demonstrate the critical role of quantitative geosite assessment in advancing geoconservation, supporting sustainable geotourism, and strengthening the scientific foundation for UNESCO Global Geopark designation in underrepresented regions.

Keywords: geosites, inventory, Arusha National Geopark, assessments, geotourism

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INTRODUCTION

Geodiversity encompasses the variety of geological features like rocks, minerals, fossils, landforms, soils, hydrological systems, and the processes that create them (Gray, 2008; 2018). These components form the basis of geoheritage, which includes sites and features of geological importance that document Earth's history, climate changes, and biological evolution. They are also valuable for scientific investigation, education, and geotourism (Brilha, 2018; Prosser et al., 2013; Singh et al., 2021). To protect these resources effectively, it is crucial to accurately identify and assess them, making a systematic inventory of geological heritage a fundamental initial step.

Geoparks serve as structured frameworks for the conservation and promotion of geological heritage by employing a comprehensive approach that integrates geodiversity, biodiversity, and cultural values (Ansori, 2018; Newsome & Dowling, 2018; Hadian & Suganda, 2023). As noted by Brilha (2015, 2016), Henriques & Brilha (2017), geoparks are defined territories of notable geological significance, managed through strategies designed to advance sustainable development, geotourism, and public education. The primary aims include the protection of geoheritage, reinforcement of regional identity, encouragement of sustainable economic growth, and the enhancement of public understanding and appreciation of Earth sciences (Frey et al., 2006; Hose, 2006; Briggs et al., 2021; Mastika et al., 2023; Reinhart et al., 2023; Simbaña-Tasiguano et al., 2024). Geological sites within geoparks serve as accessible spots where local

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communities can participate in scientific education, recreation, and sustainable resource use (Newsome & Dowling, 2018; Prosser et al., 2013). These areas often carry scientific, educational, aesthetic, and tourism value, so assessing them properly is essential for effective geopark planning and management. While there are several methods available for evaluating geosites and geomorphosites (e.g., Coratza & Giusti, 2005; Bruschi & Cendrero, 2005; Pereira & Pereira, 2012; Kubalíková, 2013; Brilha, 2016; Tavares et al., 2020), choosing the right criteria depends on the objectives of geopark management, which must balance scientific significance with educational and touristic appeal.

Despite increasing global research on geoheritage and geoparks, quantitative geosite assessment studies remain limited in Africa, particularly in Tanzania. The Arusha National Geopark represents an area of significant geological importance, yet systematic quantitative evaluation of its geosites remains insufficient.

Therefore, this study aims to: (1) identify and inventory geosites within the geopark, (2) evaluate their scientific, educational, and touristic value, (3) assess their degradation risk, and (4) provide recommendations for conservation and sustainable development. This study contributes to filling the existing research gap in Africa and supports the sustainable management and international recognition of the Arusha National Geopark.

LITERATURE REVIEW

Geodiversity and Geoheritage: Concepts and Scientific Relevance

Geodiversity encompasses the natural diversity of geological, geomorphological, and soil features, such as rocks, minerals, fossils, landforms, sediments, and hydrological systems, along with the processes that create and alter them (Gray, 2008, 2018). These elements form the basis of geoheritage, which includes geological sites and features with significant scientific, educational, cultural, and aesthetic importance, illustrating Earth's history, environmental change, and biological development (Brilha, 2018; Prosser et al., 2013). Geoheritage plays a fundamental role in understanding geological processes and contributes significantly to geoscience research, education, and geotourism (Singh et al., 2021).

In recent years, geoheritage has gained increasing recognition as a key component of sustainable development and environmental conservation (Reynard & Brilha, 2018; Sengar & Shah, 2025). Systematic geoheritage inventories have been identified as essential tools for geoconservation planning and management, particularly in regions with high geological diversity but limited documentation (Carrión-Mero et al., 2022).

However, several limitations remain in current geoheritage research. Gray (2018) highlighted the lack of standardized assessment frameworks, which leads to inconsistencies in geosite identification and evaluation. Similarly, Prosser et al. (2013) emphasized that many geoheritage inventories focus primarily on scientific value while overlooking educational and touristic potential. Furthermore, Sengar & Shah (2025) noted that geoheritage remains underrepresented in conservation policies, particularly in developing countries, where geological resources are increasingly threatened by human activities.

These limitations highlight the need for systematic, quantitative, and comprehensive assessment methods to support effective geoheritage conservation and sustainable management.

Role of Geoparks in Geoheritage Conservation and Sustainable Development

Geoparks represent an integrated territorial management approach that combines geoheritage conservation, geotourism, education, and sustainable development (Newsome & Dowling, 2018). They are defined as areas with internationally significant geological heritage that are managed using holistic strategies to promote conservation, education, and regional economic development (Brilha, 2015; Henriques & Brilha, 2017).

Recent studies have demonstrated the significant contribution of geoparks to sustainable regional development. Mastika et al. (2023) reported that geoparks enhance local economic growth through geotourism development, while Reinhart et al. (2023) highlighted their role in improving public awareness and geoscience education. Similarly, Simbaña-Tasiguano et al. (2024) emphasized that geoparks support biodiversity conservation and strengthen regional identity.

Despite these benefits, several challenges limit the effective implementation of these measures. Newsome & Dowling (2018) identified insufficient scientific documentation and a lack of detailed geosite inventories as major obstacles. Carrión-Mero et al. (2022) further noted that many geopark projects fail to meet international standards due to inadequate quantitative geosite assessment. Moreover, Reynard et al. (2016) emphasized that limited research in developing countries, particularly in Africa, represents a significant gap in global geopark development.

Quantitative Assessment of Geosites: Methods, Advances, and Limitations

The quantitative assessment of geosites is widely recognized as a fundamental step in geoheritage conservation and geopark development (Brilha, 2016). Various assessment methods have been proposed to evaluate geosite value based on scientific, educational, and touristic criteria. Early methods focused mainly on scientific importance (Coratza & Giusti, 2005; Bruschi & Cendrero, 2005), but these approaches were criticized for neglecting educational and tourism aspects. Later methods incorporated additional evaluation criteria, including accessibility, aesthetic value, and cultural significance (Kubalíková, 2013; Pereira & Pereira, 2012). However, these methods often lacked standardization and were affected by subjectivity. The quantitative assessment method proposed by Brilha (2016) represents a significant advancement, as it provides a comprehensive and standardized framework for evaluating Scientific Value (SV), Potential Educational Value (PEV), Potential Touristic Value (PTV), and Degradation Risk (DR). This method has been widely applied in geopark studies worldwide due to its reliability and reproducibility.

Recent studies using this approach include Carrión-Mero et al. (2022), Mastika et al. (2023), and Simbaña-Tasiguano et al. (2024), who successfully identified priority geosites for conservation and geotourism development. However, several

limitations have been identified. First, although quantitative, the method still involves expert judgment, which may introduce subjectivity (Reynard et al., 2016). Second, many studies lack integration with Geographic Information Systems (GIS), limiting spatial analysis and management applications (Carrión-Mero et al., 2022). Third, most studies have been conducted in Europe, Asia, and South America, while Africa remains significantly underrepresented.

These limitations highlight the need for further quantitative geosite assessment studies, particularly in developing countries and geoparks undergoing UNESCO Global Geopark evaluation.

Recent Geosite Assessment Studies

Several recent studies have applied quantitative geosite assessment methods in geopark development. Carrión-Mero et al. (2022) conducted a quantitative assessment of geosites in Ecuador and identified several sites of high scientific and tourism value. However, the study lacked a detailed degradation risk analysis. Mastika et al. (2023) evaluated geosites in Indonesian geoparks and demonstrated their importance for sustainable tourism development. However, the study did not fully integrate educational value assessment. Reinhart et al. (2023) assessed geoheritage in European geoparks and emphasized the importance of geosite evaluation for UNESCO Global Geopark designation. However, the findings were less applicable to developing countries. Simbaña-Tasiguano et al. (2024) conducted a geosite assessment in Ecuador and identified priority conservation areas, but the study lacked spatial analysis. Hadian & Suganda (2023) conducted a geosite inventory and assessment in Indonesia and highlighted the importance of geoheritage conservation for sustainable development, although their study did not fully evaluate degradation risk. These studies demonstrate the importance of quantitative geosite assessment but also highlight significant geographical gaps, particularly in Africa.

MATERIALS AND METHODS

Study area. Geographical location

Arusha National Geopark (Figure 1) is located in Northern Tanzania, Northeast of Arusha city. It covers an area of 552 square kilometres. It is 25km east of Arusha, 58km from Moshi, and 35km from Kilimanjaro International Airport (KIA). It takes about a 40-minute drive from Kilimanjaro International Airport to reach the park. The park has a scenic landscape with distinct features such as Meru Crater in the west, Ngurdoto Crater in the southeast, and shallow alkaline Momella lakes with varying algae colours in the northeast of the park. The name was derived from the Waarusha people, who used to live in the area. The population around Mt. Meru is primarily concentrated in Arusha town on the southern flanks of the volcano. There are also dispersed rural populations on all flanks, except within the National Park boundaries on the eastern flank. The arid western flank, heavily impacted by tephra deposits from recent Holocene eruptions, has the lowest population density. The geological sites within the Arusha National Park (Figure 2) are linked to the collapse of Mt. Meru and the subsequent formation of the area's geomorphology. These sites vividly illustrate how geological processes have influenced the landscape, ecology, and culture of the region and serve as a living laboratory for Earth science education, providing visitors with insight into its evolution over time. Furthermore, they offer scenic views for visitors to appreciate, while also serving as a reminder to the community of potential geohazards associated with volcanic eruptions, tectonic movements, and landslides.



Figure 1. Map of Arusha National Geopark from Google Earth displaying some prominent features of the park (Source: Modified from Scoon, 2021)

Geological description

Arusha National Geopark is dominated by Mount Meru, the fourth-highest summit in Africa, and a giant stratovolcano located on older, faulted volcanic terranes in northern Tanzania. Mt. Meru is the main volcanic centre,

with the smaller centres of Meru West and Little Meru on its flanks, and small parasitic cones and craters on the lower slopes and surrounding plains (Dawson, 2008). The main cone (Figure 1) has a diameter of 25km and was built up from numerous, explosive, Plinian-style eruptions that occurred between 0.20 Ma and 80,000 BP (Scoon, 2018).

Little Meru is on the northeastern flank of Mt Meru and is a steep-sided symmetrical volcano with a height of 3800m (Roberts, 2002). As documented by Bennett et al. (2021), most rocks in the area are Pleistocene volcanic-sedimentary sequences, with older sequences dating back to the Miocene-Pliocene. The region's lithology is dominated by volcanic rocks, lava flows, pyroclastic deposits, and debris avalanche deposits (DADs) from Mount Meru.

Lava flows are primarily at higher elevations on the main cone and southern flank, while DADs, ash deposits, alluvium, alluvial fan deposits, and lake deposits are found at lower elevations around the base. Pyroclastic deposits are mainly on the western flank, and DADs are dominant on the eastern and northern flanks. Pumice and ash deposits cover much of Mt. Meru's western slopes and parts of the northern and southern flanks. These deposits include sequences of pumice fall, ash fall, and reworked materials, visible in drainage valleys. Roberts (2002) categorized them into near-vent pumice, early/proximal pumice fall, and main pumice fall deposits. The Mt. Meru debris avalanche deposit, resulting from a collapse about 8600 years ago, formed a 5 km wide and 8 km long horseshoe-shaped crater open to the east (Wilkinson et al., 1986), covering ~390 km². Initially thought to be a lahar, Delcamp et al. (2008) confirmed its hummocky nature, which confirmed it as a debris avalanche deposit with an estimated volume of 28 km³, one of the largest recorded. The exact cause of the collapse remains unclear, but the pumice and ash deposits likely preceded this event. Post-collapse volcanic activity at Mt. Meru has been confined to the crater, including the formation of an ash cone, a nephelinite lava dome, and subsequent lava flows (Roberts, 2002). The most recent eruption was in 1910, with ongoing fumarolic activity reported until 1953 and intermittent steam emissions in recent years (Roberts, 2002). The geological interpretations are primarily based on Wilkinson et al. (1986), with subsequent revisions by Delcamp et al. (2008), who reclassified deposits previously identified as lahars as debris avalanche deposits (DADs). Additionally, features originally mapped as tholoids by Wilkinson et al. (1986) have been reinterpreted as lava domes in the updated mapping of Bennett et al. (2021).

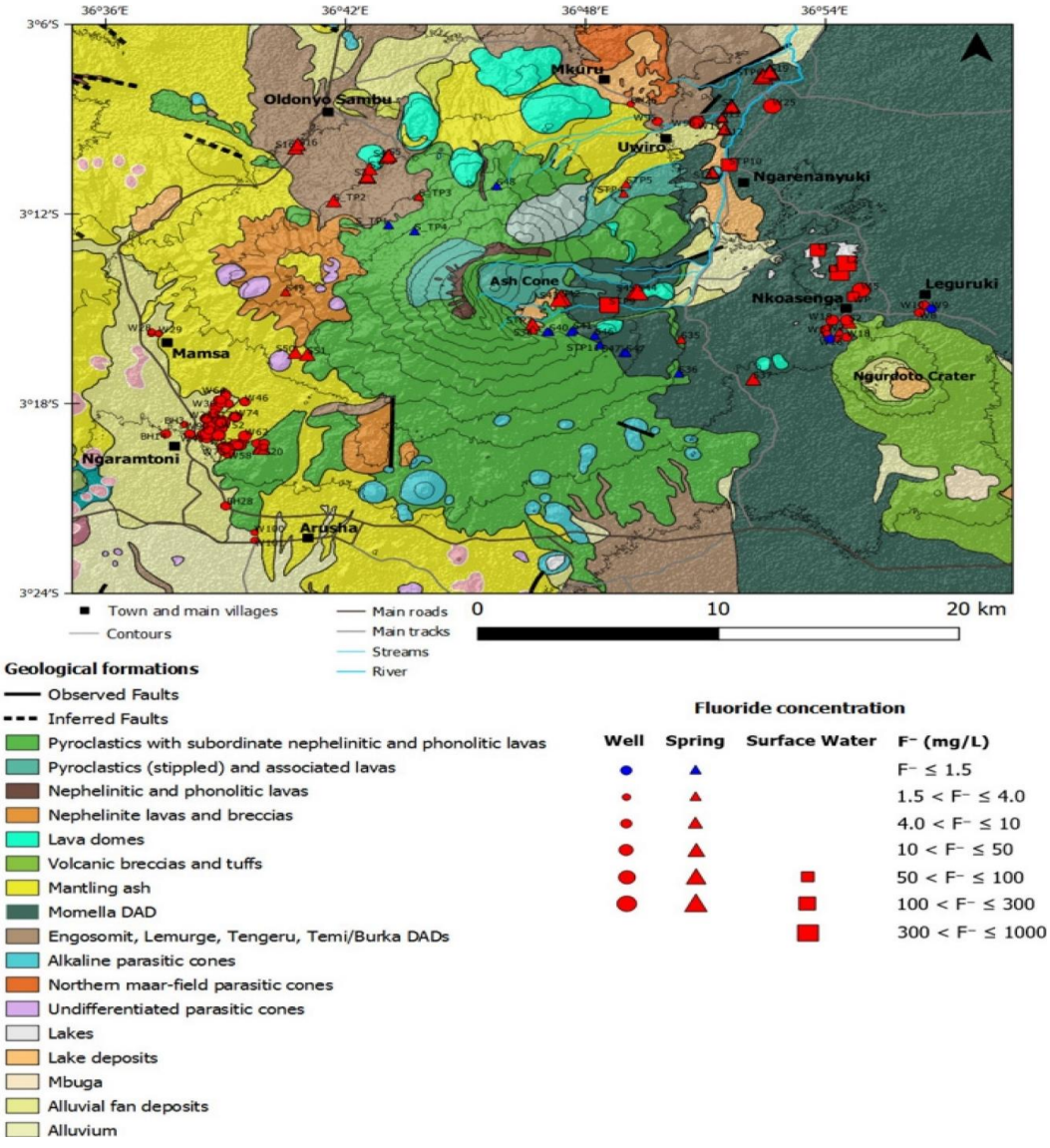


Figure 2. Geological map of the study area (Source: Bennett et al., 2021), illustrating the various geological formations

Quantitative Assessment of Geosites

A quantitative assessment of the potential geosites was conducted by employing the principles and procedures set out by Brilha (2016). This approach enables the differentiation of criteria across four key aspects: scientific value (SV), potential educational use (PEU), potential touristic use (PTU), and degradation risk (DR). For each of these dimensions, dedicated indicators and corresponding tables are utilised in the evaluation process: Table 1 for scientific value, Table 2 for degradation risk, and Table 3 for both educational and touristic potentials.

Each geosite is appraised using a four-point rating scale, ranging from 1 to 4, with the option to assign a score of zero when applicable. Individual criteria, linked to each of the four aspects, are scored independently from 1 to 4 points. The overall scores for scientific value, degradation risk, educational potential, and touristic potential are determined by calculating the weighted sum of the scores attributed to each relevant criterion, as presented in Tables 1, 2, and 3.

Table 1. Weight percent of the various criteria for the final evaluation of the scientific value of geosites (Brilha 2016)

Scientific value	
Criteria	**Weight**
A. Representativeness	30%
B. Key locality	20%
C. Scientific knowledge	5%
D. Integrity	15%
E. Geological Diversity	5%
F. Rarity	15%
G. Use limitation	10%
Total	**100%**
Total weighted	**SV**
<200	Low
201-300	Moderate
301-400	High

Table 2. Weight percent for the different criteria used for the assessment of degradation risk (DR) of geosites (Brilha, 2016)

Degradation risk		
Criteria		**Weight**
A. Deterioration of geological elements		35%
B. Proximity to areas/activities with potential to cause degradation		20%
C. Legal protection		20%
D. Accessibility		15%
E. Density of population		10%
Total		**100%**
Total weighted	**Degradation risk**	
<200	Low	
201-300	Moderate	
301-400	High	

Table 3. Weight percent for the different criteria used for the assessment of the potential educational and touristic uses

Potential use			
Educational	Weight	Touristic	Weight
A. Vulnerability	10%	A. Vulnerability	10%
B.Accessibility	10%	B.Accessibility	10%
C.Use limitations	5%	C.Use limitations	5%
D. Safety	10%	D. Safety	10%
E.Logistics	5%	E.Logistics	5%
F.Density of population	5%	F.Density of population	5%
G. Association with other values	5%	G. Association with other values	5%
H. Scenery	5%	H. Scenery	15%
I. Uniqueness	5%	I. Uniqueness	10%
J. Observation	10%	J. Observation	5%
K. Didactic potential	20%	K. Didactic potential	10%
L.Geological diversity	10%	L.Economic level	5%
		M. Proximity of recreational areas	5%
Total	**100%**	**Total**	**100%**
Total weighted		**EPU/PTU**	
<200		Low	
201-300		Moderate	
301-400		High	

The scientific value was assessed based on seven criteria: representativeness (30%), key locality (20%), scientific knowledge (5%), integrity (15%), geological diversity (5%), rarity (15%), and use limitation (10%). Each criterion's weight reflects its importance in the overall scientific evaluation, as shown in Table 1. The risk of degradation was evaluated using these factors (Table 2) deterioration of geological elements (35%), proximity to areas or activities that could cause

degradation (20%), legal protection status (20%), accessibility (15%), and population density (10%). A geosite faces the highest degradation risk when geological elements are highly susceptible to deterioration from human or natural causes, it is near potential sources of degradation, lacks legal protection or access restrictions, is easily accessible, and is situated in a densely populated area. The potential for educational use was assessed using 12 criteria: Vulnerability (10%), Accessibility (10%), Use limitations (5%), Safety (10%), Logistics (5%), Population density (5%), Connection with other values (5%), Scenery (5%), Uniqueness (5%), Opportunity for observation (10%), Didactic potential (20%), and Geological diversity (10%). Similarly, touristic potential was measured across 13 criteria: Vulnerability (10%), Accessibility (10%), Use limitations (5%), Safety (10%), Logistics (5%), Population density (5%), Connection with other values (5%), Scenery (15%), Uniqueness (10%), Opportunity for observation (5%), Interpretative potential (10%), Economic level (5%), and Proximity to recreational areas (5%). Each criterion is assigned a specific weight based on its significance within the evaluation of educational and touristic potential uses (Table 3). The graphical data of the weight percent of the different criteria used in the evaluation of the geosites is presented in Figure 3.

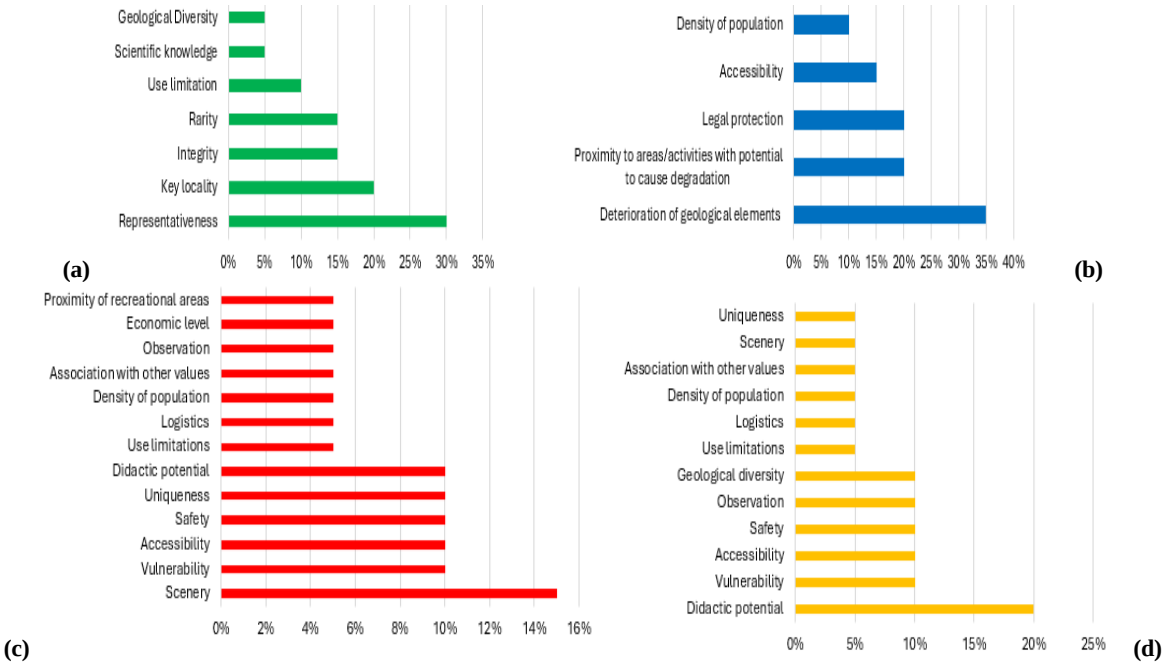


Figure 3. (a). Weight percent of the various criteria for the final evaluation of the scientific value of geosites (b). Weight percent for the different criteria used for the assessment of degradation risk (DR) of geosites (c). Weight percent for the different criteria used for the assessment of the potential touristic use (d). Weight percent for the different criteria used for the assessment of the potential educational use

Definition of Geological Framework

The definition of the geosite inventory method is fundamentally determined by the overarching purpose of the inventory. According to Lima et al. (2010), this involves addressing four key components: object, value, scope, and utility. In the context of this study, the approach focused on identifying and selecting geosites located in the Arusha National Geopark, Tanzania. This was achieved through an integrated methodology that combined a comprehensive review of relevant literature with field observations and an aerial view of each geosite. Additionally, the literature review served to enhance and contextualise the field observations, offering insights into the geological processes linked with the observed geosites.

The methodology adopted for this study encompassed both the inventory and the quantitative assessment of the geosites, ensuring a systematic and evaluative approach to geosite documentation and analysis.

Description and evaluation of geosites

The evaluation focused on seven selected geosites within Arusha National Park. They include Ngurdoto Crater, Momella Debris Avalanche Deposits (DAD), Momella Lakes, Mt. Meru Ash Cone, Little Meru Mountain, Socialist Peak, and Tephra Fallout Deposits. In line with UNESCO's mandate of managing a unified geographical area by holistically combining the protection of its geological resources with educational and sustainable development, these seven geosites were prioritized based on criteria such as their scientific relevance, socio-economic and cultural importance, aesthetic characteristics, and their educational potential.

Ngurdoto Crater

Ngurdoto Crater is a volcanic crater located at 3^0 17' 30.76'' S and 36^0 55' 39.30'' to the east of Mount Meru, within the Arusha National Park, approximately twenty-eight kilometers from the city of Arusha. It is protected by the Tanzania National Parks Act 1973 (Cap. 282)**,** the act is part of the Laws of Tanzania, which outlines the roles, responsibilities, and powers of the Tanzania National Parks Authority (TANAPA). Its accessibility is very easy via a well-maintained network of roads within the park. Visitors typically enter the park through the Momella gate, which is linked to the main roads

leading to Arusha city. Within the park, there are designated viewpoints and trails that allow visitors to observe the crater because direct access to the floor of the crater is restricted to minimize human impact.

Ngurdoto Crater (Figure 4a & 4b) is a volcanic caldera formed by a series of eruptions and subsequent collapse of a volcanic cone. It measures around 3.6km in diameter and about one hundred meters deep, with steep-sided walls (Scoon, 2016). The current pear-shaped configuration of the crater suggests that during its waning stages of activity, two cones existed in proximity. As the underlying molten rock receded to deeper layers, the cones lost support, leading to their collapse and the formation of the present-day crater (Scoon, 2021). The crater floor is a flat, swampy area that supports a variety of plant species and hosts permanent water sources. The volcanic origin and its well-preserved structure make it an important site for geological study, highlighting the volcanic history of the region and caldera formation processes.

The crater's geological features, including its steep walls and volcanic formations, are sensitive to natural weathering and erosion, and unregulated human activities such as trampling, hiking, and other tourism-related activities can accelerate the natural weathering and erosion. The crater is also home to many distinct flora and fauna, including unique species adapted to its specific environment. The ecosystem within the crater is fragile and susceptible to disturbances from human activity.

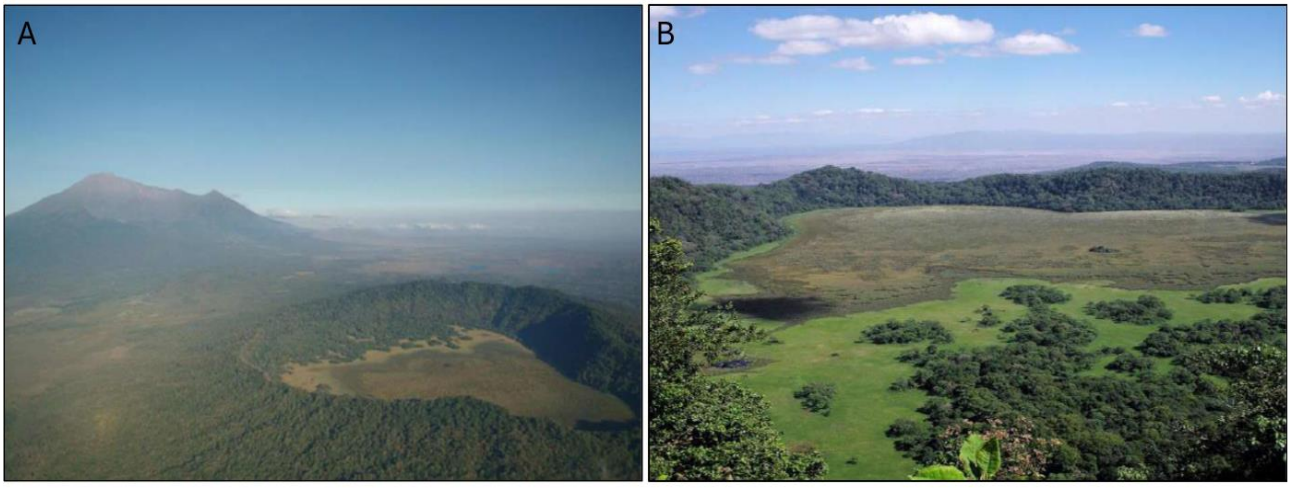


Figure 4. (A) Ngurdoto Crater from the aerial view, (B) Ngurdoto Crater from the close view (Source: Arusha National Geopark)

The Momella Debris Avalanche Deposit (DAD)

The Momella Debris Avalanche Deposit (DAD) (Figure 5) is located at latitude 3^0 16' 25.83'' S and longitude 36^0 53' 04.93''E within the Arusha National Park and protected under the national law of the Tanzania National Parks Act 1973 (Cap. 282)**.** Tanzania National Parks Authority (TANAPA) manages Arusha National Park. Once inside the park, the geosite is easily accessible on foot via the established trails. However, due to the extent of the geosite in terms of area, one can easily observe it from the viewpoint. The Momella Debris Avalanche Deposit (DAD) is an important geological feature that formed because of a massive volcanic landslide that occurred on Mount Meru (Delcamp et al., 2008). This debris avalanche is notable for its size and the insights it highlights into the volcanic processes, landslide dynamics, and sedimentary deposition (Scoon, 2021). It ranks as the largest of its kind recorded for a continental volcano worldwide.



Figure 5. The debris avalanche deposits on the lower eastern slopes of Meru form characteristic hummock ground (Source: Arusha National Geopark)

The sector collapse occurred approximately 8,600 years BP (Wilkinson et al., 1983, 1986), generating deposits that cover an area of about 390 km². These deposits were initially interpreted as laharic in origin (Wilkinson et al., 1983); however, their hummocky morphology and the presence of a horseshoe-shaped collapse scar are diagnostic of a debris-avalanche deposit

(Delcamp et al., 2008). Based on the volume of the missing volcanic sector, Roberts (2002) estimated the debris-avalanche volume at approximately 28 km³, ranking it among the largest documented debris-avalanche deposits worldwide.

Although most Debris Avalanche Deposits are prone to weathering and erosion because they consist of fragmented rock and loose material, Momella DAD remains in excellent condition. Its large size may have helped preserve it.

Momella lakes

The Momella Lakes are located at coordinates around 3^0 13' 19.04'' S and 36^0 54' 32.19''E in the northeastern region of the park, around 40km from the city of Arusha. The lakes are part of the protected area of Arusha National Park, managed by the Tanzania National Parks Authority (TANAPA), under the national law of the Tanzania National Parks Act 1973 (Cap. 282)**.** Accessibility is quite easy once you are in the park; visitors can access the lakes via the paved road on foot or by safari vehicles. Guided canoeing tours are also available on some of the lakes. There are designated viewpoints and pathways as well. As documented by Scoon (2021), the lakes are formed in depressions created by volcanic activity, which formed a hummocky landscape associated with Momella debris avalanche deposits. Momella lakes comprise three large lakes fed by subterranean streams, as well as smaller lakes, ponds, and marshes (Ghiglieri et al., 2012). They show distinct variations in chemical composition and alkaline levels despite originating from the same deposit (Ghiglieri et al., 2012; Bennett et al., 2021). Big Momella Lake (Figure 6B), reaching depths of 10 to 30 meters, has moderate alkalinity. Conversely, Small Momella Lake (Figure 6C) is renowned for its scenic charm, features shallower waters ranging from 4 to 10 meters (Scoon, 2021), with central sections characterized by alkaline and saline properties. Rishateni Lake (Figure 6D), though diminutive in size, stands out for its exceptionally high concentration of dissolved fluorine, stemming from the erosion of alkaline-rich volcanic rocks, potentially marking one of the highest levels recorded in natural lakes (Bennett et al., 2021). These distinct mineral compositions influence the growth of algae in each lake, contributing to their individual colours. They serve as crucial rest stops for a diverse array of migratory birds traveling between Europe, East Africa, and Southern Africa.The lakes and their surrounding wetlands are delicate ecosystems that support a variety of flora and fauna. The water levels of the lakes fluctuate seasonally and are influenced by rainfall and evaporation rates. Changes in climate or water usage upstream can significantly affect the lake's ecosystems.

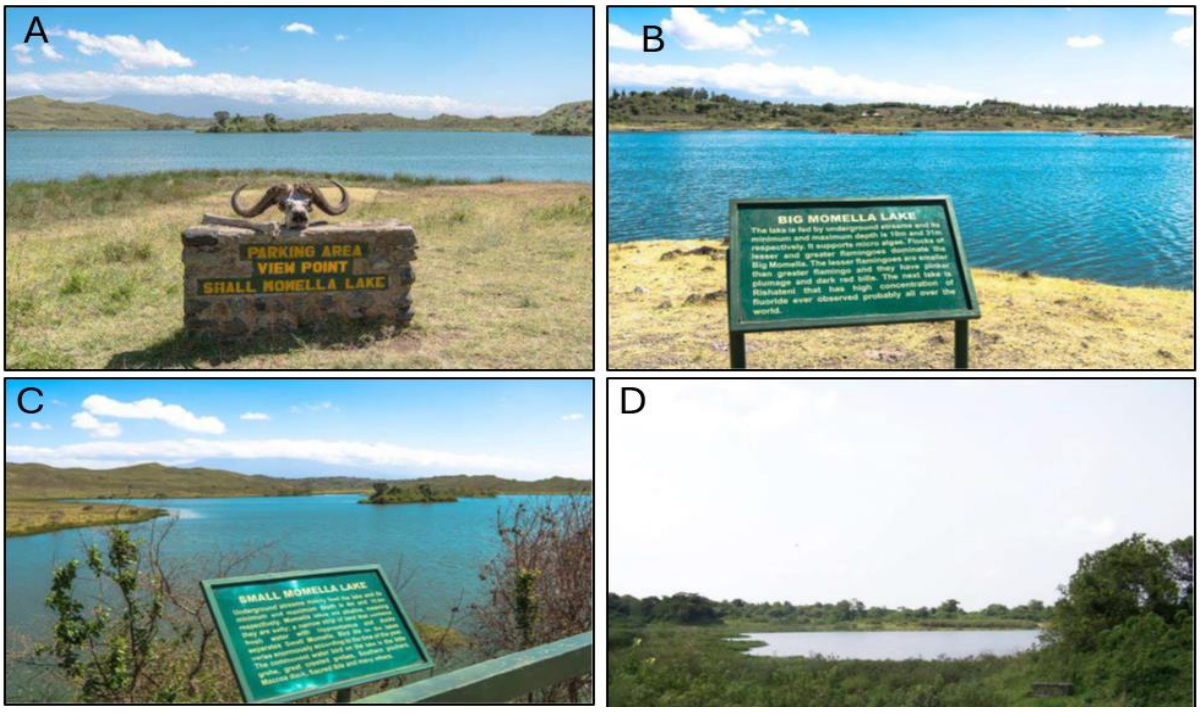


Figure 6. Parking space and viewpoint of Big Momella Lake (B), Big Momella Lake (C), Small Momella Lake (D), Rishateni Lake (Source: Arusha National Geopark)

The Ash Cone

The Ash Cone of Mountain Meru (Figure 7) is located at 3^0 14' 17.67'' S and 36^0 45' 47.29''E on the eastern side of Mountain Meru, within Arusha National Park. The ash cone, like the rest of Mountain Meru, is protected under the authority of Arusha National Park, which is managed by Tanzania National Park Authority (TANAPA) under the national law of the Tanzania National Parks Act 1973 (Cap. 282)**.** Accessibility is difficult due to its location at the summit of mountain Meru. However, there is a trail leading to the various parts of Mount Meru, including the Ash Cone, but due to the difficulties of the trails, visitors typically need to be accompanied by park rangers or guides, ensuring safety and compliance with the conservation rules. As documented by Scoon (2021), the Ash Cone is a pyramid-shaped formation that extends to around 1.5 kilometres in width and rises approximately 200 metres above the crater floor. It features dark ash and vesicular pumiceous blocks, some reaching diameters of up to thirty centimetres. Situated at the western base of the ash cone

lies a nephelinite lava dome, measuring 350 meters in diameter and standing 70 meters tall. From this dome, numerous subsequent lava flows emerged, cascading down the collapse scar and extending up to 7 kilometres. The exposed layers of volcanic materials offer a clear view of the stratification, allowing geologists to study past eruptive events and understand the volcano's history. The Ash cone can be easily eroded by heavy rains because of its loose volcanic materials. In addition, sparse vegetation on the cone provides little protection against erosion, making it particularly vulnerable. Mt. Meru may still be active, but the last eruption recorded on the Ash Cone was in 1910 (Scoon, 2021), so there is always a potential risk of volcanic activity, which could pose threats to the cone and its surroundings.



Figure 7. Mt. Meru Ash Cone (Source: Arusha National Geopark)

The Little Meru

Little Meru (Figure 8) is located on the eastern slope of Mountain Meru within the Arusha National Park, with the geographical coordinates of 3^0 12' 44.63'' S and 36^0 46' 27.49''E. It is part of Arusha National Park, protected under the management of the Tanzania National Parks Authority (TANAPA). This statutory protection ensures the conservation of unique geological, ecological, and cultural features, with regulations in place to manage and protect the natural environment from human impacts. Once you are in the National Park, Little Meru is accessible via well-maintained hiking trails beginning from the Momella Gate. Due to the difficulties in climbing it, the climb to Little Meru is typically included as an acclimatization hike for those ascending Mount Meru. The trail is clearly marked and suitable for trekkers with moderate fitness levels. Hikers are required to be accompanied by a licensed guide, which enhances safety.

As documented by Roberts (2002), Little Meru is part of the larger Mountain Meru volcanic complex, which has a history of volcanic activity. It is composed of volcanic rocks, including basalt and trachyte. It is a monogenetic volcanic cone, which ascends to 3800 meters in elevation northeast of the primary Meru cone. Its proximity to the main Meru cone has resulted in its southern slopes being enveloped by erupted lava, rendering it the most accessible route to the summit of Mt. Meru. The mountain's slopes contribute to local hydrological systems, with streams and rivers originating from its higher elevations. It is part of the Meru volcanic complex, which offers stunning views of the surrounding landscape, including the city of Arusha and Kilimanjaro on clear days.

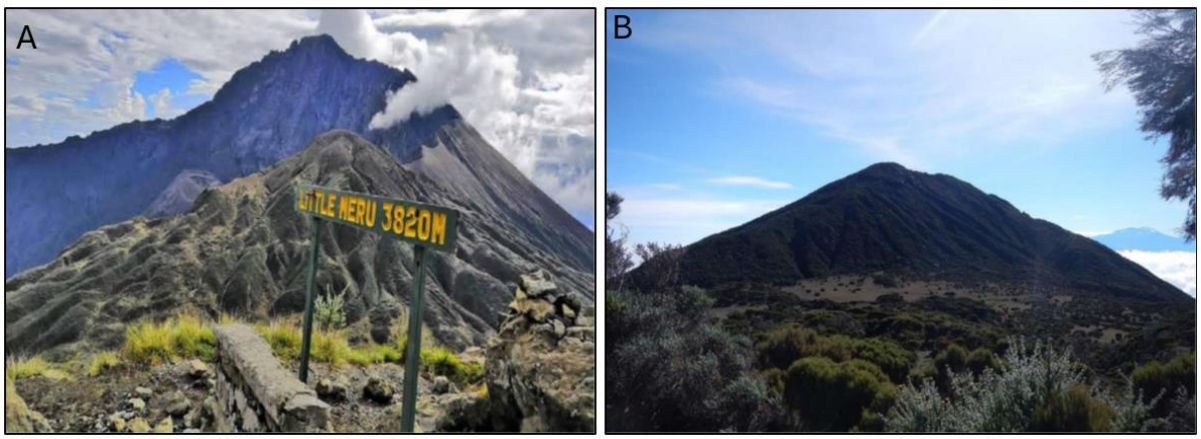


Figure 8. (A) Little Mt. Meru summit (B) Little Mt. Meru from the side view (Source: Arusha National Geopark)

The "Socialist Peak" of Mt. Meru

The socialist peak (Figure 9) is located at 3^0 14' 35.37'' S and 36^0 44' 59.30E. It is the highest point on Mountain Meru and stands 4566m above sea level. It is part of Mount Meru, which is protected under Arusha National Park and managed by the Tanzania National Parks Authority (TANAPA) under the national law of the Tanzania National Parks Act 1973 (Cap. 282)**.** Once you are in the park, Socialist Peak is accessible from the starting point of the trails leading to the summit of mountain Meru, at the Momella gate. However, to reach the summit of the mountain, one requires a multi-day trek along well-established trails. The trek usually takes 3-4 days. The licensed guides and porters, for safety and guidance, must accompany visitors. The Socialist Peak stands as the mountain's highest summit, representing the second generation of the Meru stratovolcano. According to Scoon (2021), after the formation of Mt. Meru's main cone about 200,000BP- 80,000BP, there was a period of volcanic inactivity, which was followed by erosion, during which gullies and ridges were carved out of the main cone. Around 60,000BP, a new burst of activity resulted in the formation of the Summit Group, a capping of lavas that include phonolite and nephelinite. The Summit Group forms a prominent, partially eroded 150m-high rock dome that includes the highest point on the mountain, Socialist Peak (Figure 9A & B). Interlayered deposits of fine and coarse-grained ash are prominent on the summit ridge. The ash deposits are intercalated with phonolite lava that has phenocrysts of alkali feldspar. From Socialist Peak, one can enjoy a clear and close view of Mt. Kilimanjaro, often accompanied by a triangular shadow cast during sunrise.

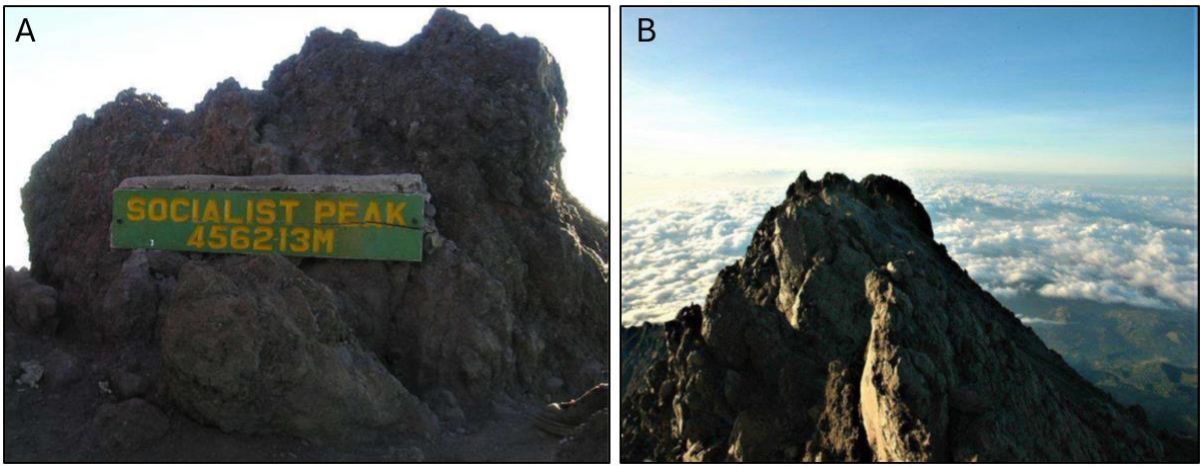


Figure 9. (A) The Socialist Peak from a close view. (B) The Socialist Peak from the aerial view (Source: Arusha National Geopark)

Tephra fall deposits geosite

This geosite is approximately located at 30 09' 13.63''S and 360 49' 27.49''E. It is part of Arusha National Park, protected under the management of Tanzania National Parks Authority (TANAPA) under the national law of the Tanzania National Parks Act 1973 (Cap. 282). This statutory protection ensures its conservation under the National Park. Once you are in the National Park, this geosite is located on the north-western slope of Mountain Meru, on the main road of Arusha-Nairobi, close to a Maasai village. According to Vye-Brown et al. (2014), the geosite consists of a gorge approximately 10 m deep that exposes a thick (>2.7 m) tephra fallout sequence, overlain by multiple tephra and ash-fall layers. These units are, in turn, capped by a pumice-rich deposit about 70 cm thick. The main fallout layer is clast-supported and composed predominantly of light-grey pumice clasts, with a low lithic content.

Phenocrysts are clearly visible within the pumice fragments, which typically measure around 3 cm in diameter, with frequent clasts reaching up to 5cm. Kisaka et al. (2021) did a well-documented study on composite stratigraphic succession representing three distinct explosive events. This geosite will be a good place to study tephra stratigraphy of the area because it has at least three tephra fall deposits, all of which are pumice-supported with abundant lithics. This geosite is vulnerable to natural erosion and weathering, especially during the rainy season.

RESULTS AND DISCUSSION

Quantitative Assessment of Scientific Value (SV) and Degradation Risk (DR)

The results for scientific value (Table 4) and degradation risk (Table 5) are in accordance with Brilha's methodology (2016). The evaluation reveals that all seven geosites have substantial scientific value with scores ranging from 275 to 325 out of the possible 400 points (Table 4). However, the DR varies across the geosites with values ranging from 65 to 205 out of 400 (Table 5). Geosites like Little Mt. Meru, The Ash cone and Socialist Peak have low degradation Risk, while Tephra fallout deposits and Momella Lakes have moderate degradation risk.

Table 4. Evaluation of geosites based on their scientific values

Scientific Value		**Name of geosite**						
Criteria	Weight (Max %)	Ngurdoto Crater	Momella DAD	Momella lakes	The Ash cone	Little Meru Mt.	The Socialist Peak	Tephra fallout deposits
Representativeness	120	120	120	120	120	120	120	120

Key locality	80	40	40	20	40	40	40	20
Scientific Knowledge	20	20	20	20	20	20	10	40
Integrity	60	60	60	60	60	60	60	60
Geological diversity	20	5	5	5	10	5	5	5
Rarity	60	45	60	60	60	30	30	30
Use limitation	40	10	20	20	10	10	10	20
Total	400	300	325	305	320	285	275	295

Table 5. Evaluation of geosites based on their degradation risk

Degradation risk		**Name of geosite**						
Criteria	Weight (Max %)	Ngurdoto Crater	Momella DAD	Momella lakes	The Ash cone	Little Meru Mt.	The Socialist Peak	Tephra fallout deposits
Deterioration of geological elements	140	35	0	70	35	35	35	140
Proximity to areas/activities with potential to cause damage	80	20	20	40	20	20	0	20
Legal protection	80	20	20	20	20	20	20	20
Accessibility	60	60	60	60	0	0	0	15
Density of population	40	10	10	10	10	10	10	10
Total	400	145	110	200	85	85	65	205

Quantitative Assessment of Educational and Touristic Potential Uses

The quantitative assessment on potential educational use (Table 6) and potential touristic use (Table 7) reveals that the evaluated geosites have varying levels of potential for educational and touristic use. Ngurdoto Crater, Momella lakes, and Momella DAD have the highest potential, making them prime sites for both learning and tourism. Conversely, Tephra Fallout Deposits have the lowest potential in both categories.

Table 6. Quantitative evaluation of geosites based on their potential educational use

Potential Educational Use		**Name of geosite**						
Criteria	Weight (Max %)	Ngurdoto Crater	Momella DAD	Momella lakes	The Ash cone	Little Meru Mt.	The Socialist Peak	Tephra fallout deposits
Vulnerability	40	20	40	20	40	40	40	20
Accessibility	40	40	40	40	0	0	0	20
Use limitation	20	15	10	15	5	5	5	10
Safety	40	40	40	40	30	30	30	20
Logistic	20	20	20	20	15	15	15	20
Density of population	20	5	5	5	5	5	5	5
Association with other values	20	20	20	20	10	10	10	10
Scenery	20	20	10	20	20	15	15	0
Uniqueness	20	10	40	15	10	5	10	10
Observation condition	40	20	40	40	30	20	40	40
Didactic potential	80	40	20	20	40	60	20	20
Geological diversity	40	10	20	10	10	10	20	10
Total	400	260	305	265	215	215	210	185

Table 7. Quantitative evaluation of geosites based on potential touristic use

Potential Touristic Use		**Name of geosite**						
Criteria	Weight (Max %)	Ngurdoto Crater	Momella DAD	Momella lakes	The Ash cone	Little Meru Mt.	The Socialist Peak	Tephra fallout deposits
Vulnerability	40	20	40	20	40	40	40	20
Accessibility	40	40	40	40	0	0	0	20
Use limitation	20	15	10	15	5	5	5	10
Safety	40	40	40	40	30	30	30	20
Logistic	20	20	20	20	15	15	15	20
Density of population	20	5	5	5	5	5	5	5
Association with other values	20	20	20	20	10	10	10	10
Scenery	60	60	15	60	60	45	45	0
Uniqueness	40	20	40	30	20	10	20	20
Observation condition	20	20	20	20	15	10	20	20
Interpretative potential	40	30	20	20	30	30	20	20
Economic level	20	10	10	10	10	10	10	10
Proximity of recreational areas	20	20	20	20	5	5	5	15
Total	400	320	300	300	245	215	225	190

A geosite is defined as an outstanding geological location where unique elements of geodiversity hold scientific, educational, cultural, or touristic value (Brilha, 2005). As a result, cataloguing geosites is essential for understanding

geoconservation. In recent decades, geoconservation practices (Sharples et al., 2002) have gained widespread recognition and now play a significant role in broader nature conservation efforts (Prosser et al., 2013). Growing environmental degradation caused by increasing human activity has highlighted the necessity to document, protect, and promote both biodiversity and geodiversity (Gray, 2013). The conservation of geological heritage has become an essential consideration for future legislation and policy development, facilitating more effective management of the natural environment through the protection of geosites (Gordon et al., 2018). To fulfil these objectives, implementing geosite conservation practices is necessary to mitigate both anthropogenic and natural deterioration and destruction (Prosser et al., 2013).

However, before planning or undertaking specific geoconservation measures, particularly in areas where such efforts can be enhanced, such as geoparks, it is critical to conduct thorough geosite assessments. These assessments identify their significance, potential threats, and the necessity for protection (Prosser et al., 2013; Crofts et al., 2020). Beyond geoconservation, geoparks also aim to foster sustainable development and generate economic benefits for local communities through geotourism and educational initiatives. Central to their mission is connecting people with nature and linking geodiversity with biodiversity, cultural heritage, and local communities (Gordon et al., 2018; Gordon, 2019; Farsani et al., 2014). Geotouristic and educational activities organized by geoparks play a vital role in disseminating geoscientific knowledge and geoconservation principles to the public (Farsani et al., 2014).

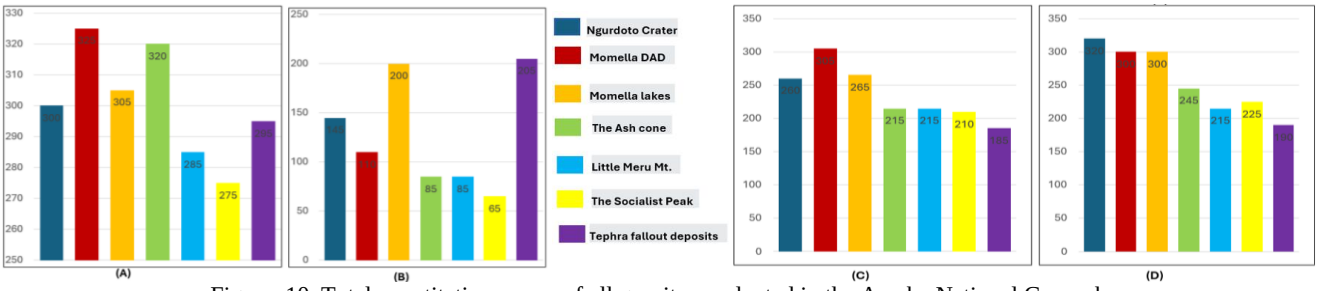


Figure. 10. Total quantitative scores of all geosites evaluated in the Arusha National Geopark
(A), Scientific Value (B), Degradation Risk (C), Potential Educational Value (D), and Potential Touristic Value

Based on the quantitative assessment (Figure 10), Ngurdoto Crater, Momella DAD, Momella lakes, Ash Cone, and the Tephra Fallout Deposits hold substantial scientific value (Table 4, Figure 10A) due to their unique geological formation and ecosystem as expressed by their representatives (120 points), contributing approximately 40% of the total score in all the geosites. The other contributing factors include integrity, scientific knowledge, and rarity (Table 4).

Momella lakes and Tephra Fallout Deposits have moderate degradation risks (Figure 10B) because of their high accessibility (60 points), and deterioration of geological elements (140 points) resepetively (Table 5). The moderate scientific value of the Tephra Fallout Deposits is threatened by its high degradation risk. Out of the 205 score for degradation risk, 140 points (68% weight) came from the criterion 'deterioration of geological elements' (Table 5). This geosite, therefore, needs urgent conservation efforts to prevent erosion and other forms of damage. Ngurdoto Crater has a moderate degradation risk, which can be managed by controlling access to the geosite. On the other hand, the trio of Ash Cone, Little Meru, and the Socialist Peak has a low degradation risk due to their poor accessibility, low density population, and distance from activities that have the potential to cause damage of geological elements.

All the geosites except Tephra Fallout Deposits have moderate to high potential for educational use (Figure 10C) because of their didactic potential, geological diversity, association with other values, uniqueness, accessibility, and safety (Table 6). The poor scenery (0 points) of the Tephra Fallout Deposits contributes to its low potential educational use, limiting the current use of the site. A strategic development to protect and promote this geosite is therefore required.

Ngurdoto Crater, Momella DAD, and Momella lakes all have a high potential touristic value because of their scenery, interpretation potential, accessibility, safety, and uniqueness. The Socialist Peak geosite has moderate scientific value (275 points) and low degradation risk (65 points). It also has moderate educational and touristic potential. This can be attributed to its poor accessibility, specifically the difficulties in ascending it and the lack of excellent infrastructure in place.

The high educational and touristic potentials of the Ngurdoto Crater suggest it is well suited for educational programs and tourism, if conservation measures are enforced to mitigate the impact from increased human activity. Similarly, the high scientific and educational values of the Momella DAD highlight its importance as one of the most remarkable geosites in the geopark. Its low degradation risk also reflects the favourably maintained conservation status of the geosite. However, the site needs interpretative materials and guided tours to improve its touristic appeal.

The Momella lakes geosite has substantial scientific (305 points) and touristic values (300 points), particularly for studies on hydrogeology and biodiversity. However, the higher degradation risk calls for stringent conservation measures to protect the water quality and surrounding habitat from human and natural impacts.

The Mt. Meru Ash Cone has high scientific value (320 points) due to its volcanic features and relatively low degradation risk, indicating good stability. However, its moderate educational (215) and touristic (245) scores suggest a need for improved accessibility and interpretative resources to enhance its use and appreciation by visitors and scholars. Little Meru Mountain shows moderate scientific value (285) and low degradation risk (85), making it a stable geosite. Its moderate educational and touristic potentials indicate underutilization, suggesting a need for development of infrastructure and educational programs to maximize its geoconservation benefits.

CONCLUSION

The seven geosites evaluated within the Arusha National Geopark highlight their considerable scientific, educational, and touristic significance, reflecting the exceptional geodiversity associated with Mount Meru's volcanic history. All evaluated geosites exhibit moderate to high scientific value, confirming their relevance for geological research and heritage interpretation. However, the degradation risks vary significantly, with sites such as Momella Lakes and Tephra Fallout Deposits requiring urgent conservation measures to mitigate erosion, human impacts, and environmental threats. Ngurdoto Crater, Momella lakes, and Momella DAD emerged as the most promising sites for educational and touristic development, indicating their strong potential for geotourism and community engagement. Overall, there is a need for tailored geoconservation strategies, improved interpretative infrastructure, and sustainable tourism planning to enhance the visibility, protection, and utility of the geosites. Strengthening these efforts will support the geopark's aspirations for UNESCO Global Geopark status and reinforce long-term stewardship of Tanzania's unique geoheritage.

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THE IMPACT OF TOURISM DEVELOPMENT DIMENSIONS ON THE EFFECTIVENESS OF CONSERVING MARINE CULTURAL HERITAGE IN THANH HOA PROVINCE, VIETNAM

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Abstract: This study examines how tourism development dimensions influence the effectiveness of conserving marine cultural heritage in Thanh Hoa Province, Vietnam, and clarifies the mediating role of overall tourism development and the moderating role of conservation policy. A mixed-methods design was adopted, including semi-structured interviews with 45 stakeholders and a questionnaire survey that produced 540 valid responses. The quantitative data were analyzed using Cronbach's Alpha, exploratory factor analysis, confirmatory factor analysis, and structural equation modeling. The findings indicate that tourism development policy, tourism infrastructure, heritage-based products, community participation, and human resource quality all have positive and statistically significant effects on overall tourism development. Among these factors, heritage-based products and tourism infrastructure exert the strongest effects. Overall tourism development, in turn, has a strong positive effect on heritage conservation effectiveness and mediates the effects of the five development dimensions on conservation outcomes. The moderation analysis further shows that conservation policy strengthens the relationship between overall tourism development and conservation effectiveness, meaning that tourism growth is more likely to generate conservation benefits when regulations, monitoring, sanctions, carrying-capacity management, and reinvestment mechanisms are effectively implemented. The study contributes an integrated empirical model for understanding how tourism resources and governance mechanisms jointly support marine cultural heritage conservation at the provincial level. The results suggest that Thanh Hoa should prioritize authentic heritage-based products, synchronized infrastructure, trained human resources, substantive community participation, and conservation policies that activate and guide tourism development toward sustainable conservation outcomes.

Keywords: community participation; conservation policy, heritage conservation; marine cultural heritage, Thanh Hoa Province, tourism development, Vietnam

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INTRODUCTION

Marine cultural heritage (MCH) refers to the cultural form, culture and practice based on the interaction between coastal people and sea, and tangible and intangible heritage resources related to sea environments (Ounanian et al., 2021). It is also becoming apparent as an underwater cultural heritage that is inextricably linked with marine ecosystems and that requires more integrated conservation strategies that link cultural and ecological stewardship (Meyer-Kaiser & Mires, 2022). Due to the integrated nature of the coastal management and planning of cultural-heritage management, MCH can be effectively protected through integrated governance, since it is deeply embedded in dynamic coastal systems and across multiple jurisdictions (Breen et al., 2024; Flannery et al., 2022; Khakzad et al., 2015).

New syntheses also indicate a fast increase in the scope of MCH studies, as well as the correlation with the agendas of coastal management and sustainable tourism (Huang et al., 2024; Phuong & Lam, 2025). Regarding tourism, MCH could be converted to heritage-related products that convey the local significance of the context, e.g., cultural and cuisine customs, and create genuine experiences of visitors (Dai et al., 2021; Phrammanachot et al., 2026).

Applied research also indicates that incorporating MCH into the coastal management system can facilitate the protection of the coastal systems in a broader sense (Holly et al., 2022).

Heritage-based tourism can also be used to create awareness and enhance local dedication towards conservation when developed sustainably (Nguyen, 2025). Nevertheless, commercialization and excessive tourism may erode cultural identities and perceived authenticity to underpin conservation in the long run because human development pressures affect these issues (Quang et al., 2022). Thanh Hoa has a long coastline and a rich marine cultural landscape (festivals, fisheries, cuisine, relics, and scenic sites) and has also been among the localities with rapid growth in coastal tourism in recent years (Nguyen & Lam, 2025). However, management practice indicates that the effectiveness of conserving

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marine cultural heritage is substantially influenced by the level of synchronization of infrastructure and environmental services, the quality of human resources (especially interpretive/guiding capacity), the degree of community participation, governance capacity, as well as the effectiveness of conservation policy implementation in coordination and supervision (Thanh Hoa Provincial People's Committee, 2024).

This suggests that conserving marine cultural heritage is a composite outcome, dependent on how destinations transform tourism development inputs into resources and conservation governance mechanisms.

According to the literature, the dimensions of tourism development are often addressed in terms of groups of factors: (i) institutions/policy; (ii) technical-physical conditions (infrastructure); (iii) market-product; (iv) social factors (community); and (v) resources (human resources), and the outcomes of heritage conservation are also associated with these factors (UNWTO, 2018). Stakeholder engagement and community involvement are consistently mentioned in works on the topic concerning coastal and marine settings as one of the major strategies to facilitate the alignment of tourism development with conservation objectives (Breen et al., 2024; Pham-Do & Pham, 2020; Quang et al., 2023; Rasoolimanesh et al., 2017; Sumarmi et al., 2026). Spatial zoning and information-supported decision-making tools also become more widely used to ensure that the development of ecotourism in the marine sphere is balanced between exploitation and conservation (Shabrina et al., 2026). Newer research in the Vietnamese heritage studies also focuses on interactive strategies that bridge heritage investigation and sustainable tourism evaluation (Azzopardi et al., 2023; Do & Kieu, 2026 ; Truong & Knight, 2025). Moreover, alternative tourism is mentioned as one of the ways to diversify products and promote territorial development by means of participatory governance (Fatnassi et al., 2026).

Despite the previous literature recognizing the contributions of the factors, empirical data are still almost divided on the basis of the sets of variables and hardly ever consider the causal pathway of factors in tourism development dimensions tourism development to conservation effectiveness of the marine cultural heritage at the local scale. Specifically, the conservation policy as a moderating mechanism to activate/amplify the effect of tourism development to conservation efficacy has not been explicitly measured using structural modeling on the case of Vietnam coastal provinces.

The study aims to examine how tourism development dimensions (tourism development policy, tourism infrastructure, heritage-based products, community participation, and human resource quality) affect overall tourism development and, through it, influence the effectiveness of conserving marine cultural heritage in Thanh Hoa; it also investigates whether conservation policy amplifies the relationship between overall tourism development and conservation effectiveness. To address these questions, the study proposes an integrated model (Figure 1) and operationalizes the concepts following a concise measurement logic with consistent terminology as follows: CS refers to the adequacy and effectiveness of the institutional framework promoting tourism development; HT refers to the availability and quality of connectivity infrastructure and public, environmental, and digital services supporting the visitor experience; SP refers to the diversity and attractiveness of heritage-based experience packages; TG refers to the substantive participation of the community in co-management, service provision, and benefit sharing; NL refers to the level of service skills and interpretive / guiding capacity; PT refers to the destination's overall development in terms of growth and competitiveness; QT refers to the clarity and effectiveness of implementing conservation regulations and standards, monitoring and sanctions, carrying-capacity management, and reinvestment mechanisms; and BT refers to the attainment of conservation objectives regarding authenticity/integrity, the continuation of cultural practices, and improvements in governance and interpretation quality.

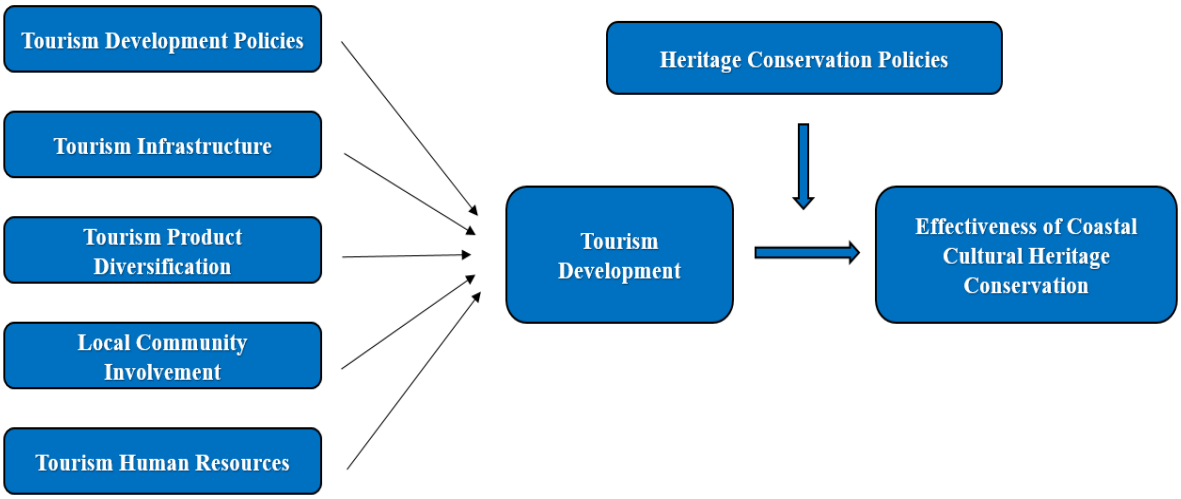


Figure 1. Research model (Source: Author's research results)

MATERIALS AND METHODS

Study area and research design

The research was done in Thanh Hoa Province, which paid attention to the coastal and near-coastal tourism space and communities practicing marine cultural traditions (Government Portal, 2023). The study was carried out using a mixed-methods methodology to integrate the advantages of qualitative studies (context clarification and refinement of

measurement tools) and quantitative studies (model and hypothesis testing) according to the guidelines of mixed-method studies in the social sciences (Creswell & Plano Clark, 2017).

Qualitative phase: The study conducted semi-structured interviews with 45 participants from the following groups: government officials, management boards/cultural units, businesses/accommodation providers, community representatives, and experts. Semi-structured interviews were selected because they ensure consistency through an interview guide while remaining flexible enough to elicit context-specific information (Kallio et al., 2016). The number of participants met the "data saturation" logic in qualitative research (Guest et al., 2006). Qualitative findings were used to review the content of observed variables, standardize terminology, and refine questionnaire wording prior to the large-scale survey.

Quantitative phase: The study used a questionnaire survey with a 5-point Likert scale (Likert, 1932), collecting 540 valid responses for factor analysis and structural modeling (Hair et al., 2010). The data were cleaned, coded, and used to describe sample characteristics; the sample structure is presented in Table 1.

Table 1. Characteristics of the survey sample (n = 540) (Source: Author's survey data)

Characteristic group	Category	Frequency	Percentage (%)
Gender	Male	291	53.9
	Female	246	45.6
	Prefer not to answer	3	0.6
Age	18-25	20	3.7
	26-35	173	32.0
	36-45	128	23.7
	46-55	103	19.1
	Over 55	116	21.5
Respondent group	Residents	139	25.7
	Tourists	210	38.9
	Businesses/accommodation providers	128	23.7
	Government agencies	63	11.7
Education level	High school	64	11.9
	Vocational/college	173	32.0
	Bachelor's degree	282	52.2
	Postgraduate	21	3.9
Main occupation	Agriculture/fisheries	126	23.3
	Tourism services	187	34.6
	Government	150	27.8
	Students	77	14.3

Scales, research variables, and the questionnaire

The research model comprises eight constructs in the context of marine cultural heritage in Thanh Hoa. The five exogenous variables include CS (tourism development policy), HT (tourism infrastructure), SP (heritage-based products), TG (community participation), and NL (human resource quality). PT (overall tourism development) serves as the mediating variable; BT (heritage conservation effectiveness) is the dependent variable; and QT (conservation policy) is the moderating variable. The questionnaire uses a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree), which is appropriate for measuring perceptions/attitudes in social research (Likert, 1932). The scale development and refinement process followed standard scale-development logic: defining constructs, developing observed variables, expert/stakeholder content review, and refinement through qualitative work prior to the formal survey (DeVellis, 2016). The coding and content of the observed variables are presented in Table 2.

Table 2. Measurement scales and coding of observed variables (Likert 1-5) (Source: Author's research results)

No.	Factor	Code	Description of observed variable
1	Tourism development policy CS)	CS1	Local policies prioritize tourism development linked to marine heritage.
2		CS2	Procedures/permits for coastal tourism activities are clear and transparent.
3		CS3	Incentive mechanisms (tax, land, credit) support sustainable tourism projects.
4		CS4	Tourism planning integrates objectives for conserving marine cultural heritage.
5	Tourism infrastructure (HT)	HT1	Transportation to marine heritage sites is convenient.
6		HT2	Water supply/drainage and waste services for tourism meet demand.
7		HT3	Visitor facilities (piers/parking/service areas) are adequate.
8		HT4	Digital infrastructure (digital maps, Wi-Fi, digital signage) supports the experience.
9		HT5	On-site signage/interpretation at heritage sites is clear and bilingual.
10	Heritage-based products (SP)	SP1	There are many cultural marine experience products (festivals, craft villages, cuisine, etc.).
11		SP2	Heritage visit routes/tours are designed to be attractive.
12		SP3	Products are distinctive and reflect local identity.
13		SP4	Heritage performances/introductions are organized regularly.
14		SP5	Destination information (website/app/social media) is sufficient and easy to access.
15	Community participation (TG)	TG1	The community participates in management and tourism service provision.
16		TG2	Residents benefit fairly from tourism activities.

17		TG3	Community opinions are consulted when new tourism projects are proposed.
18		TG4	Tourism does not disrupt local livelihoods/traditions.
19		TG5	The community is willing to work with visitors to protect resources and heritage.
20	Human resource quality (NL)	NL1	Personnel have expertise and a professional service attitude.
21		NL2	Guides/interpreters are knowledgeable about marine cultural heritage.
22		NL3	Businesses/accommodation providers comply with civilized codes of conduct.
23		NL4	Training and upskilling are conducted regularly.
24	Overall tourism development (PT)	PT1	Local tourism has grown steadily in recent years.
25		PT2	Tourism improves community income and welfare.
26		PT3	A destination image/brand is built around marine culture.
27		PT4	Tourism management is coherent and oriented toward sustainability.
28	Conservation effectiveness (BT)	BT1	Community/visitor awareness of conservation has improved.
29		BT2	Conservation activities are carried out regularly and effectively.
30		BT3	Heritage retains authenticity, limiting excessive commercialization.
31		BT4	The environment/landscape associated with heritage is improved.
32		BT5	Tourism benefits contribute to reinvestment in conservation.
33	Conservation policy (QT)	QT1	Clear regulations/criteria exist for conservation in tourism exploitation.
34		QT2	Resources (finance/personnel) for conservation are ensured.
35		QT3	Monitoring and sanctions for violations involving heritage are enforced.
36		QT4	Cross-sector collaboration (culture-tourism-environment-government) is effective.

Data analysis procedure

To be sure that measurement reliability and validity could be achieved before hypothesis testing, quantitative data were processed according to a conventional scale development and structural equation modeling (SEM) sequence (Hair et al., 2010; Kline, 2023). Scale reliability: Scale internal consistency was determined with Alpha of Cronbach (Cronbach, 1970).

EFA: EFA was carried out as a technique of investigating the structure of factors that lay behind the observed variables and to eliminate those variables that failed to meet the factor-loading requirements (Hair et al., 2010).

CFA: CFA was conducted to assess the measurement model (factor loadings, the whole model fit, and the construct validity). The assessment of the model fit adhered to commonly used recommendations of SEM fit (Hu & Bentler, 1999; Kline, 2023). Convergent and discriminant validity: The AVE/CR method was used to test convergent validity and the Fornell-Larcker criterion was used to evaluate discriminant validity comparing shared variance among constructs (Fornell & Larcker, 1981; Hair et al., 2010). SEM Structural equation modeling was used to test the hypothesized relationships between constructs and to estimate the direct and indirect effects (Hair et al., 2010; Kline, 2023).

Mediation test: The research investigates the mediating effect of PT of the correlation between CS/HT/SP/TG/NL and BT with nonparametric bootstrapping with 5,000 resamples, and presents normal bias-corrected confidence intervals (CIs). The 95 percent confidence interval can be found not to contain zero on an indirect effect to determine that this effect is statistically significant (Hayes, 2022). The study also gives a rough estimate with the use of the product of coefficients method, i.e. multi-plying the standardized coefficients along the component paths (e.g. CS → PT and PT → BT) to allow the comparison of the direction and relative strength of the indirect pathways (Hayes, 2022). Moderation testing: The interaction term (PT × QT) tested as moderating the effect of conservation policy (QT) was standardized in the structural model, which is similar to conditional process and interaction-effect testing (Hayes, 2022; Kline, 2023).

RESULTS AND DISCUSSION

Research results

1. Scale reliability (Cronbach's Alpha)

Scale reliability was assessed using Cronbach's Alpha to examine the internal consistency of the observed variables within each construct (Cronbach, 1970). Following common practice in behavioral and social research, observed variables with a corrected item-total correlation (CITC) below 0.30 are considered to contribute weakly to the scale and should be considered for removal to improve reliability (DeVellis, 2016). In addition, an Alpha value of 0.70 or above is generally regarded as acceptable for research purposes (Nunnally & Bernstein, 1994).

The results show that four observed variables with low CITC values were removed: CS3, TG1, TG4, and QT2. After refinement, the scales achieved moderate to good reliability, with Alpha coefficients ranging from 0.748 to 0.843, indicating adequate internal consistency for subsequent factor analysis and structural modeling (Hair et al., 2010). Specifically, the CS scale increased from 0.665 to 0.762 after removing CS3; the TG scale increased from 0.665 to 0.781 after removing TG1 and TG4. For QT, QT2 was removed and the scale was adjusted according to the model, retaining QT1 and QT3 with an Alpha of 0.748, which meets the minimum acceptable threshold (Nunnally & Bernstein, 1994). The detailed reliability results are presented in Table 3.

Removing observed variables with low CITC values helps improve reliability without altering the conceptual meaning of the construct, while also providing a foundation for EFA/CFA to test factor structure and scale validity (DeVellis, 2016). Notably, the QT scale retained only two items after refinement, which should be monitored in the CFA step (factor loadings and measurement model fit), because a small number of observed variables may affect estimation stability; however, in applied SEM, short scales can still be acceptable if factor loadings and overall model fit are satisfactory (Kline, 2015).

Table 3. Cronbach's Alpha and deleted items (Source: Author's data analysis results)

Scale group	Initial no. of items	Initial Alpha	Deleted items (CITC < 0.3)	Alpha after refinement
CS - Tourism development policy	4	0.665	CS3	0.762 (3 items)
HT - Tourism infrastructure	5	0.839	None	0.839 (5 items)
SP - Heritage-based products	5	0.837	None	0.837 (5 items)
TG - Community participation	5	0.665	TG1, TG4	0.781 (3 items)
NL - Human resource quality	4	0.814	None	0.814 (4 items)
PT - Overall tourism development	4	0.810	None	0.810 (4 items)
BT - Conservation effectiveness	5	0.842	None	0.842 (5 items)
QT - Conservation policy	4	(before deletion)	QT2 (and model-based refinement)	0.748 (2 items: QT1, QT3)

2. EFA: Assumptions and factor structure

After the scales were screened for reliability using Cronbach's Alpha, the study proceeded with exploratory factor analysis (EFA) to (i) assess the suitability of the data for factor analysis and (ii) examine the preliminary factor structure of the measurement instrument (Hair et al., 2010). Regarding assumptions, the KMO index reflects the adequacy of the correlation matrix for factor extraction, while Bartlett's test indicates whether the correlation matrix differs significantly from an identity matrix; these are two widely used prerequisite tests prior to EFA (Field, 2018).

The results indicate that the data met the conditions for EFA, with KMO = 0.921 (a "very good" level) and a statistically significant Bartlett's test (Sig. = 0.000), suggesting that the observed variables were sufficiently intercorrelated to form latent factors (Hair et al., 2010). The cumulative variance explained reached 53.734%, with eight factors having eigenvalues > 1, indicating that the scale structure had adequate explanatory power and was appropriate for proceeding to CFA in the next stage. The summary results are presented in Table 4.

Table 4. KMO/Bartlett and total variance explained (EFA) (Source: Author's data analysis results)

Indicator	Value
KMO	0.921
Bartlett - Approx. Chi-Square	6,887.841
Bartlett - df	465
Bartlett - Sig.	0.000
Total variance explained (cumulative)	53.734%
Number of factors extracted	8

Regarding factor structure, after EFA the observed variables loaded onto the expected construct groups, and the primary loadings were generally at an acceptable level, indicating the clarity and consistency of the scale structure (Hair et al., 2010). In applied practice, factor loadings of approximately ≥ 0.50 are often considered practically meaningful in the context of large samples; therefore, the primary loadings in these results support retaining the observed variables for the CFA step (Hair et al., 2010; Field, 2018). A summary of the factor structure is presented in Table 5.

Table 5. Factor structure after EFA (Source: Author's data analysis results)

Factor	Construct group	Observed variables loading on the factor (primary loading)
1	SP	SP5 (0.764), SP2 (0.722), SP4 (0.701), SP3 (0.660), SP1 (0.603)
2	HT	HT3 (0.780), HT4 (0.762), HT1 (0.717), HT5 (0.675), HT2 (0.589)
3	BT	BT5 (0.785), BT4 (0.717), BT1 (0.692), BT3 (0.683), BT2 (0.651)
4	NL	NL1 (0.792), NL3 (0.710), NL4 (0.708), NL2 (0.645)
5	PT	PT3 (0.780), PT2 (0.682), PT4 (0.681), PT1 (0.662)
6	TG	TG3 (0.778), TG2 (0.719), TG5 (0.672)
7	CS	CS2 (0.739), CS1 (0.713), CS4 (0.639)
8	QT	QT1 (0.848), QT3 (0.713)

The EFA results confirm an eight-factor structure consistent with the proposed conceptual model and indicate that the scales exhibit good convergent patterning within each construct. Notably, QT comprises only two observed variables; therefore, in the CFA step it is necessary to closely monitor standardized loadings and measurement-model fit, and to clearly report convergent and discriminant validity indices (CR/AVE) to strengthen the argument for the scale's validity.

3. CFA: Convergent and discriminant validity

The study employed confirmatory factor analysis (CFA) to evaluate the measurement model, including (i) overall model fit and (ii) scale validity through convergent and discriminant validity (Hair et al., 2010).

Fit indices were interpreted based on commonly recommended SEM fit thresholds (Hu & Bentler, 1999). The CFA results indicate that the measurement model achieved a good fit: Chi-square = 589.450; df = 406; Chi-square/df = 1.452; GFI = 0.934; CFI = 0.972; TLI = 0.968; RMSEA = 0.029; PCLOSE = 1.000. This set of indices supports the conclusion that the measurement model demonstrates good fit and is appropriate for proceeding to structural model testing in the SEM step (Kline, 2015). The CFA model is illustrated in Figure 2.

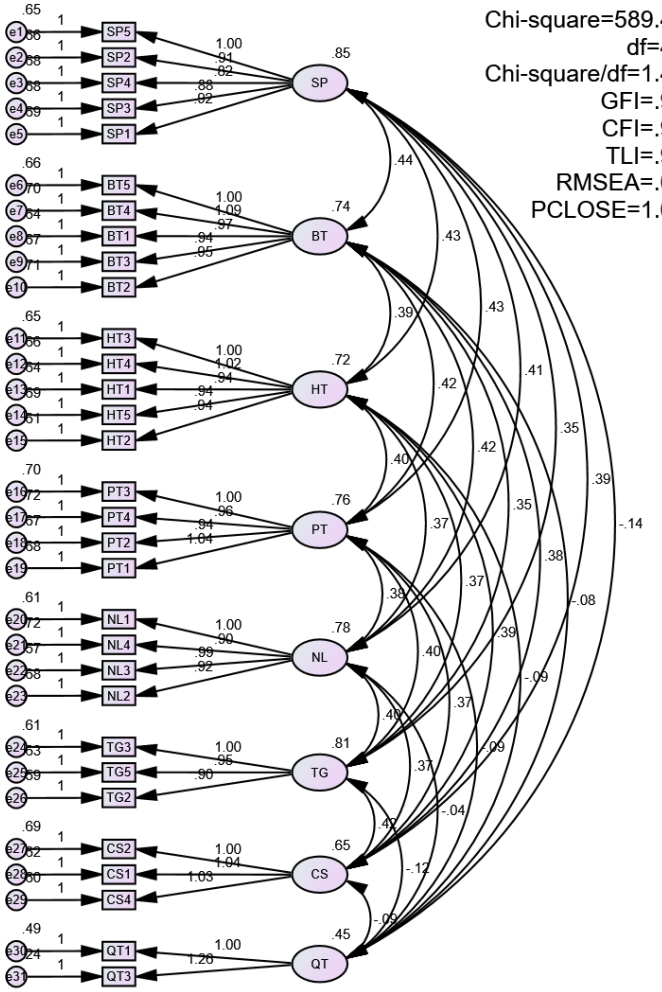


Figure 2. Overall fit of the measurement model (CFA) (Source: Author's research results)

Next, convergent validity was assessed using Composite Reliability (CR) and Average Variance Extracted (AVE), where CR reflects the composite reliability of the scale and AVE indicates the proportion of variance explained by the latent construct (Fornell & Larcker, 1981). Discriminant validity was examined using the criterion MSV < AVE, meaning that the maximum shared variance of a construct with another construct must be smaller than its average variance extracted, to ensure that constructs are distinct at the measurement level. The summary results in Table 6 show that all scales met the required thresholds: CR ≥ 0.757 and AVE ≥ 0.507, and MSV < AVE, confirming both convergent and discriminant validity.

Table 6. CR, AVE, and MSV (Source: Author's CFA results)

Scale	CR	AVE	MSV	Remarks
SP	0.837	0.507	0.309	Convergent and discriminant validity achieved
BT	0.843	0.517	0.311	Convergent and discriminant validity achieved
HT	0.839	0.510	0.318	Convergent and discriminant validity achieved
PT	0.811	0.517	0.311	Convergent and discriminant validity achieved
NL	0.814	0.523	0.310	Convergent and discriminant validity achieved
TG	0.781	0.544	0.333	Convergent and discriminant validity achieved
CS	0.762	0.517	0.333	Convergent and discriminant validity achieved
QT	0.757	0.612	0.051	Convergent and discriminant validity achieved (very strong)

Following the process of reliability refinement, the observed QT2 was dropped; hence, the QT scale had two observed indicators. The few indicators notwithstanding, QT has shown good reliability and convergent validity, with CR = 0.757 (> 0.70) and AVE = 0.612 (> 0.50). Moreover, MSV = 0.051 is lower than the AVE, which means that the discriminant validity has also been guaranteed. In addition, both the measurement model and structural model had acceptable overall model estimates (CFA: 2/df = 1.452, RMSEA = 0.029, CFI = 0.972, TLI = 0.968; SEM: 2/df = 1.663, RMSEA = 0.035) which also helps to justify the acceptability of the QT scale in the study setting. The CFA results reinforce that the measurement instrument is appropriate for capturing the constructs in the research model. Notably, although the QT scale contains a small number of observed variables (two items), it still achieved strong CR and AVE values and a very low MSV. This suggests that QT's convergent and discriminant validity remain well supported in the measurement model; however, in international reporting it is important to clearly emphasize the CR/AVE evidence and the overall model fit as presented above.

4. SEM: Model fit and hypothesis testing

Structural equation modeling (SEM) was used to simultaneously test (i) the effects of the five tourism development dimensions (CS, HT, SP, TG, NL) on overall tourism development (PT) and (ii) the effect of PT on conservation effectiveness (BT). The analysis also evaluated mediation effects (via PT) and the moderating effect of conservation policy (QT), in line with recommendations for structural modeling.

4.1. Model fit: CFA and SEM

Fit indices indicate that both the measurement model (CFA) and the structural model (SEM) achieved good fit. Specifically, the CFA yielded $\chi^2/df = 1.452$ and RMSEA = 0.029, while the SEM produced $\chi^2/df = 1.663$ and RMSEA = 0.035. In addition, comparative fit indices (CFI/TLI/IFI) were all greater than 0.95, consistent with commonly used SEM fit thresholds (Hu & Bentler, 1999). The full set of fit indices is summarized in Table 7.

Table 7. Model fit indices (CFA and SEM) (Source: Author's research results)

Index	CFA	SEM	Suggested threshold
χ^2/df	1.452	1.663	< 5 (good if < 2–3)
GFI/AGFI	0.934 / 0.919	0.928 / 0.913	> 0.90
RMR	0.044	0.075	The smaller, the better
CFI	0.972	0.962	> 0.90 (good if > 0.95)
TLI	0.968	0.957	> 0.90
IFI	0.972	0.962	> 0.90
NFI	0.916	0.910	> 0.90
RMSEA	0.029	0.035	< 0.08 (good if < 0.05)
PCLOSE	1.000	1.000	> 0.05
HOELTER .05	416	365	> 200

Both the CFA and SEM models achieved good fit. The CFA results show $\chi^2/df = 1.452$ and RMSEA = 0.029; the SEM results show $\chi^2/df = 1.663$ and RMSEA = 0.035; and CFI/TLI/IFI are all > 0.95. The SEM model is shown in Figure 3.

The fact that SEM fit indices remained good after moving from CFA to SEM indicates that the hypothesized relational structure fits the data and that the model can be used to interpret direct and indirect effects with confidence (Hair et al., 2010).

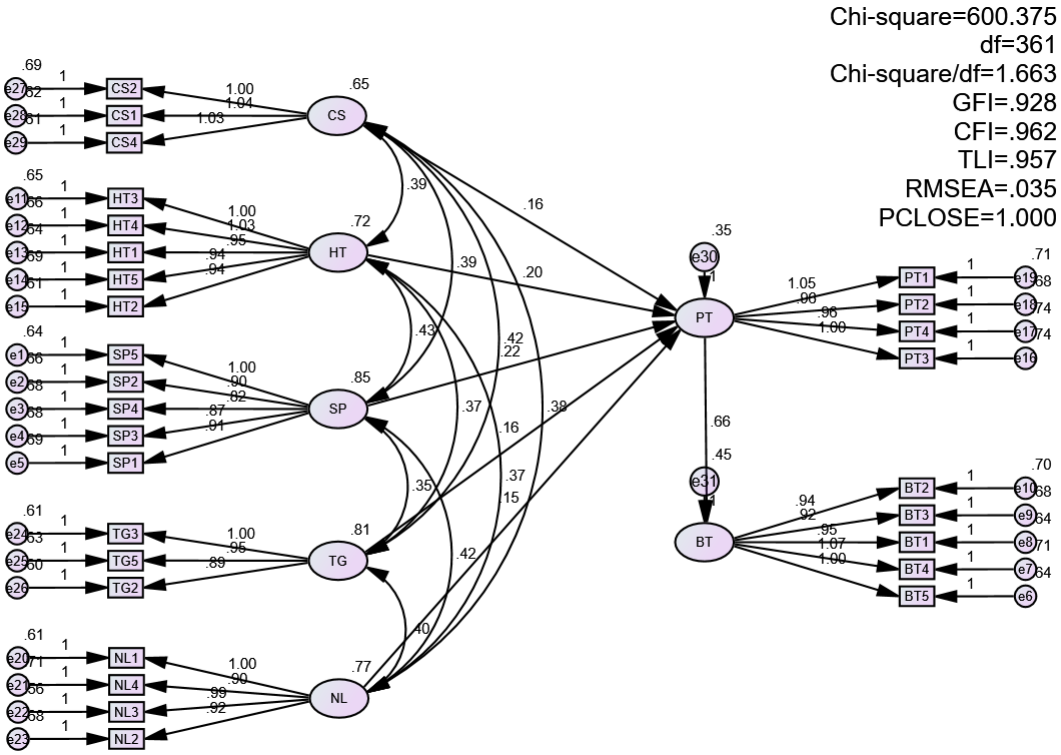


Figure 3. SEM model (Source: Author's research results)

4.2. Hypothesis testing: direct effects

SEM results indicate that CS, HT, SP, TG, and NL all have positive and statistically significant effects on PT, thereby supporting hypotheses H1-H5. Among these dimensions, SP has the strongest effect on PT ($\beta = 0.235$), followed by HT ($\beta = 0.198$). In addition, PT has a very strong effect on BT ($\beta = 0.639$), supporting H6 and reinforcing the argument that overall tourism development is an important channel through which development resources are transformed into conservation outcomes (Kline, 2015). The direct effect estimates are reported in Table 8.

Table 8. SEM results: direct effects (Source: Author's SEM results)

Relationship	β	p-value	Conclusion
PT ← CS	0.157	0.023	H1 supported
PT ← HT	0.198	0.001	H2 supported
PT ← SP	0.235	< 0.001	H3 supported
PT ← TG	0.173	0.005	H4 supported
PT ← NL	0.157	0.007	H5 supported
BT ← PT	0.639	< 0.001	H6 supported

4.3. Indirect effects via PT: mediation testing

Due to the high impact of PT on BT, the impact of CS/ HT/ SP/ TG/ NL on BT will be indirectly mediated by PT. The study also indicates indirect effects following the recommendation of the reviewer with nonparametric bootstrapping (5,000 resamples) having a 95% bias-corrected confidence interval (CI) to identify statistical significance; an indirect effect is significant when 95% CI excludes 0. Table 9 also presents an approximate estimate, based upon the product of coefficients method (i.e. the product of standardized coefficients along the component paths), to compare the direction and relative magnitude across the indirect pathways to supplement the current presentation. This pattern implies that interventions at the dimension level-especially heritage-based products and infrastructure-contribute to conservation primarily by raising the overall level of tourism development (PT), rather than producing immediate direct effects on BT.

Table 9. Indirect effects via PT (Source: Synthesized from the author's SEM results)

Indirect pathway	Approx. coefficient	Significance	Remarks
CS → PT → BT	≈ 0.100	p < 0.01	Positive, significant
HT → PT → BT	≈ 0.127	p < 0.01	Positive, relatively strong
SP → PT → BT	≈ 0.150	p < 0.001	Strongest
TG → PT → BT	≈ 0.111	p < 0.001	Positive, significant
NL → PT → BT	≈ 0.100	p < 0.01	Positive, significant

4.4. Moderation testing: the role of conservation policy (QT)

To test H7, the study standardized variables (Z-scores) and introduced the interaction term PT × QT into the model. The results show that: (i) standardized PT has a strong positive effect on BT (Estimate = 0.419; p < 0.001); (ii) standardized QT alone is not statistically significant at the 0.05 level (p = 0.100); but (iii) the PT × QT interaction is clearly significant and positive (Estimate = 0.258; p < 0.001; standardized coefficient = 0.266). According to moderation logic, this indicates that QT amplifies the effect of PT on BT-that is, when conservation policy is implemented more effectively, the extent to which tourism growth is translated into conservation effectiveness becomes higher (Hayes, 2018). The moderation results suggest an important governance implication: conservation policy is not merely an "independent input" but acts as an "activating mechanism" that enables PT to generate better BT outcomes. In other words, tourism development can create resources and incentives, but the effectiveness of implementation, monitoring and sanctions, carrying-capacity management, and reinvestment mechanisms determines whether that growth is translated into conservation outcomes.

Table 10. Moderation results (standardized Z-scores) (Source: Author's moderation analysis results)

Relationship	Estimate	S.E.	C.R.	p-value	Standardized coefficient
Z_BT ← Z_PT	0.419	0.037	11.351	***	0.419
Z_BT ← Z_QT	-0.060	0.037	-1.645	0.100	-0.060
Z_BT ← PT×QT	0.258	0.036	7.232	***	0.266

The SEM results show that the dimensions CS, HT, SP, TG, and NL all positively affect overall tourism development (PT), with heritage-based products (SP) exerting the strongest influence, followed by infrastructure (HT). PT strongly affects conservation effectiveness (BT) and serves as a mediator for the indirect effects. At the same time, conservation policy (QT) moderates the relationship in a strengthening direction; that is, better implementation effectiveness of QT helps PT translate more clearly into BT (Hair et al., 2010; Hayes, 2018; Kline, 2015).

The prominent roles of SP and HT are consistent with the argument that destination competitiveness is determined by experience quality (products) and accessibility/service capacity (infrastructure) (UNWTO, 2018). The PT → BT result reinforces the view that "tourism can support conservation" by generating resources, raising awareness, and improving governance conditions, if managed appropriately (UNESCO, 2015). The moderating effect of QT aligns with the observation that conservation improves only when clear regulations, monitoring and sanctions, and implementation capacity are in place-especially under pressures of overcrowding and commercialization (ICOMOS, 2022; UNESCO, 2003).

CONCLUSION

This study tested a model of how tourism development dimensions affect the effectiveness of conserving marine cultural heritage in Thanh Hoa, while clarifying the mediating role of overall tourism development (PT) and the moderating role of conservation policy (QT). The results show that tourism development policy, infrastructure, heritage-based products, community participation, and human resource quality all positively influence PT, with products and infrastructure

emerging as two prominent drivers. PT strongly affects conservation effectiveness, and most effects of the dimensions on conservation occur indirectly through PT. QT moderates in a strengthening direction, implying that when conservation policy is implemented effectively, tourism development is more clearly translated into conservation outcomes.

Based on these findings, the study recommends prioritizing the development of heritage-based tourism products in ways that enhance experiential value while protecting authenticity; investing in infrastructure and environmental infrastructure; improving human resource quality; promoting community participation and benefit sharing; and designing conservation policy to manage carrying capacity, strengthen monitoring and sanctions, and operate reinvestment mechanisms for conservation to ensure sustainable development linked with conservation.

The research possesses a number of limitations: (i) the cross-sectional and self-reported data might cause common method bias; (ii) due to refinement, the QT scale consisted of only two indicators that were observed; and (iii) the research was limited to one locality and therefore cannot be generalized. Even though QT once again was in the satisfactory CR and AVE values and the overall model fit was high, the few number of indicators possibly diminished the coverage of the construct in the content. The next generation of studies needs to extend the design both in time and in different destinations, include more objective data, and create/add more data on the QT, which should be re-evaluated on the scale of reliability and validity.

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ASSESSMENT OF THE RECREATIONAL POTENTIAL OF LAKES IN THE ESIL RIVER BASIN (WITHIN THE NORTH KAZAKHSTAN REGION)

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Abstract: Lakes represent primary physiographic features that attract significant tourist flows. Their presence, distribution, hydrological regimes, hydrochemical profiles, and other characteristics serve as critical determinants for the development of the tourism industry. The lacustrine systems of the North Kazakhstan Region function as natural biomes for semiaquatic and aquatic nesting and migratory birds; furthermore, they contain concentrated stocks of ichthyofauna, therapeutic muds, sapropels, and brine (rapa). To date, a comprehensive assessment of the recreational potential of these lakes for integration into the tourism sector has not been previously conducted. This comprehensive evaluation encompasses four primary dimensions: functional, sanitary-hygienic, aesthetic, and technological. The assessment was based on an integrated analysis of ten criteria: morphometric, hydrological, hydrochemical, and hydrobiological indicators, as well as climatic factors, aesthetics, transport accessibility, current economic utilization, and the sanitary-ecological state. Each criterion comprised a specific set of variables. In total, 20 distinct parameters were examined, including: linear dimensions, surface area, water mass volume, mean depth, mineralization (salinity), average water and air temperatures, wind velocity, among others. Thirty-three key lakes within the Esil River basin were selected as focal points for this study. A specialized database was developed, and geoinformation mapping was performed using the ArcGIS 10.8 software suite. The evaluation employed a point-based scoring system. During the scoring process, the weight of each criterion was accounted for through the application of a significance coefficient. As a result of the study, the recreational potential of the region's lakes was determined, followed by their classification and physiographic regionalization based on suitability for the tourism sector. The obtained results allowed us to identify 5 levels of the recreational potential of the lakes of the studied region: low, below average, medium, increased/good high, very high. Specific types of tourist and recreational activities were proposed for designated lake clusters.

Keywords: lake, recreational potential, North Kazakhstan Region, assessment, Esil River basin

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INTRODUCTION

In the modern scientific paradigm, the study of natural and recreational potential acquires strategic significance, forming the methodological basis for the development of the tourism industry. The transformation of tourism into a significant sector of the national economy and an instrument of sustainable development determines the growing need for comprehensive research aimed at assessing recreational potential (Wendt, 2020; Dmitriyev et al., 2025; Sagatbayev et al., 2025).

Lakes as multifunctional natural-territorial complexes possess significant recreational potential, determining their strategic importance for tourism development and sustainable regional development (Agybetova et al., 2023; Mukayev et al., 2020; Rakhimzhanova & Mussina, 2025). The recreational value of lake ecosystems is formed under the influence of a complex of natural and anthropogenic factors, creating unique conditions for the organization of various types of recreation, fishing, and health tourism (Akhmedenov, 2020; Valeyev et al., 2024; Tokpanov et al., 2021; Sagatbayev et al., 2019).

The hydrological characteristics of lakes, including temperature regime, duration of ice cover and swimming season, chemical composition of water and features of the coastline, act as key determinants of their recreational attractiveness (Sabri et al., 2025; Nazarova et al., 2019; Fomin et al., 2020). A review of international scientific publications led to the general conclusion about the need for a balanced approach combining the development of tourist infrastructure with the preservation of the natural environment and the introduction of sustainable methods of recreational stress management. The common denominator of all the work is the search for a balance between the economic development of lake territories and the ecological sustainability of their ecosystems (Gündüz, 2025; Rajkovic et al., 2025; Tessar, 2025). The natural and

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recreational potential favorable to tourism development in the North Kazakhstan region is determined by the high concentration of lakes, and the region ranks first in Kazakhstan in terms of the number of lakes. According to the state register, the number of lakes with an area of more than 10 hectares is 2,328 water bodies (Dmitriyev et al., 2018).

The numerous lakes of the region have limited economic application, mainly for fishing and in isolated cases for the use of therapeutic mud for balneological purposes (Kolomin, 2004; Dmitriyev et al., 2023).

To date, the level of use of lake systems does not meet the potential capabilities of water bodies and has not been fully studied. In this regard, the research and comprehensive assessment of the recreational potential of lakes in the North Kazakhstan region is an urgent task. The objective of the study was to conduct a comprehensive assessment of the recreational potential of the lakes within the North Kazakhstan Region situated in the Esil River basin.

Study Object

In the study, 33 lakes located in the Yesil River basin were selected. The schematic map of the location of the lakes under consideration is presented in Figure 1.

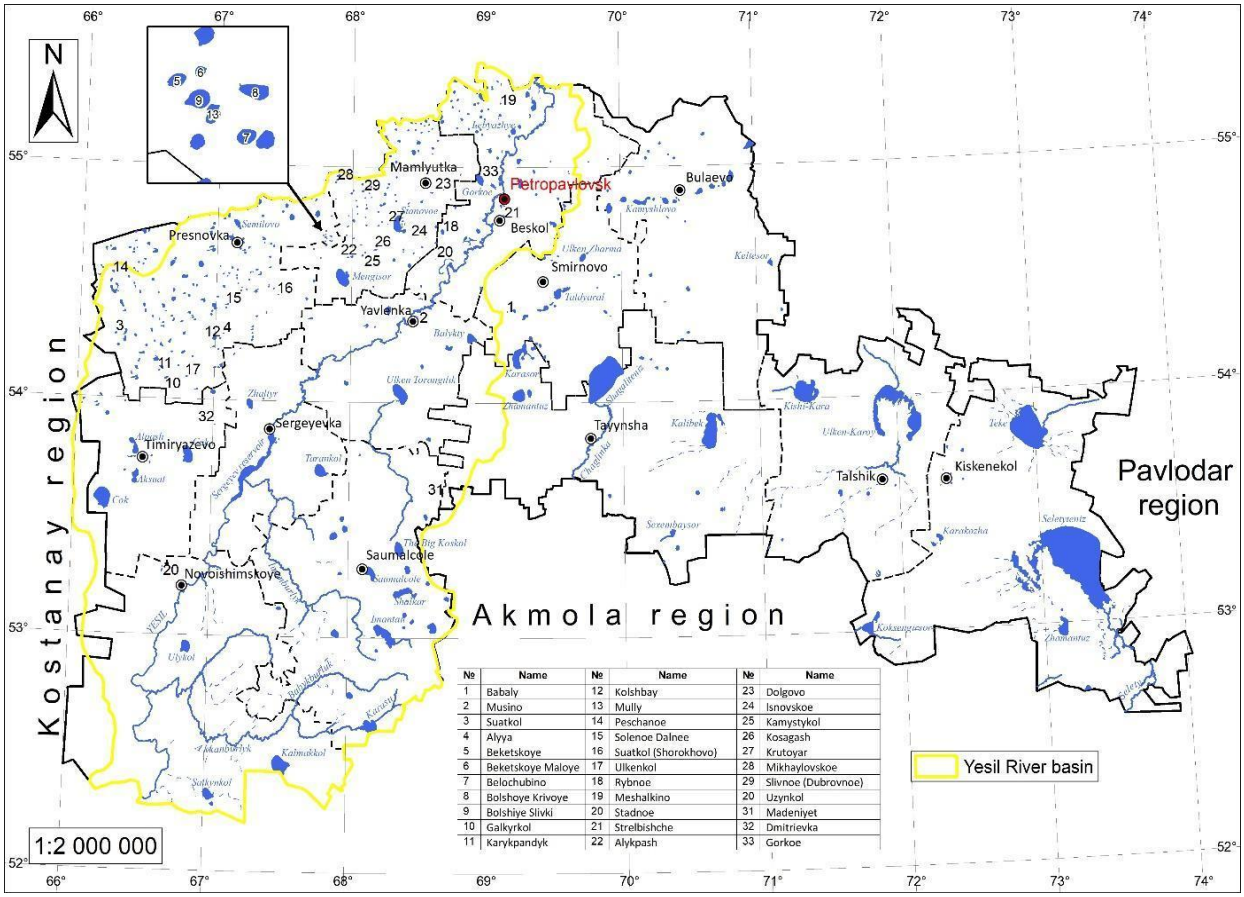


Figure 1. Schematic map of lakes locations (Source: developed by the authors)

The lakes are located within the boundaries of 9 administrative-territorial units of the North Kazakhstan Region (NKR): Akkaiynsky, G. Musrepov, Yesilsky, Zhambylsky, Kyzylzharsky, Mamlyutsky, Tayynshinsky, Timiryazevsky districts.

According to the genetic classification of lake basins, the lakes under consideration belong to the floodplain terraces of the Yesil River valley, floodplain, hollow-hilly-ridge types (Beletskaya et al., 2022). The source of nutrition for most lakes is the water mass coming from the catchment area during spring snowmelt. Underground waters play a small role in the hydrological regime of individual water bodies. The sizes of the lakes vary within significant limits from 3.1 ha Lake Madeniet (Tayynshinsky district) to 1,282 ha Lake Gorkoe (Kyzylzharsky district). For the most part, the lakes are small. By size, lakes can be grouped into small with an area not exceeding 10.0 ha; small, whose sizes vary within 10-50 ha (14 lakes - 43%); medium - 50-100 ha (12 lakes - 36%); large - 100-150 ha (4 lakes - 12%) and large - with an area exceeding 150 ha (3 lakes - 9%). The shape of the lakes is mainly oval. The bottom is flat with a gradual depression, usually covered with silty sediments. In some lakes, the bed is covered with organomineral accumulations (sapropel) (Kirillov et al., 2011; Dmitriyev et al., 2023). The slopes are low and gentle. The shores are slightly indented, accumulative.

Lakes are characterized by insignificant depth. Their maximum depth reaches 3 m - Lake Peschanoye (Zhambylsky district) and Lake Madeniet (Shunkyrkol) (Tayynshinsky district). The smallest depth indicator is noted on Lake Solenoe Dalnee (Zhambylsky district) - 0.55 m. The predominant part of lakes (15 or 45.5%) have depths from 1.0 to 2.0 m. Among the lakes under consideration, 15 (45.5%) have a depth from 2.1 to 3.0 m. The depth of 3 (9%) lakes does not exceed 1.0 m.

Due to the significant difference in the size and depth of lakes, the volume of their water mass varies from 0.095 million m³ Lake Madeniet (Shunkyrkol) (Tayynshinsky district) to 31.18 million m³ Lake Gorkoe (Kyzylzharsky district). According to this parameter, lakes are conditionally united into several groups: small, whose water mass volume does not exceed 1 million m³ (15 lakes - 45.5%); small - the volume of water mass is 1.1-2.1 million m³ (8 lakes - 24.2%); medium - the volume of water mass is equal to 2.1-4.0 million m³ (6 lakes - 18.3%), above average - 4.1-6.0 million m³ (3 lakes - 9%) and high-water - more than 6 million m³ (1 lake - 3%) (Dmitriyev et al., 2018). Most lakes are endorheic, and as a result, become final receivers of salts brought by surface runoff, groundwater and wind. The chemical composition of lake waters is characterized by great diversity and inconstancy of total mineralization and salt composition. Wide seasonal and multi-year fluctuations in salt concentration and their composition are associated with the extreme instability of the water regime of water bodies. The salinity of lakes sharply decreases during spring floods and increases by autumn, and in shallow lakes it also increases in winter due to ice formation. The mineralization of lake waters ranges from 141 mg/dm³ Lake Mully to 261,377 mg/dm³ Lake Solenoe Dalnee (Zhambylsky district). According to the degree of water salinity, the lakes under consideration can be divided into three groups: fresh - with mineralization up to 1 g/dm³, 20 lakes (61%) are assigned to this group; brackish - with mineralization from 1 to 25 g/dm³ - 12 lakes (36%), and hypersaline with mineralization more than 40 g/dm³ - 1 lake (3%). The indicator of water hardness of lakes differs significantly - from 2 meq./dm³ Alykpash (Mamlyutsky district) to 132.5 meq./dm³ Lake Solenoe Dalnee (Zhambylsky district). According to the degree of water hardness, lakes can be divided into 4 groups: with soft water - up to 4 meq/dm³, 9 lakes (27.3%) are assigned to this group; with water of medium hardness - from 4 to 8 meq/dm³ - 7 lakes (21.2%); with hard water - from 8 to 12 meq/dm³ - 9 lakes (27.3%); with very hard water - over 12 meq/dm³ - 8 lakes (24.2%). The value of oxidizability varies from 0.51 mg/dm³ Lake Belochubino to 35.6 mg/dm³ Lake Solenoe Dalnee (Zhambylsky district). For plain lakes, the values of permanganate oxidizability should not exceed 5-12 mg/dm³. For recreation, 15-30 mg/dm³ is allowed. In 13 (39%) lakes, this indicator exceeds the established norm, which indicates a high content of organic substances in the water.

The content of dissolved oxygen varies from 5.39 mg/dm³ Lake Stadnoe to 8.24 mg/dm³ Lake Gorkoe (Kyzylzharsky district). In general, the content of oxygen dissolved in water in lakes is favorable for most species of fish and invertebrates. The area of lake overgrowth differs significantly. The lowest rate of overgrowth is noted on Lake Gorkoe (Kyzylzharsky) - 3.2%, the highest on Lake Rybnoe (Zhambylsky district) - 98% (Dmitriyev et al., 2018; Kolomin, 2004).

Emergent and submerged plants play the main role in the overgrowth of water bodies. Among emergent plants, the leading place in the overgrowth of water bodies (in terms of area occupied and production of organic matter) belongs to common reed (*Phragmites australis*). In addition to reed, narrow-leaved cattail (*Typha angustifolia*) and lake rush (*Schoenoplectus lacustris*), flowering rush (*Butomus umbellatus*), common water-plantain (*Alisma plantago-aquatica*) and various species of sedge (*Carex* spp.) are of great importance in overgrowth.The degree of overgrowth of water bodies with aquatic vegetation is largely determined by the depth of the water body; the higher the depth, the lower the degree of overgrowth. This is explained by the biological characteristics of one or another species of aquatic vegetation. Thus, the most common type of rigid emergent vegetation - lake reed occupies areas with depths, as a rule, not exceeding 2.5 m. Among submerged plants, the leading place in lake overgrowth belongs to fennel pondweed (*Stuckenia pectinata*), shining pondweed (*Potamogeton lucens*), perfoliate pondweed (*Potamogeton perfoliatus*) and water milfoil (*Myriophyllum aquaticum*). The degree of overgrowth of water bodies with submerged vegetation changes not only by seasons of the year (its value reaches a maximum in July-August), but can differ greatly by years.

The hydrological regime of water bodies is generally favorable for the habitation of certain species of fish. The hydrochemical parameters of lakes are favorable for the habitation of certain species of fish, with the exception of Lake Solenoe Dalnee. The ichthyofauna is represented by 5 species from 2 families. Four species from the carp family (*Cyprinidae*) live in the lakes: silver crucian carp (*Carassius gibelio*), goldfish (*Carassius carassius*), roach (*Rutilus rutilus*) and tench (*Tinca tinca*), one species - Chinese sleeper (*Perccottus glenii*) from the sleeper family (*Odontobutidae*). The latter is non-commercial, acclimatized. The most widespread species is silver crucian carp. This species is native and has commercial significance. The wide distribution of this species in the lakes of the region is determined by the low requirement for the content of oxygen dissolved in water. There are no fish listed in the Red Book of Kazakhstan and the IUCN. Fish stocks in lakes vary within significant limits. The largest reserves (75.19 t) are noted in Lake Gorkoe (Kyzylzharsky district). The smallest volume of fish reserves among the lakes under consideration (0.531 t) was revealed in Lake Beketskoye (Zhambylsky district). In 4 lakes: Lake Stadnoe (Kyzylzharsky district), Lake Solenoe Dalnee (Zhambylsky district), Lake Kosagash (Mamlyutsky district), Lake Dmitrievka (Timiryazevsky district), not a single representative of ichthyofauna was caught, which indicates its absence in these water bodies.

Economic use and anthropogenic impact. The lakes under consideration are not included in the list of fishery water bodies and are not currently used for fishing and aquaculture purposes. A number of lakes are used for cattle watering (Lake Uzynkol, Musino, Isnovskoye, Mikhailovskoye, etc.). Many water bodies near settlements are used for water intake by filling special tanks (barrels) (Lake Mikhailovskoye, Isnovskoye, etc.) for watering gardens and household needs. Lake Gorkoe (Kyzylzharsky district) is part of the water supply facilities of Petropavlovsk city. It is a second-order storage pond for sewage treatment facilities of Limited Liability Partnership (LLP) (Kyzylzhar su LLP, 2025).

MATERIALS AND METHODS

Within the framework of the study, the recreational potential of lakes is considered as a set of natural, engineering-technical, ecological conditions and resources that are necessary to ensure the possibility of developing various types of recreational and tourist activities. Lakes as objects of recreation can be used for various types of recreation (beach-swimming,

fishing, walks, etc.). In this regard, the task of the study was not only to assess the recreational potential, but also to determine the most suitable type of recreation that can be recommended for the organization for the lakes under consideration.

To assess the recreational potential of North Kazakhstan Region lakes, a complex of criteria was determined, including morphometric, hydrological, hydrochemical, hydrobiological, sanitary-hygienic, aesthetic indicators and parameters.

A total of 20 evaluated parameters were selected: lake area, km²; average depth, m; volume of water mass, million m³; water mineralization, mg/dm³; water hardness, meq./dm³; oxidizability (permanganate), mg/dm³; dissolved oxygen in water, mg/dm³; overgrowth with emergent vegetation, %; fish resource reserves, t; diversity of ichthyofauna (species composition); character of the shore; character of the shallows (beach); approach to water; air temperature in summer during daytime, °C; air temperature in winter during daytime, °C; water temperature, °C; wind speed in summer and winter period, m/s; landscape diversity; transport accessibility, km; anthropogenic load. The assessment of the recreational potential of the region's lakes was carried out in 4 aspects: functional, sanitary-hygienic, aesthetic and technological. Lakes were evaluated from the standpoint of favorable conditions for the organization of recreational activities (presented in Figure 2).

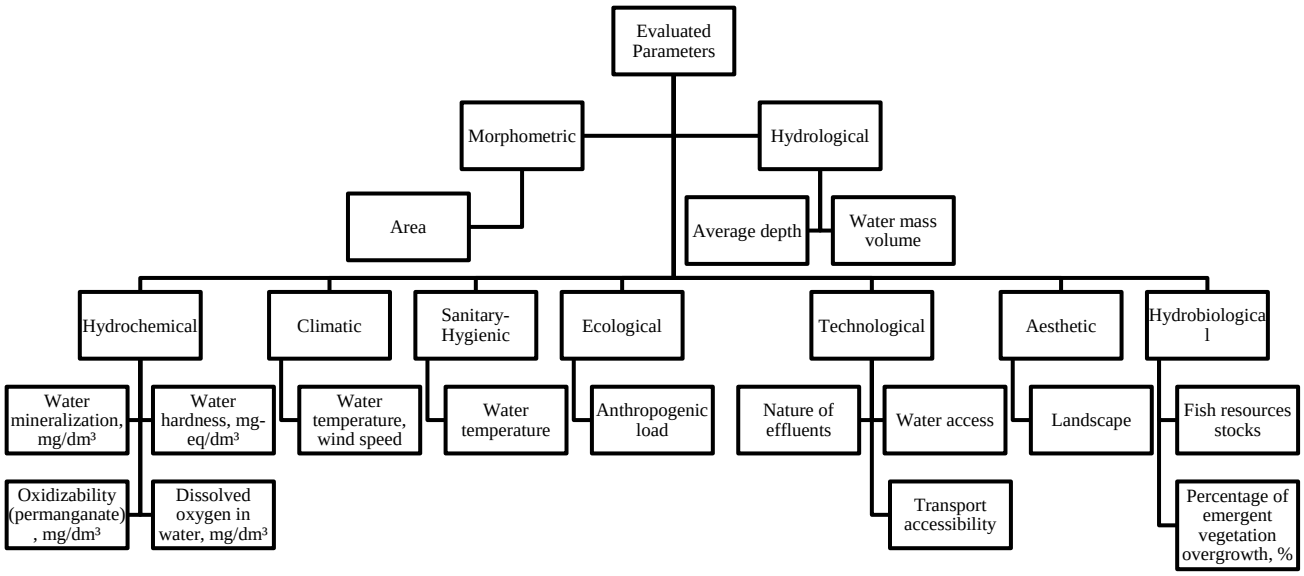


Figure 2. System of Evaluation Parameters and Indicators (Source: developed by the authors)

The necessary data for the assessment were obtained based on the analysis of available literary, cartographic materials, information provided by specialized institutions, as well as measurements and calculations carried out from satellite images, field research (2023-2025). The sources of initial data on morphometric, hydrological, hydrochemical, hydrobiological parameters of lakes were water body passports, hydrographic bulletins of the Branch of the Republican State Enterprise (RSE) "Kazhydromet" for the NKR, reports on the biological justification of lakes of the Communal State Institution (KSU) "Department of Natural Resources and Regulation of Nature Management of the Akimat of the NKR", Republican State Institution (RSU) "Yesil Basin Inspectorate for the Regulation of Use and Protection of Water Resources of the Committee on Water Resources of the Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan". The necessary climatic parameters were obtained based on the analysis of data from meteorological and climatic bulletins of the Branch of the RSE "Kazhydromet" for the North Kazakhstan Region for the period 2000-2024. Based on observations from meteorological stations and agricultural posts closest to the lakes, interpolation was used to calculate indicators of air temperature, wind speed for the warm and cold periods of the year (July, January) near the coastline and coastal zone of water bodies. Remote sensing data processing. To determine the surface temperature of water bodies, satellite images from the Landsat 8 satellite in the far infrared spectrum (Band 10) with wavelengths of 10.30-11.30 μm were used. Image processing consisted of the following stages:

1. The calculation of the spectral radiance of the upper atmospheric layers (Lλ) was performed in accordance with the official Landsat 8 radiometric calibration methodology published on the U.S. Geological Survey website (USGS, 2025):

$$L_\lambda = M_L \times Q_{cal} + A_L$$

where: L_λ - spectral radiance in channel 10, W/(m²·sr·μm); M_L - multiplicative coefficient (Radiance_Mult_Band_10); Q_{cal} - digital pixel value (DN) from Band 10 raster; A_L - additive coefficient (Radiance_Add_Band_10).

2. Calculation of brightness temperature of the upper atmosphere layers (USGS, 2025):

$$TB = K_2 / \ln(K_1/L_\lambda + 1)$$

where: TB - brightness temperature of the upper atmosphere layers, K; K_1, K_2 - thermal calibration constants; ln - natural logarithm; L_λ - spectral radiance in channel 10.

The implementation of this calculation was carried out in the Raster Calculator module of the ArcGIS software environment or similar spatial analysis tools. This formula allows converting digital pixel values from the raster (DN)

obtained from satellite images into a physically measurable quantity - radiance, expressed in watts per square meter per steradian per micrometer (presented in Figure 3). This is the first and necessary stage of thermal data calibration, without which it is impossible to conduct accurate temperature. The calculated brightness temperature (TB) is typically used as an intermediate metric for the subsequent determination of Land Surface Temperature. However, the obtained value does not reflect the physical properties of the underlying surface, particularly its emissivity. Therefore, to improve calculation accuracy and ensure physical interpretability, an additional correction accounting for the emissivity coefficient was applied.

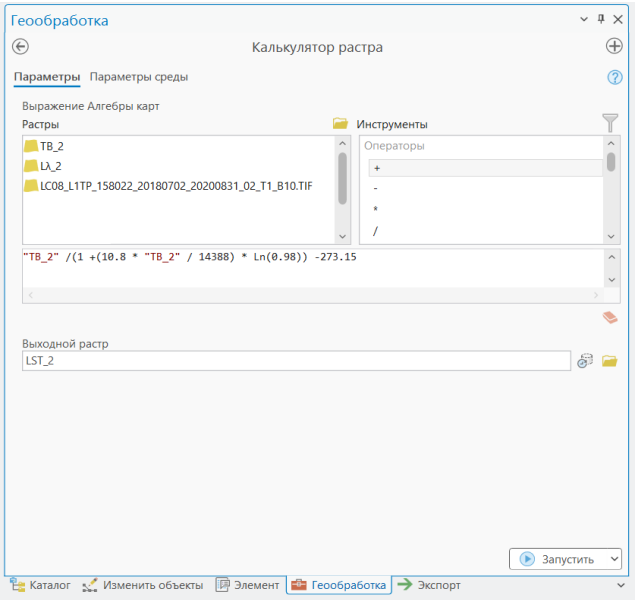


Figure 3. Example of a calculation in the Raster Calculator in ArcGIS Pro

3. Calculation of land surface temperature (LST):

At this stage, the formula for calculating land surface temperature (Land Surface Temperature, LST) was used, which allows converting brightness temperature into values close to the actual temperatures of land surface objects. This enabled a more accurate assessment of microclimatic conditions and facilitated a comparative analysis between different land cover types, including green spaces, water bodies, and residential areas (Le et al., 2015). To derive Land Surface Temperature (LST) from brightness temperature, a correction for surface emissivity is applied. The formula accounting for emissivity is presented below (Artis & Carnahan, 1982).

$$LST = \left(\frac{TB}{\left(1+\left(\lambda\times\frac{TB}{c_2}\right)\times ln\ln\left(\varepsilon\right)\right)}\right) - 273.15$$

where: LST - land surface temperature, °C; TB - brightness temperature of the upper atmosphere layers, K; λ = 10.8 μm - wavelength for Band 10 channel; c_2 = 14,388 μm·K - Planck's second constant; ε = 0.98 - surface emissivity coefficient; ln - natural logarithm (Artis et al., 1982; Kurolap et al., 2023).

Assessment methodology. The character of shallows and shores determine the ecological stability of the coastal strip and biodiversity of the coastal zone. Accessibility to water reflects the practical possibilities of using the lake for recreational purposes. Along with this, these characteristics ensure the safety, convenience and comfort of recreationists, the possibility of beach recreation. The above parameters were determined and evaluated during field research, as well as morphometric analysis of satellite images and photographs of water bodies. Landscape diversity is important for the visual perception of the lake and its surrounding landscape. This indicator was determined expertly during field research, as well as through visual perception and evaluation of a series of photographs of the water bodies under consideration.

Transport accessibility - the distance from the nearest paved road to the lake was calculated from satellite images (GoogleEarth) in the ArcGIS Pro program with clarification during field surveys. The evaluation parameters were collected and systematized in a single database. The latter was linked to the cartographic base. Geoinformation mapping of lakes was carried out using topographic maps with the involvement of electronic cartographic resources (GoogleEarth, Gis-lab.info, etc.). GIS mapping and spatial analysis was performed using the ArcGIS 10.8, ArcGIS Pro software package. To assess the level of recreational potential of the lakes, a composite (integrated) index (Ri) was applied, calculated using the Weighted Linear Combination (WLC) method, which is widely employed in multi-criteria spatial analysis (Malczewski, 1999; Eastman, 2012). The index was computed as the weighted average of the analyzed parameters, taking into account their relative significance. The calculation was performed using the following formula (USGS, 2025):

$$R_i = \sum k_i \sum a_i$$

where k_i - indicators of the i-th parameter, points; a_i - coefficient of importance of indicators k_i, unit fractions (weight) ($\sum a_i = 1$)

This approach allows simultaneously taking into account many factors affecting recreation comfort and obtaining comparable values for different water bodies. The assessment was carried out using a point system. Due to the fact that the selected parameters are characterized by significant heterogeneity, for the possibility of their comparison, absolute units of measurement were converted into relative ones (points). 5 points were assigned to the most favorable conditions for recreational use of lakes, 1 point - to unfavorable ones. Each evaluated indicator-parameter (i) was assigned a weight coefficient of significance (k_i), reflecting its contribution to the recreational use of lakes.

The methodology for determining the coefficient of significance included several steps. The significance of indicators was preliminarily evaluated expertly and ranked by 5 levels (very high, high, medium, low, etc.). Indicators were grouped into five blocks important for recreational use of lakes. Thus, indicators assigned to higher levels of significance received greater weights, less significant ones - smaller weights, while maintaining the overall consistency of the weight system. This ensured a certain hierarchy of evaluated parameters. The normalization of the initial indicators was carried out using the linear standardization method, whereby each parameter value was converted into a relative proportion within the overall set of analyzed indicators. This approach ensures the comparability of heterogeneous data (Malczewski, 1999). The calculation was performed using the following formula:

$$a_i = \frac{si}{\sum_{k=1}^{n} sk},$$

With this, $\sum a_i = 1$, which makes the weights comparable with each other. The higher the initial level of significance s_i, the greater the weight a_i, which means the stronger the influence of this indicator on the final recreational index.

The obtained values were normalized taking into account weight coefficients, and their sum became the resulting assessment of the recreational potential of lakes.

The following scale for assessing the recreational potential of lakes was adopted in the study (Table 1).

Table 1. Assessment of Recreational Potential of Lakes (Source: Developed by the authors, based on data from Kyzylzhar su LLP, 2025; USGS Landsat data USGS, 2025; RSE Kazhydromet, 2025)

Evaluation Criteria	Score Values					Weighting Coefficient
	5	4	3	2	1	
Area, km²	>150	150-100	100-50	50-10	<10.0	0.07
Average depth, m	>3.0	3.0-2.6	2.5-2.1	2.0-1.1	<1.0	0.09
Water mass volume, mln. m³	>6.0	6.0-4.1	4.0-2.1	2.0-1.1	<1.0	0.03
Water mineralization, mg/dm³	<1000.0	1000.1-1500.0	1500.1-2500.0	2500.1-4000.0	>4000.0	0.06
Water hardness, mg-eq./dm³	≤4.0	4.1-8.0	8.1-12.0	12.1-16.0	>16.0	0.03
Oxidizability (permanganate), mg/dm³	≤1.0	1.1-10.0	10.1-25.0	25.1-35.0	>35.0	0.03
Dissolved oxygen in water, mg/dm³	>8.0	8.0-7.1	7.0-6.1	6.0-5.1	≤5.0	0.06
Overgrowth percentage, %	≤5.0	5.1-10.0	10.1-25.0	25.0-50.0	>50.0	0.03
Fish resources stocks, t	>30.1	30.0-20.1	20.0-10.1	10.0-1.1	≤1.0	0.03
Air temperature in summer, °C	19.9	-	19.8	-	19.7	0.03
Air temperature in daytime during summer, °C	-15.9 and below	-	-16.0	-	-16.1 and below	0.02
Water temperature, °C	>25.1	25.0-24.1	24.0-23.6	23.5-23.1	<23.0	0.08
Wind speed during warm period, m/s	2.6	2.7	2.8	2.9	>3.0	0.02
Wind speed during cold period, m/s	2.6-2.8	2.9-3.1	3.2-3.4	3.5-3.7	3.8-4.0	0.02
Nature of shallow (beach)	Wide gentle shallow: bottom gradually deepens to 1.5-2 m from shore, further to 2.5-3 m, sandy-silty soil, with sandy-loamy soil, vegetation development is well-expressed.	Gentle shallow: shore depth 1.5-3 m with gradual deepening at 0.5-2 m from shore, sandy bottom with soil; participation of underwater vegetation in coastal strip, rocky sites, developped plant groupings, coastal vegetation is well-expressed.	Moderate shallow: shore depth increases from 0.5-2 m to 10-15 m from shore; stony-sandy bottom; vegetation varies; shore and underwater vegetation development; coastal plants are rare.	Steep shallow: shore depth reaches 5-10 m at 5-10 m from shore, stony or rocky bottom without vegetation; bank vegetation; water entry is polluted.	Shallow absent: shore overgrown, immediately >10 m depth; solid (boulders, rocks), without bank or aquatic vegetation, shoreline plants on adjacent areas.	0.05

Shore character	Low gentle shore (≤0.3-1 m height) with uniform natural vegetation cover (grasses, reed); sandy-silty substratum, bereg, shore relatively flat, minimally dissected.	Moderately gentle shore (≤1-1.5 m) with herbaceous vegetation; alternating grassy and reed sections interspersed with gallery-forest sections and reed areas.	Moderate elevation (1.3-2 m): alternating marshy and elevated shoreline sections; coastal vegetation varies; vegetation traces visible to eroded soils; shoreline vegetation is rare.	Steep shore (2-3 m): elevated and reinforced sections of the coastline, signs of erosion; overgrown with stone, gravel, shrubs (willow, birch); shore deeply dissected erosion.	Very steep or artificially reinforced shore (>3 m): denuded or covered with retaining walls or riprap structures; no or sparse vegetation.	0.05
Water access	Free access: equipped path, no dense vegetation, soft silty entrance (sand/silt), safe access for person and equipment.	Moderately free: there is grassy path or soft grassy area, minor areas of difficult access in water up to soft ground, accessible in most areas, small natural obstacles.	Difficult access: path present, shore overgrown (reeds, cattails, rushes), limited access, water entry requires overcoming natural obstacles.	Very difficult: dense marshy or culturally overgrown shore (marshes, bushes, dense undergrowth), possible access along shore, steep descent only from narrow paths.	Absent: shore strongly degraded or absent, shore impassable (silty marshes, floodland, bog), physical or legal barriers (restrictions); practically no access to water.	0.10
Multi-plan landscape	High: pronounced multi-plane relief – foreground (coastal-shore vegetation by promenade, near plains with coastal edge), middle plane (open water surface or lake, water elements), and background plane (distant trees, shrubs). Viewpoints: diverse, abundant colorful natural textures and contrasts.	Moderate: two-three planes for example, near lake and distant shore, or near shore and lake background, less variety, landscape elements present (shrubs, rare trees, poles).	Medium: one-two planes – open lake and shore or coastal shore with lake, possibly one dominant element (solitary landmark, prominent tree, shrub area).	Low: one plane only – monotonous flat or swampy area, single or two perspective plane elements (distinctive landmark, plains in visible surrounding areas).	Absent: absolutely flat landscape – single plane, swampy or artificially dominated elements; no distinctive elements, excessive agricultural use; lack of recreational spatial dominant elements.	0.04
Transport accessibility, km	<1.0	1.1-10.0	10.1-20.0	20.1-30.0	>30.1	0.07
Anthropogenic load	Absence of human impact signs: natural condition, no buildings, roads or dumps; water is clean, minimally affected by eutrophication.	Weak impact: insignificant anthropogenic changes or rare dispersed campsites - infrequent activities, sporadic parking, small-scale grazing or hay making, infrequent waste accumulation or footpath, trash, minor traces of livestock grazing.	Moderate impact: proximity of fields, pastures or villages; visible logging and waste dumpsites; moderate shoreline overgrowth and presence of noticeable trash accumulation, slight colored plant-related trash.	Strong impact: directly adjacent farms or land use or industrial facilities or roads; regular discharge (waste, wastewater), significant amounts of trash and traces of mass tourism, regulated canals, colored water.	Critical load: presence of heavy industrial or acute facilities directly adjacent to water; significant water surface pollution (waste, chemical, oil spills, discharge eutrophication), shore transformed into dump, ecosystem extremely polluted.	0.09

Table 2. Scale for assessing the recreational potential of North Kazakhstan Region lakes (Source: developed by the authors)

R Value	Level of Recreational Potential
< 2.0	Low
2.0-2.5	Below average
2.5-3.0	Medium
3.0-3.5	Increased/Good
> 3.5	High, Very high

RESULTS AND INTERPRETATION

The highest assessment score is for Lake Peschanoye - 3.52, the lowest for Lake Stadnoe - 2.38. The average indicator was 2.87 points. The result of the assessment of the recreational potential of lakes showed that most of the water bodies under consideration have a sufficiently high recreational potential, are favorable for various types of recreation. Peschanoye is the only lake assigned to the group with very high recreational potential. Good prospects for recreation development on this lake are associated with a favorable combination of conditions for organized recreation (morphometric, fish resource reserves, transport accessibility, etc.). This lake is popular among "wild" tourists. Increased recreational potential (>3.0) is

possessed by 8 lakes (24%) (Belochubino, Galkirkol, Karykpandyk, Meshalkino, Slivnoe-Dubrovnoe, Ulkenkol, Musino, Gorkoe). These lakes are characterized by favorable morphometric and climatic parameters, convenient approach to water, pronounced landscape attractiveness and moderate anthropogenic load, high prospects for recreation development.

The majority of lakes (15 or 46%) belong to the "medium" class of recreational potential (2.5-3.0), which indicates the presence of reserves for improving the quality of the recreational environment and developing infrastructure (Suatkol, Bolshie Slivki, Bolshoe Krivoe, Maloe Beketskoye, Mully, Kamystykol, etc.).

Below average (2.0-2.5) received an assessment of 6 (18%) lakes (Strelbishche, Isnovskoye, Dolgovo, Mikhailovskoye, Suatkol-Shorokhovo, Kolshbay). Low recreational potential (<2.0) is characterized by 3 lakes (9%) (Solenoe Dalnee, Alykpash, Stadnoe). The main factors that determined insufficiently favorable conditions for recreational activity are: increased water hardness, inconvenient approach to water, high overgrowth, anthropogenic load, etc. (Figure 4).

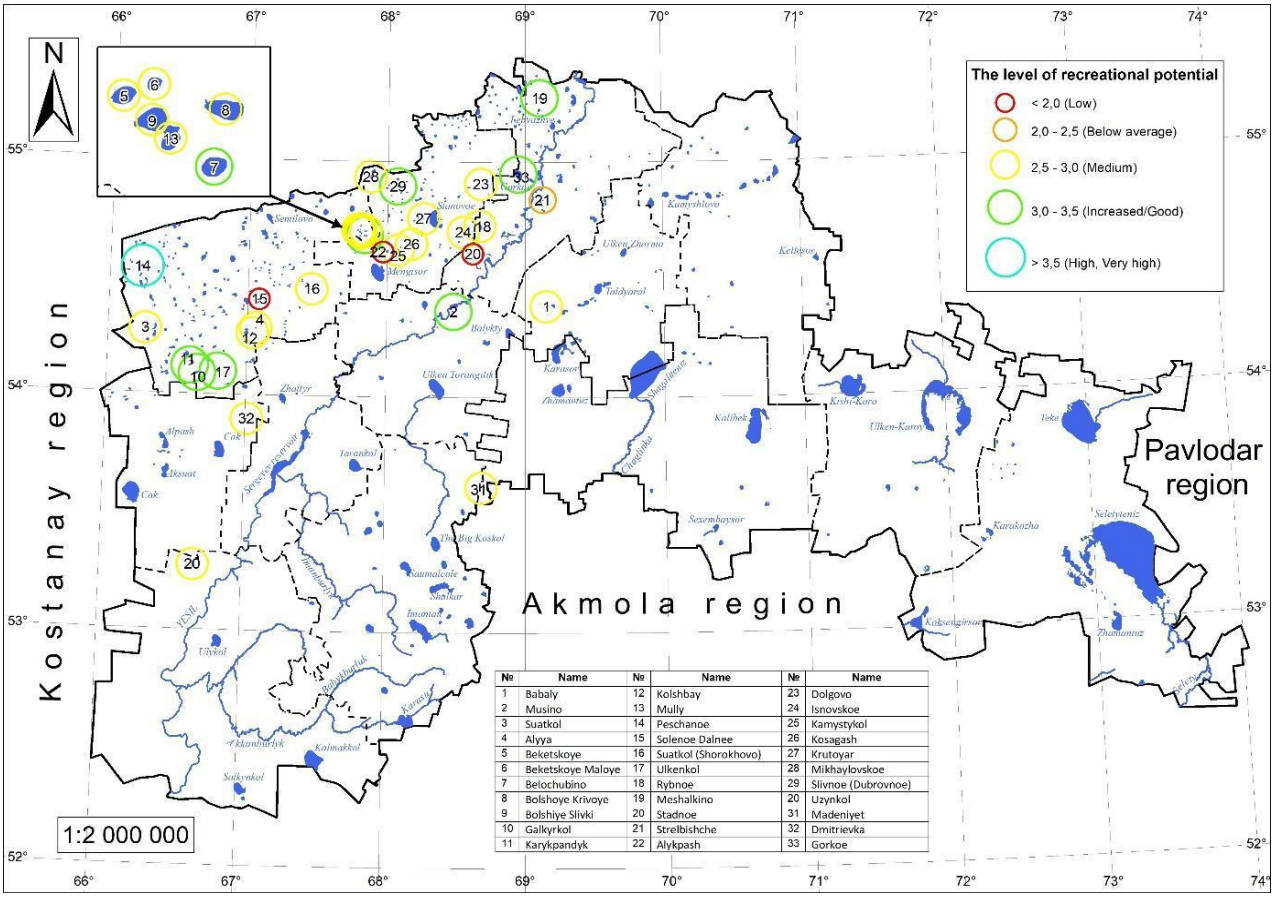


Figure 4. Map of assessment of recreational potential of North Kazakhstan Region lakes (Source: developed by the authors)

Recommended types of tourism activities

For lakes characterized by increased recreational potential, a list of recommended types of tourist and recreational activities and the most suitable season (period) for their organization and conduct were determined. For the summer period: beach-swimming, fishing, walking-excursion, boat riding, event tourism (Ivan Kupala, fisherman's day), ecological trails. For the winter period: ice fishing, walking-excursion, sledding, skating, skiing, winter swimming (walrus swimming), event tourism (Epiphany). According to hydrological parameters and fish reserves, the following can be included in the group of lakes for organizing recreation of local significance (fishing, swimming): Lake Musino, Lake Beketskoye, Lake Bolshie Slivki, Lake Galkirkol, Lake Karykpandyk, Lake Peschanoye, Lake Suatkol, Lake Suatkol (Shorokhovo), Lake Ulkenkol, Lake Meshalkino, Lake Karabul, Lake Dolgovo, Lake Isnovskoye, Lake Kosagash, Lake Mikhailovskoye, Lake Slivnoe (Dubrovnoe); Lake Stadnoe, Lake Dmitrievka (the last two lakes - swimming only).

For the organization of sport (amateur) fishing of local significance, Lake Madeniet (Shunkyrkol) can be recommended.

A number of lakes have relatively large fish reserves, which can contribute to the development of commercial tourism here. The following can be included in the group of fishery water bodies of local significance for commercial fishing: Lake Uzynkol, Lake Alya, Lake Beketskoye Maloe, Lake Belochubino, Lake Bolshoe Krivoe, Lake Kolshbay, Lake Strelbishche, Lake Alykpash, Lake Kamystykol and Lake Krutoyar. Lakes with increased mineralization can be used for local salt extraction, balneotherapy and treatment of skin diseases, joints (Lake Madeniet, Lake Kosagash, Lake Solenoe Dalnee). Small lakes in size can be used for recreation primarily by local residents living in nearby villages. Medium and large lakes have higher potential for the development of various types of health and sports recreation and are able to meet the demand for recreational services of residents not only of local residents, but from nearby districts and regions.

Lake Gorkoe should not be included in the list of water bodies for organizing recreational activities. This water body is part of the water supply and sewerage facilities of Petropavlovsk. It is a second-order storage pond for sewage treatment facilities of Limited Liability Partnership (LLP) "Kyzylzhar Su" Limiting factors. The following unfavorable (limiting) factors for the development of recreational activities on the lakes under consideration were identified: Most water bodies are located at an insignificant distance from settlements, experiencing anthropogenic impact. The catchments are heavily plowed, limited by the road network, which unfavorably affects the hydrological and hydrochemical regime.

Significant overgrowth of lake surfaces limits approach to water, acts as an unfavorable factor for organizing beach-swimming recreation, water walks, fishing, reduces visibility. On the other hand, aquatic plants protect coastal areas of lakes from wind well, reduce wave speed. In a number of the lakes under consideration, ichthyofauna was not detected (Lake Stadnoe, Lake Kosagash, Lake Dmitrievka), which excludes them from the list of water bodies for organizing such a type of recreation as fishing. A number of lakes are characterized by an unfavorable hydrological regime and cannot be recommended for use as recreation objects (Lake Babaly, Lake Mully, Lake Rybnoe). These water bodies can be used for recreation (fishing, swimming) only in case of restoration of a favorable hydrological regime.

CONCLUSION AND FINDINGS

An assessment of the recreational potential of lakes was carried out using a complex of criteria. Of the 33 lakes under consideration, 24 (73%) have sufficient potential for organizing recreational activities on them. On 6 lakes, anthropogenic impact and any types of nature management should be limited until their hydrological and other parameters improve. 3 lakes have low potential and are not recommended for inclusion in recreational nature management.

Based on the assessment results, measures for the development of recreation (tourism) on these lakes were proposed.

Recommendations

Infrastructure development: The reconstruction of existing and construction of new dirt roads and access roads to lakes is necessary. This work should be carried out by relevant services and regional administrations. Almost all water bodies need clearing of shores from reed and rush thickets. Hydrological restoration: On lakes: Lake Babaly, Lake Mully, Lake Rybnoe, restoration of the hydrological regime is required. This work should be carried out by relevant services.

Tourism infrastructure: For lakes characterized by sufficiently high recreational potential, it is necessary to: create safe swimming zones, equip convenient descents to water, install information stands, navigation. Organization of tourist infrastructure is required: light modular changing rooms, gazebos, canopies, benches, picnic areas, toilets, installation of trash bins, garbage tanks (containers) for waste, regular cleaning in the recreation zone. Ecological tourism: The development of ecological and educational tourism is promising: development of eco-trails around lakes with a description of natural features, observation of landscapes, local flora and fauna, creation of observation points with minimal interference with nature.

It is possible to include a number of lakes in tourist routes of the NKR, develop excursions "Lakes of the North Kazakhstan Region". Fishing tourism: On lakes that have potential for sport (amateur) fishing, it is necessary to create places for fishermen to stay, develop fishing routes. Monitoring and regulation: An important aspect of effective and ecologically balanced organization of recreational and tourist activities on lakes is its regulation taking into account the structure and features of their recreational potential, compliance of recreational infrastructure with the ecological capacity of aquatic and terrestrial natural-territorial complexes. A mandatory condition is periodic monitoring of overgrowth, the eutrophication process, oxygen regime of lakes, conducting periodic microbiological and toxicological studies. Educational use: Lakes with low recreational potential are inappropriate to consider as tourist objects of mass visitation. Possible use for ecological-educational purposes. Ecological-educational routes. School excursions on topics of hydrobiology, ecosystem processes, overgrowth of water bodies.

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SUSTAINABLE DEVELOPMENT OF COMMUNITY-BASED ECOTOURISM AS A DRIVER OF LOCAL LIVELIHOODS IN A COASTAL WETLAND PROTECTED AREA. A CASE STUDY IN XUAN THUY NATIONAL PARK, VIETNAM

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Abstract: Community-based ecotourism (CBET) has been increasingly promoted as a strategy to reconcile biodiversity conservation with livelihood improvement in protected areas, particularly in climate-vulnerable coastal wetlands. This study examines the potential of CBET as a driver of sustainable local livelihoods in Xuan Thuy National Park, Vietnam—a Ramsar-listed coastal wetland of international ecological importance. Using a mixed-methods approach, the study integrates household perception analysis with econometric modeling to assess community readiness for CBET development. Primary data were collected from a structured survey of 320 households in buffer-zone communes surrounding the park. A Sustainability Perception Index was constructed to capture community perceptions across environmental, socio-cultural, economic, and institutional dimensions, while a binary logistic regression model was employed to identify key determinants of household willingness to participate in CBET. The results reveal strong environmental and socio-cultural support for ecotourism, moderate economic expectations, and notably weak institutional confidence. Livelihood diversification emerges as the most robust determinant of participation willingness, followed by prior tourism experience, highlighting the importance of economic resilience and experiential capacity. In contrast, environmental awareness and institutional trust alone are insufficient to motivate participation. The findings underscore the need for livelihood-integrated, capacity-building, and governance-oriented CBET strategies to enhance community engagement and align conservation objectives with sustainable development in coastal wetland protected areas.

Keywords: community-based ecotourism, coastal wetlands, livelihood diversification, participation willingness, Ramsar site

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INTRODUCTION

Ecotourism has increasingly been recognized as a development pathway capable of reconciling biodiversity conservation with socio-economic improvement, particularly in environmentally sensitive and protected areas. As a form of tourism that emphasizes minimal ecological impact, environmental education, and meaningful local participation, ecotourism has been widely documented to generate employment, diversify rural livelihoods, and contribute to conservation outcomes when appropriately designed and governed (Weaver & Lawton, 2007; Fennell, 2025; Buckley, 2012). Within this framework, community-based ecotourism (CBET) has emerged as a distinctive model that prioritizes local ownership, participatory decision-making, and equitable benefit-sharing, thereby aligning conservation objectives with community development goals (Scheyvens, 1999; Stronza & Gordillo, 2008).

In coastal wetland regions, ecotourism also serves as a potential climate adaptation strategy by reducing reliance on climate-sensitive livelihoods such as aquaculture, capture fisheries, and salt production. These livelihood systems are increasingly threatened by sea-level rise, saline intrusion, coastal erosion, and extreme weather events associated with climate change (Adger, 2000; IPCC, 2022). By promoting diversified income sources and conservation-compatible activities, CBET can enhance household resilience while simultaneously supporting ecosystem-based adaptation, particularly in mangrove-dominated landscapes that provide critical climate-regulating services, including coastal protection and carbon sequestration (Alongi, 2008; Barbier et al., 2011).

Vietnam hosts a dense and ecologically diverse network of protected areas, yet many remain weakly integrated into local development processes and livelihood strategies. Xuan Thuy National Park (XTNP), located in the Red River Delta of Nam Dinh Province, exemplifies this challenge. As Vietnam's first Ramsar site, XTNP supports internationally significant mangrove ecosystems and serves as a vital stopover for migratory waterbirds along the East Asian–Australasian Flyway. At the same time, communities in the surrounding buffer zone remain highly dependent on climate-sensitive and

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resource-based livelihoods, rendering them particularly vulnerable to environmental and economic shocks. This duality highlights the need for development approaches that simultaneously support biodiversity conservation and strengthen community resilience. Consistent with this need, Tuan et al. (2025) identified XTNP as having high potential for community-based ecotourism through an Analytic Hierarchy Process (AHP) assessment. However, their study focused on evaluating development potential and did not examine household willingness to participate or the socio-economic determinants of CBET participation, leaving these important issues largely unexplored.

In recent years, research on community-based ecotourism (CBET) has increasingly emphasized its role in linking biodiversity conservation with sustainable livelihood development in protected areas. Empirical studies across Asia and Africa indicate that CBET can generate local income, strengthen conservation incentives, and improve community resilience to environmental change (Benu et al., 2020; Khan et al., 2021; Jin et al., 2024; Gayo et al., 2025). However, the success of CBET initiatives varies widely depending on governance structures, community empowerment, and benefit-sharing mechanisms. For example, Luc et al. (2026) found that community participation significantly enhances tourism sustainability outcomes in rural Vietnam, while Stone & Stone (2022) highlight that weak institutional capacity and unequal benefit distribution remain major barriers to CBET success in protected areas. Similarly, Desalegn & Javed (2024) demonstrate that residents' empowerment and perceived economic benefits are key drivers of community support for tourism development. Despite these advances, recent reviews note that many CBET projects continue to struggle with governance fragmentation, limited financial sustainability, and inadequate integration of community perspectives into tourism planning (Botero et al., 2025; Casimiro et al., 2023; Paulus et al., 2023).

Recent scholarship increasingly emphasizes that the success of ecotourism initiatives depends not only on natural resource endowments or spatial suitability, but also on community perceptions, institutional readiness, and willingness to participate (Kiss, 2004; Nunkoo & Ramkissoon, 2011). Sustainable tourism theory conceptualizes tourism as a long-term process that must maintain ecological integrity while delivering enduring socio-economic benefits (Butler, 1999). Within CBET research, empowerment—across economic, social, psychological, and political dimensions—has been identified as a central criterion for evaluating success and sustainability (Scheyvens, 1999). Empirical studies consistently demonstrate that local support and participation are critical determinants of ecotourism outcomes, and that high environmental awareness alone is insufficient if communities lack trust in institutions or meaningful opportunities to influence governance and benefit-sharing arrangements (Stronza & Gordillo, 2008; Bennett & Dearden, 2014).

Several recent studies have examined community participation and livelihood outcomes associated with ecotourism in protected areas. In China, Xu & Hu (2021) demonstrated that community participation strengthens residents' support for tourism while encouraging environmentally responsible behavior. Qin et al. (2021) further showed that perceived economic benefits and positive tourism impacts are important determinants of residents' support for tourism development. In Nepal, Khatiwada (2022) found that community-based ecotourism enhances local participation, equitable benefit sharing, and rural livelihoods through homestay tourism. More recently, research from the Annapurna Sanctuary Trail indicated that ecotourism promotes livelihood diversification, social equity, and community participation, although challenges related to income inequality and governance remain (Tiwari & Nguyen, 2024). Nevertheless, empirical evidence from Ramsar wetland protected areas remains scarce, particularly in Vietnam, where the socioeconomic and governance contexts differ substantially from those reported in existing studies.

In developing-country contexts, CBET initiatives often face persistent challenges related to weak governance, externally driven project design, unequal benefit distribution, and limited inclusion of women and vulnerable groups (Kiss, 2004; Tosun, 2006). In Vietnam, CBET has expanded in both mountainous and coastal regions, yet implementation remains uneven due to institutional fragmentation and limited integration of community perspectives into tourism planning. In the case of Xuan Thuy National Park, existing research has largely focused on biodiversity conservation and climate vulnerability, with comparatively limited attention to community willingness, perceived benefits and concerns, and the institutional feasibility of CBET development.

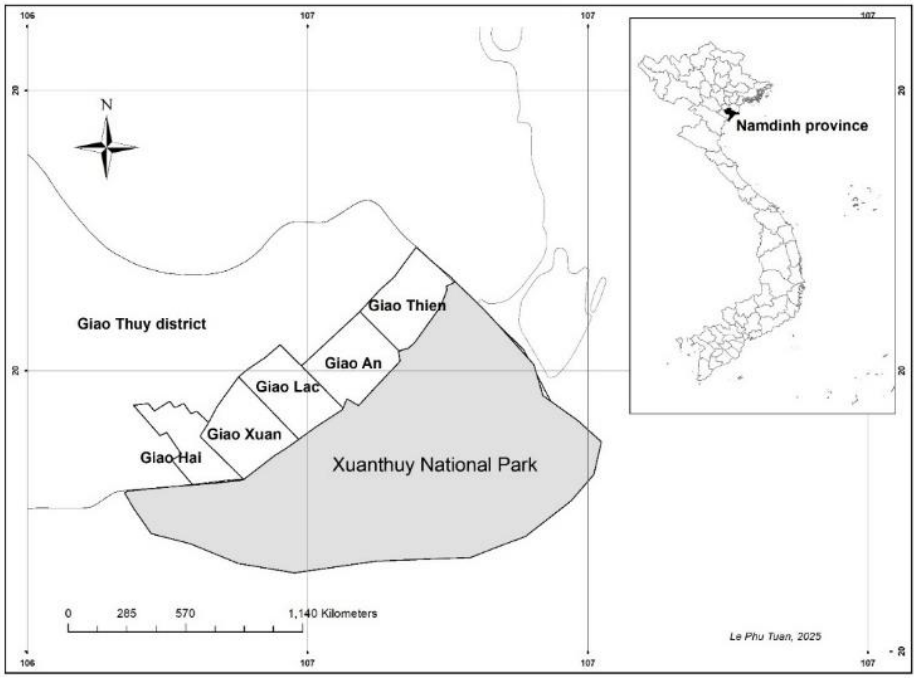
Although the existing literature provides important insights into the relationship between ecotourism development and local livelihoods, several limitations remain. First, many studies focus primarily on environmental or economic outcomes while paying limited attention to the institutional conditions that influence community participation. Second, previous research frequently relies on qualitative case studies or descriptive approaches, which may limit the ability to quantitatively identify determinants of household participation in ecotourism activities. Third, relatively few studies examine CBET in coastal wetland protected areas, where communities face unique climate risks and livelihood vulnerabilities associated with sea-level rise, salinity intrusion, and extreme weather events. These gaps highlight the need for empirical studies that combine perception analysis with econometric modelling to better understand the socio-economic drivers of community participation in CBET initiatives.

Against this background, the primary objective of this study is to evaluate the potential of community-based ecotourism (CBET) to support sustainable local livelihoods in a coastal wetland protected area, using Xuan Thuy National Park in Vietnam as a case study. Specifically, the study aims to (1) assess community perceptions of ecotourism sustainability across environmental, socio-cultural, economic, and institutional dimensions; (2) examine perceived benefits and concerns related to CBET development; and (3) identify key socio-economic determinants influencing household willingness to participate in CBET using a binary logistic regression model. By integrating perception analysis with econometric modelling, the study contributes to the growing literature on sustainable tourism governance and provides policy-relevant insights for promoting inclusive ecotourism development in climate-vulnerable coastal wetland protected areas.

MATERIALS AND METHODS

Study Area

Xuan Thuy National Park, also known as the Xuan Thuy Ramsar Site, is in Nam Dinh province. It was the first wetland in Southeast Asia designated under the Ramsar Convention in 1989. In 2003, it was officially upgraded to a national park, and in 2004, UNESCO recognized it as the core zone of the Red River Delta Biosphere Reserve. Recently, the Ministry of Natural Resources and Environment proposed its nomination as an ASEAN Heritage Park, aiming to enhance protection and regional significance. Covering approximately 7,100 hectares, the park includes core protection areas, buffer zones, and transition zones. The ecosystem consists of estuarine mudflats, mangrove forests, tidal creeks, and coastal sandbars, providing habitat for over 200 bird species. Figure 1 illustrates the location of Xuan Thuy National Park together with representative landscapes of its mangrove ecosystems and intertidal wetlands that support numerous migratory waterbirds.Communities in the buffer zone rely primarily on aquaculture (clam and shrimp farming), capture fisheries, salt production, and small-scale agriculture. These livelihoods are highly exposed to climatic and market risks, creating strong incentives for diversification through non-extractive activities such as ecotourism.



(a)



(b)



(c)

Figure 1. Some pictures from the study area (a) Location of Xuan Thuy National Park (Tuan et al., 2025); (b) Mangrove ecosystems in Xuan Thuy National Park(c) Intertidal wetland habitat supporting migratory waterbirds in Xuan Thuy National Park

Household Survey

A structured household survey was conducted between August and October 2025 in the buffer-zone communes surrounding Xuan Thuy National Park. A total of 320 households were selected using a stratified random sampling approach to ensure adequate representation across communes and key socio-economic groups.

The questionnaire comprised three main components: (i) 20 Likert-scale items assessing household perceptions of ecotourism sustainability across multiple dimensions; (ii) binary and ordinal questions capturing household willingness to participate in community-based ecotourism (CBET); and (iii) a set of questions examining perceived benefits and concerns associated with ecotourism development.

Sustainability Perception Index

To quantify household perceptions of ecotourism sustainability, a Sustainability Perception Index (SPI) was constructed for each sustainability dimension following established practices in perception-based tourism and sustainability research (Likert, 1932; Nunkoo & Ramkissoon, 2011; Bennett & Dearden, 2014). For each dimension *d*, the index was calculated as the arithmetic mean of the corresponding perception items:

$$SPI_d \frac{1}{n_d} \sum_{i=1}^{n_d} x_i \qquad (1)$$

Where: SPI_d denotes the sustainability perception index for dimension *d*, x_i represents the score of item *i*, and n_d is the total number of items used to measure that dimension. All items were measured on a five-point Likert scale, with higher values indicating stronger agreement and more positive perceptions of ecotourism sustainability.

This aggregation approach allows for a standardized and comparable assessment of household perceptions across environmental, socio-cultural, economic, and institutional dimensions, and has been widely applied in studies examining residents' attitudes toward tourism development and protected area management (Butler, 1999; Stronza & Gordillo, 2008).

Binary Logistic Regression Analysis

To identify the determinants of household willingness to participate in community-based ecotourism (CBET), a binary logistic regression model was estimated. The dependent variable, Willingness to participate, was coded as 1 = willing and 0 = not willing or conditionally willing. Independent variables were selected based on the literature on community-based tourism and preliminary descriptive analysis and include gender, education, household income, livelihood diversification, environmental awareness, prior tourism experience, and institutional trust (Table 1).

The binary logistic regression model can be expressed in its basic form as (Hosmer et al., 2013):

$$Ln\left(\frac{P_i}{1-P_i}\right) = \beta_0 + \beta_1 Female_i + \beta_2 Education_i + \beta_3 Income_i + \beta_4 Diversified\_Livelihood_i + \beta_5 Envi\_Awareness_i + \beta_6 Tourism\_Experience_i + \beta_7 Instututional\_Trust_i \qquad (2)$$

where P_i is the probability that household *i* is willing to participate in CBET, β_0 is the intercept, and β_k (k=1,…,7) are the corresponding coefficients. Exponentiating the coefficients yields odds ratios (ORs), which indicate the change in the odds of women's leadership participation associated with a one-unit change in each predictor, holding other variables constant (Long & Freese, 2014).

Table 1. Definition and measurement of variables used in the binary logistic regression model

Variable name	Type	Definition	Measurement / Coding
Willingness to participate in CBET (willing_cbet)	Dependent	Household's expressed willingness to participate in community-based ecotourism activities (e.g., homestay, guiding, food services, conservation support)	Binary variable: 1 = willing to participate; 0 = not willing or conditionally willing
Female respondent (female)	Independent	Gender of the main survey respondent representing the household	Binary variable: 1 = female; 0 = male
Education (years) (education)	Independent	Human capital of the respondent measured by formal schooling	Continuous variable: number of completed years of education
Income (income)	Independent	Economic capacity of the household	Continuous variable: monthly household income (million VND)
Diversified livelihood (diversified_livelihood)	Independent	Whether the household engages in more than one income-generating activity (e.g., aquaculture + farming + services)	Binary variable: 1 = diversified livelihood; 0 = single livelihood
Environmental awareness index (environmental_awareness)	Independent	Household awareness of environmental values, conservation importance, and ecosystem services of XTNP	Composite index (Likert scale 1–5), calculated as the mean score of environmental awareness items
Prior tourism experience (tourism_experience)	Independent	Household's previous involvement in tourism-related activities	Binary variable: 1 = has tourism experience; 0 = no experience
Institutional trust index (institutional_trust)	Independent	Level of trust in local authorities, park management, and tourism-related institutions	Composite index (Likert scale 1–5), calculated as the mean score of institutional trust items

RESULTS

Community Perceptions of Ecotourism Sustainability

Figure 2 presents the mean scores of community perceptions of ecotourism sustainability across four key dimensions—environmental, socio-cultural, economic, and institutional—based on responses from 320 surveyed households. Among these dimensions, environmental sustainability received the highest mean score (4.28), indicating a strong level of environmental awareness and widespread recognition of the ecological importance of mangrove ecosystems and migratory

bird habitats within Xuan Thuy National Park. This finding reflects a high degree of local sensitivity to conservation values and the perceived role of ecotourism in supporting environmental protection. Socio-cultural sustainability also scored highly (mean = 4.01), suggesting strong social cohesion, well-established traditions of collective action, and a generally positive perception of community-based engagement in ecotourism activities. These social attributes constitute an important foundation for the successful implementation of community-based ecotourism initiatives. In contrast, perceptions of economic sustainability were more moderate (mean = 3.34). This indicates cautious expectations regarding income generation and livelihood benefits from ecotourism, possibly reflecting uncertainty about market access, revenue stability, or the distribution of economic gains among households. The institutional dimension recorded the lowest mean score (2.39), highlighting limited trust in governance structures, institutional support, and management effectiveness related to ecotourism development. This comparatively weak institutional confidence underscores a critical challenge for the long-term sustainability of ecotourism initiatives, as effective governance and transparent coordination mechanisms are essential for translating positive environmental and social perceptions into sustained economic outcomes. Overall, the results reveal a clear hierarchy of sustainability perceptions, with strong environmental and socio-cultural foundations, moderate economic expectations, and persistent institutional constraints shaping community views on ecotourism development.

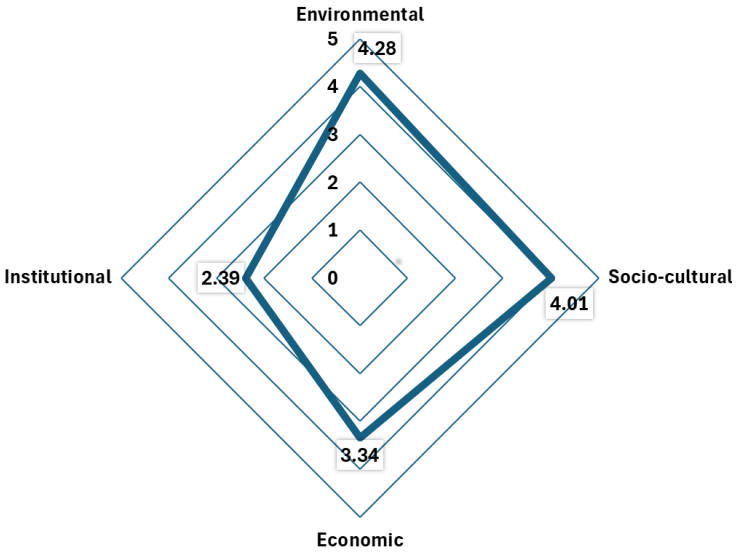


Figure 2. Sustainability perception scores across four dimensions

Perceived Benefits and Concerns Related to Ecotourism

Survey respondents identified a range of perceived benefits and concerns associated with the development of community-based ecotourism (CBET) in Xuan Thuy National Park. As shown in Figure 3, economic benefits were most frequently cited, with income diversification reported by 72.4% of households and local job creation by 64.8%.

These findings indicate strong expectations that ecotourism could contribute to livelihood enhancement and reduce dependence on climate-sensitive economic activities. Beyond economic considerations, a substantial proportion of respondents acknowledged environmental benefits, with 61.0% recognizing the role of ecotourism in supporting biodiversity conservation and ecosystem protection. Nearly half of the surveyed households (49.5%) also perceived cultural preservation as a potential benefit, suggesting that ecotourism is viewed not only as an economic opportunity but also as a means of sustaining local traditions and community identity. Despite these positive perceptions, significant concerns were also expressed, particularly with respect to equity and governance. Almost half of the respondents (46.2%) were concerned about the unequal distribution of benefits, reflecting apprehension that ecotourism revenues may be captured by a limited number of actors.

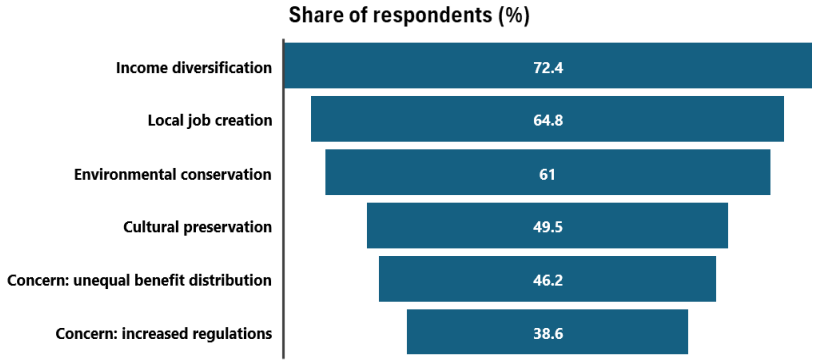


Figure 3. Perceived benefits and concerns of ecotourism development

Additionally, 38.6% of households expressed concern over increased regulations, which may impose constraints on traditional livelihood activities or exacerbate existing institutional burdens.

Overall, the results reveal a nuanced perception of ecotourism development: while communities recognize its potential economic, environmental, and cultural benefits, they remain cautious about governance arrangements and the fairness of benefit-sharing mechanisms. These concerns underscore the importance of inclusive planning, transparent management, and equitable distribution strategies in the design and implementation of CBET initiatives.

Determinants of Household Willingness to Participate in Community-Based Ecotourism

Table 2 reports the results of the binary logistic regression analysis examining the determinants of household willingness to participate in community-based ecotourism (CBET) in Xuan Thuy National Park. The overall model is statistically significant based on the likelihood ratio χ^2 test (Prob > χ^2 = 0.0050), indicating that the included explanatory variables jointly explain variations in household participation decisions. The McFadden Pseudo R^2 value is 0.1462, suggesting a modest yet acceptable level of explanatory power. In social and environmental studies, pseudo R^2 values in the range of 0.10–0.20 are commonly reported and reflect the complex nature of human behavior, particularly in household-level participation decisions shaped by multiple unobserved social and contextual factors (Menard, 2000).

Table 2. Binary logistic regression results for willingness to participate in CBET

Variable	B = ln(OR)	Odds Ratio	SE	p-value
(female)	0.784	2.191	1.162	0.139
(education)	0.108	1.114	0.097	0.217
(income)	0.189	1.208	0.171	0.180
(diversified_livelihood)	1.870	6.487	4.258	0.004
(environmental_awareness)	0.495	1.641	0.941	0.388
(tourism_experience)	1.242	3.462	2.306	0.062
(institutional_trust)	–0.072	0.931	0.428	0.875
Constant	–2.645	0.071	0.212	0.374
• Prob > chi2 = 0.0050 • Pseudo R^2 = 0.1462				

Among the explanatory variables, livelihood diversification emerges as the strongest and most robust determinant of willingness to participate in CBET. Households with diversified income sources are significantly more likely to express willingness to engage in ecotourism activities, with an odds ratio of 6.49 ($p < 0.01$). This finding suggests that households already engaged in multiple livelihood strategies perceive CBET as a complementary opportunity rather than a risky or uncertain economic shift. Tourism experience also exhibits a positive effect on participation willingness, with households possessing prior tourism-related experience being more than three times as likely to participate compared to those without such experience (OR = 3.46). Although this effect is only marginally significant ($p < 0.10$), it highlights the importance of experiential learning and familiarity with tourism operations in shaping engagement decisions.

The coefficients for female respondents, education, and household income are positive, indicating that gender and human and financial capital may facilitate participation in CBET. However, these effects are not statistically significant at conventional levels in the current model, suggesting that their influence may operate indirectly or in interaction with other socio-institutional factors. Similarly, environmental awareness shows a positive association with willingness to participate, implying that conservation values and ecological understanding may encourage engagement in ecotourism. Nevertheless, the effect is not statistically significant, indicating that pro-environmental attitudes alone are insufficient to translate into active participation without supportive economic and institutional conditions.

In contrast, institutional trust does not exhibit a meaningful effect on household willingness to participate in CBET, as reflected by its small and statistically insignificant coefficient. This result suggests that limited confidence in local institutions does not necessarily discourage initial participation, although it may have implications for the long-term sustainability and governance of CBET initiatives.

The estimated logistic regression model can be expressed as (Hosmer et al., 2013):

$$Ln\left(\frac{P_i}{1-P_i}\right) = -2.645 + 0.784Female_i + 0.108Education_i + 0.189Income_i + 1.870Diversified\_Livelihood_i + 0.495Envi\_Awareness_i + 1.242Tourism\_Experience_i - 0.072Instututional\_Trust_i \quad (3)$$

Overall, the results underscore the central role of economic resilience and prior tourism exposure in shaping household willingness to participate in community-based ecotourism, while highlighting the more limited direct influence of demographic and attitudinal factors in the study context.

DISCUSSION

This study provides a comprehensive assessment of community perceptions, perceived benefits and concerns, and econometric determinants of household willingness to participate in community-based ecotourism (CBET) in Xuan Thuy National Park. By integrating descriptive and inferential analyses, the results offer a nuanced understanding of both the opportunities and constraints shaping CBET development in a climate-vulnerable coastal wetland protected

area, while also illuminating how CBET may contribute to multiple Sustainable Development Goals (SDGs), particularly SDG 5 (Gender Equality), SDG 8 (Decent Work and Economic Growth), and SDG 13 (Climate Action).

The perception-based findings reveal a clear hierarchy across sustainability dimensions, with strong environmental and socio-cultural foundations, more cautious economic expectations, and persistently weak institutional confidence. High environmental sustainability scores reflect a widespread recognition of the ecological value of mangrove ecosystems and migratory bird habitats, indicating strong local alignment with conservation objectives.

From an SDG 13 perspective, this environmental awareness represents a critical enabling condition for climate action, as mangroves play a vital role in climate adaptation through coastal protection, carbon sequestration, and ecosystem resilience. Ecotourism, when properly designed, can reinforce these functions by creating incentives for conservation-oriented behavior and reducing pressure on climate-sensitive livelihoods.

Similarly, the high socio-cultural sustainability scores point to strong community cohesion, collective traditions, and social capital. These attributes are central to the participatory ethos of CBET and resonate with SDG 5, particularly in its emphasis on inclusive participation, empowerment, and social equity. Although gender does not emerge as a statistically significant determinant in the regression model, the positive coefficient suggests that women's participation may operate through indirect pathways, such as involvement in household decision-making, informal economic activities, and community networks—areas that are often undercaptured in quantitative models but critical to CBET implementation.

In contrast, perceptions of economic sustainability are more moderate, reflecting cautious expectations regarding income generation and livelihood security. This finding is reinforced by the perceived benefits and concerns analysis, where income diversification and job creation are widely acknowledged, yet concerns over unequal benefit distribution and increased regulatory burdens remain prominent. These patterns underscore the relevance of SDG 8, as they highlight both the potential of CBET to contribute to decent work and inclusive economic growth and the risks associated with poorly designed benefit-sharing mechanisms. Without transparent and equitable economic arrangements, CBET may fail to deliver on its promise of inclusive growth, thereby undermining community support.

The econometric results further refine these insights by identifying livelihood diversification as the most robust determinant of household willingness to participate in CBET. Households with diversified income sources are significantly more likely to engage in ecotourism, suggesting that economic resilience enables households to absorb risk and view CBET as a complementary livelihood strategy. This finding directly links CBET to SDG 8, as it emphasizes the role of diversified and resilient livelihood systems in fostering sustainable economic participation, particularly in environments exposed to climate and market uncertainties. Prior tourism experience also plays a positive role, highlighting the importance of skills, knowledge, and experiential learning in shaping participation decisions.

From a policy perspective, this suggests that targeted capacity-building and training programs could enhance CBET participation by lowering entry barriers, especially for households with limited prior exposure. Such interventions can simultaneously support SDG 8 by improving employment quality and SDG 5 by creating opportunities for women and marginalized groups to access tourism-related skills. While environmental awareness is positively associated with participation willingness, its lack of statistical significance indicates that conservation values alone are insufficient to motivate active engagement. This finding underscores a critical insight for SDG 13: climate awareness must be coupled with tangible livelihood benefits and supportive institutional arrangements to translate environmental concern into sustained climate action at the community level. The non-significant role of institutional trust is particularly revealing. Despite being the weakest sustainability dimension, low institutional confidence does not directly suppress willingness to participate in CBET. This suggests that communities may be willing to engage in ecotourism even in the absence of strong institutional support, creating a short-term opportunity for CBET development.

However, from a governance and equity perspective, this also signals a structural risk. Without improvements in participatory governance, transparency, and benefit-sharing, initial willingness may not lead to durable engagement or socially equitable outcomes—an outcome that would undermine progress toward all three SDGs. Taken together, the findings indicate that CBET readiness in Xuan Thuy National Park is primarily shaped by households' economic resilience and experiential capacity, rather than by demographic or attitudinal factors alone. The coexistence of strong environmental and socio-cultural support with weak institutional confidence creates both a strategic opportunity and a long-term challenge. On the one hand, there is clear potential to leverage CBET as an integrated pathway for advancing SDG 13 through conservation, SDG 8 through livelihood diversification, and SDG 5 through inclusive participation. On the other hand, failure to address governance and equity concerns may limit the sustainability and transformative potential of CBET initiatives. Overall, this study underscores the importance of livelihood-integrated, capacity-oriented, and institutionally strengthened CBET strategies. Policies that support livelihood diversification, provide targeted tourism training, and promote transparent and inclusive governance are more likely to align ecotourism development with the interconnected objectives of SDG 5, SDG 8, and SDG 13. In coastal wetland contexts such as Xuan Thuy National Park, aligning ecological conservation with socio-economic resilience is essential for translating community willingness into durable, equitable, and climate-resilient ecotourism outcomes.

CONCLUSION

This study examined the potential of community-based ecotourism (CBET) as a pathway for promoting sustainable local livelihoods in a climate-vulnerable coastal wetland protected area, using Xuan Thuy National Park, Vietnam, as a case study. By integrating community perception analysis with econometric modeling, the research provides a

comprehensive assessment of both the social readiness and structural conditions shaping CBET development in a Ramsar-listed ecosystem of high conservation value. The findings reveal strong environmental and socio-cultural support for ecotourism among local communities, reflecting high awareness of mangrove ecosystem services and a solid foundation of social cohesion and collective action. In contrast, perceptions of economic sustainability are more cautious, and institutional confidence remains notably weak. This imbalance underscores a critical challenge for CBET development: while communities recognize the ecological and social merits of ecotourism, concerns related to governance capacity, transparency, and equitable benefit-sharing persist. The binary logistic regression analysis further demonstrates that household willingness to participate in CBET is primarily driven by livelihood diversification and prior tourism experience, highlighting the importance of economic resilience and experiential capacity in shaping participation decisions. Demographic characteristics and environmental awareness alone are insufficient to motivate engagement, emphasizing that conservation-oriented attitudes must be complemented by tangible livelihood benefits and enabling institutional conditions. Although institutional trust does not emerge as a statistically significant determinant of initial willingness, its low perception scores signal potential risks to the long-term sustainability and equity of CBET initiatives.

From a policy perspective, the results suggest that CBET strategies in coastal wetland protected areas should prioritize livelihood-integrated approaches, targeted capacity-building, and governance strengthening. Supporting diversified livelihood portfolios, providing tourism-related training, and fostering inclusive and transparent institutional arrangements are essential for translating community willingness into sustained participation. More broadly, the study highlights CBET's potential to contribute simultaneously to climate adaptation, conservation, and inclusive development, aligning with the objectives of SDG 5 (Gender Equality), SDG 8 (Decent Work and Economic Growth), and SDG 13 (Climate Action).

Despite its contributions, this study is subject to certain limitations. The cross-sectional nature of the survey restricts causal inference, and future research could benefit from longitudinal designs to capture dynamic changes in perceptions and participation over time. In addition, qualitative approaches and gender-disaggregated analyses could further illuminate power relations, institutional dynamics, and intra-household decision-making processes that influence CBET outcomes.

Overall, this research underscores that the success of community-based ecotourism in coastal wetland protected areas depends not only on ecological assets or market potential, but fundamentally on the integration of livelihood resilience, experiential capacity, and inclusive governance. Addressing these dimensions is essential for ensuring that CBET evolves from a promising concept into a durable and equitable development pathway in Xuan Thuy National Park and similar protected areas. Despite its contributions, this study has several limitations.

First, the analysis is based on cross-sectional survey data collected at a single point in time, which limits the ability to capture dynamic changes in community perceptions and participation over time.

Second, the study focuses on households in the buffer-zone communes of Xuan Thuy National Park, and therefore the findings may not be fully generalizable to other protected areas with different socio-economic and ecological contexts.

Third, while the logistic regression model identifies key determinants of participation willingness, it does not fully capture complex institutional dynamics or power relations that may influence ecotourism governance. Future research could employ longitudinal data, comparative case studies, and mixed qualitative–quantitative approaches to better understand long-term community engagement and institutional effectiveness in CBET development.

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Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study may be obtained on request from the corresponding author.

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Use of Generative AI: Not applicable

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A MULTI-LEVEL COLLABORATIVE GOVERNANCE MODEL FOR TOURISM ECOSYSTEM MANAGEMENT: EVIDENCE FROM A SPECIAL ECONOMIC ZONE IN INDONESIA

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Abstract: Tourism ecosystem management increasingly faces governance challenges arising from institutional fragmentation, ecological vulnerability, and multi-actor complexity, particularly in developing country contexts. This study examines how multi-level collaborative governance operates in managing and restoring the tourism ecosystem of Tanjung Lesung, a tourism-based Special Economic Zone in Indonesia. The research aims to develop a conceptual model that explains how collaboration across policy, organisational, and operational levels shapes ecosystem restoration outcomes. Using a qualitative approach grounded in Soft Systems Methodology (SSM), the study draws on in-depth interviews, document analysis, and participatory observation involving government agencies, private sector actors, community groups, and academic institutions. The findings reveal that collaborative governance in Tanjung Lesung functions as an interconnected but uneven system. While collaboration exists at each governance level, weak vertical coordination, overlapping authority, and limited institutional learning constrain integration across levels. Community participation and knowledge co-production emerge as critical strengths at the operational level, yet their influence on higher-level decision-making remains limited. This study proposes a multi-level collaborative governance model that integrates policy direction, organisational coordination, and operational practice through communication, trust, coordination, and learning. The model contributes to collaborative governance theory by demonstrating that governance effectiveness depends on cross-level interaction rather than isolated partnerships. Practically, the findings offer insights for strengthening ecosystem-based tourism governance in special economic zones and similar multi-actor settings.

Keywords: collaborative governance, multi-level governance, tourism ecosystem management, Soft Systems Methodology, ecosystem restoration, sustainable tourism

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INTRODUCTION

Tourism governance increasingly operates within complex socio-ecological systems characterised by institutional fragmentation, ecological vulnerability, and multi-level authority dispersion. Such conditions resemble what public policy scholars define as wicked problems - issues that resist linear solutions due to interdependence, uncertainty, and contested values (Head & Alford, 2015). In tourism destinations, especially in developing countries, governance arrangements are frequently shaped by overlapping mandates, decentralised authority, and sectoral silos that weaken policy coherence and sustainability outcomes (Bramwell & Lane, 2011; Dredge, 2016).

Collaborative governance (CG) has emerged as a prominent response to these governance deficits. Defined as institutional arrangements in which public agencies engage non-state actors in consensus-oriented decision-making processes (Ansell & Gash, 2008), CG is widely promoted as a mechanism for managing cross-sectoral complexity (Bryson et al., 2015). Subsequent scholarship conceptualises collaborative governance regimes as dynamic systems shaped by principled engagement, shared motivation, and joint capacity for action (Emerson et al., 2012). More recent work emphasises the political and power-laden dimensions of collaboration, arguing that governance effectiveness depends on institutional design, power distribution, and meta-governance capacity (Ansell et al., 2025; Torfing et al., 2012).

Despite its normative appeal, collaborative governance frequently operates within fragmented multi-level governance systems where authority is distributed across national, regional, and local tiers (Hooghe & Marks, 2003). Such institutional

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fragmentation often creates coordination challenges, overlapping policy responsibilities, and blurred accountability, making it more difficult to sustain effective collaboration across governance levels (Peters, 2015; Trein et al., 2019).

Previous studies have shown that tourism policy implementation is frequently constrained by weak vertical coordination between national policy formulation and local implementation, resulting in fragmented governance and inconsistent policy outcomes (Krutwaysho, & Bramwell, 2010; Wang & Ap, 2013). In tourism contexts, limited vertical integration between policy formulation and local implementation remains a persistent challenge (Provan & Kenis, 2008; Hall, 2011).

This study argues that collaborative governance cannot be adequately understood without accounting for its embeddedness in multi-level policy structures. Using Tanjung Lesung Special Economic Zone (SEZ) in Indonesia as an empirical case, this research examines how collaboration operates across policy, organisational, and operational levels in tourism ecosystem management (Sukran et al., 2025). By integrating collaborative governance theory, multi-level governance, and Soft Systems Methodology (SSM), the study develops a multi-level collaborative governance model that explains how cross-level interactions shape ecosystem restoration outcomes.

Conceptual and Theoretical Framework: Multi-Level Collaborative Governance

Collaborative governance has been widely conceptualised as a response to complex public problems that cannot be effectively addressed through hierarchical control or market mechanisms alone. Ansell & Gash (2008) define collaborative governance as a governing arrangement in which public agencies engage non-state stakeholders in a consensus-oriented decision-making process that is formal, deliberative, and collective. This perspective highlights key enabling conditions, such as trust, shared understanding, and facilitative leadership, as determinants of collaborative success. Emerson et al. (2012) further develop this framework by introducing the concept of collaborative governance regimes, which emphasises the dynamic interplay between principled engagement, shared motivation, and joint capacity for action.

Recent tourism governance studies have emphasised that sustainability challenges are deeply embedded in governance structures and power relations rather than technical management failures (Bramwell & Lane, 2011). Moreover, collaborative arrangements often struggle to deliver transformative outcomes when they are not supported by effective governance networks and cross-level coordination (Huxham & Vangen, 2005; Sørensen & Torfing, 2009).

While these frameworks provide a robust foundation for understanding collaboration, they often treat governance contexts as relatively flat institutional spaces. In practice, especially in decentralised or multi-tiered systems, collaboration unfolds across multiple levels of authority with distinct roles, resources, and power relations.

Multi-level governance theory addresses this complexity by focusing on the dispersion of authority across national, regional, and local levels, as well as the interactions between them (Allmendinger, 2017). Its shift from top-down regulation to networked decision-making requires conservation practitioners to adapt by engaging with diverse actors, integrating social equity into planning, and applying flexible, adaptive strategies across different scales to effectively manage ecological resilience (Armitage et al., 2012).

In tourism governance, this dispersion is particularly pronounced, as policy formulation, investment regulation, environmental management, and community engagement are frequently handled by different institutions operating at different scales. Integrating collaborative governance with a multi-level governance perspective provides a more comprehensive understanding of how coordination occurs simultaneously across vertical and horizontal institutional arrangements. Rather than functioning solely as a managerial mechanism, collaborative governance operates as a relational process in which trust, mutual understanding, interdependence, and shared motivation enable actors to coordinate collective action across institutional boundaries (Ansell & Gash, 2008; Emerson et al., 2012). This relational perspective is especially important in multi-level governance settings, where policy coherence depends on continuous interaction and feedback among actors operating at national, regional, and local levels. The effectiveness of collaborative governance therefore depends not only on stakeholder engagement at a single level, but also on the coherence and adaptive feedback mechanisms that connect policy formulation, organisational implementation, and operational practice.

In the context of tourism ecosystem management, this multi-level perspective is essential. Ecosystems are inherently complex and adaptive, requiring governance arrangements that can respond to uncertainty, ecological feedback, and social change. Ostrom (2010) argues that sustainable management of common-pool resources depends on polycentric governance systems, where multiple centres of decision-making operate autonomously, yet are coordinated through shared rules and norms. Applied to tourism, this implies that effective ecosystem restoration requires alignment between top-down policy frameworks and bottom-up community initiatives, mediated through organisational networks and learning processes.

To operationalise this complexity, this study adopts Soft Systems Methodology (SSM) as a complementary analytical framework. Developed by Checkland (1999) and further elaborated by Checkland & Poulter (2006), SSM is designed to address "messy" problem situations characterised by multiple actors, divergent worldviews (Weltanschauung), and ambiguous objectives. Rather than seeking optimal solutions, SSM facilitates learning by modelling human activity systems and comparing conceptual models with real-world practices.

Within this study, SSM serves not merely as a data collection method, but as a model-building approach that enables the integration of collaborative governance and multi-level governance perspectives. By combining collaborative governance theory, multi-level governance, and SSM, this research conceptualises tourism ecosystem management as a multi-level collaborative system. At the policy level, collaboration shapes strategic direction, legitimacy, and regulatory coherence. At the organisational level, it structures coordination mechanisms, partnerships, and resource mobilisation. At the operational level, collaboration is enacted through community participation, local knowledge, and day-to-day management practices. These levels are interconnected through continuous feedback, learning, and adaptation.

This conceptual framework provides the analytical foundation for examining the governance dynamics of Tanjung Lesung and for developing a transferable model of multi-level collaborative governance applicable to other tourism destinations facing similar ecological and institutional challenges.

RESEARCH METHODOLOGY

This study employed a mixed-method approach combining qualitative analysis with Soft Systems Methodology (SSM) to examine collaborative governance dynamics and develop a multilevel model for Tanjung Lesung tourism ecosystem management. Primary data were collected through 30 semi-structured interviews with government officials (n=15), private sector representatives from PT Banten West Java (n=5), and community actors including *Pokdarwis* leaders (a community-based tourism awareness organization established to support local tourism development), and Micro, Small, and Medium Enterprises (MSMEs) operators (n=10), supplemented by direct observation and informal discussions from August to November 2025. Secondary data comprised policy documents (RIPARNAS (National Tourism Development Master Plan), RPJMN (National Medium-Term Development Plan), Regional Medium-Term Development Plan (RPJMD), institutional records, and Special Economic Zone (SEZ) operational reports.

Data processing followed qualitative triangulation—transcription, filtering, SSM analysis, and validation through theoretical cross-checking—yielding the Multi-Level Collaborative Governance (MLCG) model through SSM's seven iterative stages. Data analysis followed the seven-stage SSM process, including problem structuring, CATWOE formulation, conceptual modelling, and real-world comparison. Thematic coding was guided by collaborative governance constructs (trust, coordination, shared motivation) and multi-level governance dimensions (vertical and horizontal integration). Triangulation and member checking enhanced credibility (Miles et al., 2014; Newman, 2021).

Soft Systems Methodology systematically derived the MLCG model through seven iterative stages applied to primary data: (1) unstructured problem situation (SEZ/PSN fragmentation); (2) rich picture (investment vs. resilience tensions); (3) root definitions (socio-ecological transformation); (4) conceptual modeling (co-planning / implementation / evaluation); (5) comparison with reality (administrative gaps); (6) feasible/desirable changes; and (7) action recommendations yielding the three-tier MLCG structure [Checkland, 1999].

The stages of the research especially data processing as follow the Figure 1 below.

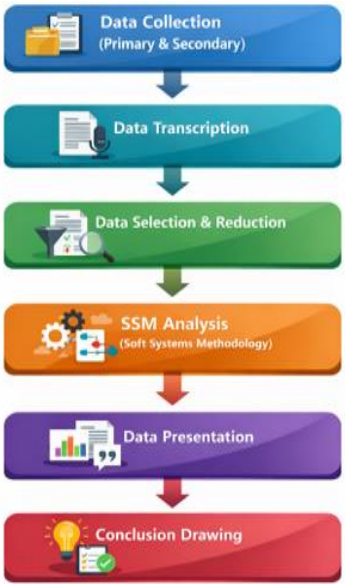


Figure 1. Stages of Data Processing

RESULTS

The multi-level collaborative governance in Tanjung Lesung demonstrates a vertically and horizontally integrated configuration spanning policy, organizational, and operational levels. At the policy level, central government agencies initiate SEZ development through regulatory frameworks and strategic infrastructure support, which provincial and district governments translate into local planning documents and derivative programs.

The organizational level features institutional structures involving district government, SEZ operator, PT. Banten West Java (PT. BWJ), local agencies, BUMDes (Village-Owned Enterprise), academic partners, and NGOs that coordinate planning, role division, and program oversight. Operationally, Pokdarwis, MSMeS groups, fisher collectives, youth organizations, and women's economic groups serve as frontline actors implementing economic recovery, ecotourism, environmental conservation, and disaster education initiatives.

Key Actors Across Governance Levels

Multi-level collaborative governance in Tanjung Lesung operates across policy, organizational, and operational domains, with vertical coordination from central SEZ/PSN mandates to local implementation.

Table 1. Multi-level actor configuration in Tanjung Lesung's collaborative governance model (Source : Author Analysis, 2025)

Governance Level	Key Actors	Primary Roles	Key Contributions
Policy (National)	Kemenparekraf (Ministry of Tourism and Creative Economy), PUPR (Ministry of Public Works and Housing), BKPM (Indonesia Investment Coordinating Board)	Policy framework, infrastructure investment	RIPARNAS (National Tourism Development Master Plan), RPJMN (National Medium-Term Development Plan), toll road, coastal protection
Policy (Provincial)	Banten Province (Regional Development Planning Agency (Bappeda), Tourism Office)	Policy mediation, program alignment	KEK (SEZ) prioritization in provincial tourism strategy
Policy (District)	Pandeglang Regency (Dispar, Investment and One-Stop Integrated Service Agency (DPMPTSP), Bappeda)	Local policy translation, capacity building	RPJMD (Regional Medium-Term Development Plan) integration, homestay training, MSMeS support
Organizational	PT BWJ, OPD (Regional Government Agencies), BUMDes	KEK management, investment facilitation	Events, hotels, marine, Islamic Center development
Operational (Community)	Pokdarwis, MSMeS, fishers, Karang Taruna (Village youth groups)	Implementation, local innovation	Homestays, mangrove ecotourism, tuna fishing festival, turtle conservation Bab-
Strategic Partners	UGM, UPI, President University, NGOs	Capacity enhancement, technical support	Digital marketing training, conservation education, disaster mitigation

At policy level, central-provincial-district alignment faces synchronization gaps : "National policies change rapidly... we often work with policy interpretations" [Provincial Official, I-P2, 2025]. Organizationally, PT BWJ, OPDs, and BUMDes synergize planning despite sectoral ego : "Sectoral egos still emerge over authority" [Bappeda Officer, I-O5, 2025]. Operationally, Pokdarwis and UMKM demonstrate co-production evolution : "From government programs to self-management... we feel ownership" [Pokdarwis Leader, I-C10, 2025].

These verbatim insights reveal MCG stages : preconception (cross-sector awareness: "We realized we can't do it alone" [Dispar Officer, I-P8, 2025], initiation (trust-building: "Initial suspicion gave way to understanding" [Community Rep, I-C3, 2025], formalization (MoUs/forums); operation (quick wins like digital promotion); and transformation (adaptive learning). Policy command-and-adjust patterns dominate higher levels, while operational joint capacity strengthens local resilience, confirming nested governance where lower-level innovations pressure upper-level reforms. Collaborative governance dynamics reveal interdependent yet unbalanced relationships between state, corporate SEZ operators, and local communities. Positive dynamics include intensified interactions through SEZ coordination forums, cross-institutional MoUs, CSR's tourism programs, joint training, and operational activities like homestay management, cultural festivals, and coastal conservation. These processes drive a shift from top-down approaches toward more participatory partnerships, evidenced by strengthened collective capacity, growing community ownership, and emerging inter-organizational routines. However, challenges persist in vertical coordination due to rapidly changing national policies outpacing local adaptation capacity, sectoral egos among organizations, and the absence of fully integrative decision-making platforms.

The emergent model constitutes an evolutionary Multilevel Collaborative Governance (MCG) framework operating through sequential stages—preconception, initiation, formalization, operation, and termination-transformation—interlinked across governance levels. The preconception stage reflects actors' recognition that post-tsunami recovery cannot be addressed sectorally, prioritizing collaboration in policy and institutional initiatives. Initiation involves negotiation and commitment-building, with district government mediating between PT BWJ and communities while cross-agency forums align visions. Formalization produces clearer governance structures through derivative regulations, SEZ coordination teams, and community institutions like tourism cooperatives. The operation stage manifests co-production practices where government, SEZ operators, and communities jointly implement infrastructure, economic empowerment, conservation, and digital promotion programs. Termination represents reflective transformation rather than cessation, yielding policy adjustments, partnership restructuring, and adaptive capacity strengthening for subsequent governance cycles.

This MCG configuration demonstrates that post-disaster collaborative governance constitutes an ongoing learning process that continuously renegotiates power relations, actor roles, and coordination mechanisms across governance levels.

DISCUSSION

Governance Fragmentation as a Systemic Problem

The empirical findings indicate that tourism ecosystem management in Tanjung Lesung is characterised by systemic fragmentation across governance levels. Rather than functioning as an integrated system, collaboration among actors tends to occur in silos, shaped by sectoral mandates and administrative boundaries. At the policy level, national, provincial, and regency authorities operate under overlapping regulatory frameworks that lack clear mechanisms for vertical coordination. While strategic documents consistently emphasise sustainable tourism and ecosystem preservation, these commitments are often diluted during implementation due to institutional discontinuity and shifting political priorities.

This condition reflects what Young (2009) describes as a governance gap, where policy aspirations are not matched by institutional capacity and coherence. Fragmentation is further reinforced by decentralisation dynamics, which distribute authority without necessarily strengthening coordination. In Tanjung Lesung, provincial government agencies

focus on macro-level development and investment facilitation, while local governments bear responsibility for environmental management and community engagement. The absence of a clearly mandated coordinating authority results in blurred accountability, particularly in ecosystem restoration initiatives that require sustained cross-sectoral collaboration (Bryson et al., 2015). Similar patterns have been observed in previous studies of tourism governance in Indonesia, where overlapping mandates and weak intergovernmental alignment undermine sustainability outcomes (Pujiyono et al., 2019; Kismartini & Pujiyono, 2020). From a systems perspective, this fragmentation represents a misalignment between governance structures and the ecological complexity of tourism ecosystems. Ecosystem restoration requires long-term commitment, adaptive management, and continuous feedback across governance levels. However, the findings reveal that policy instruments are often designed as static interventions, insufficiently responsive to local ecological dynamics and social realities. This condition reinforces the argument that conventional, hierarchical governance approaches are ill-suited for managing complex socio-ecological systems such as tourism destinations.

Multi-Level Collaborative Governance in Practice

Despite these structural limitations, the study identifies emerging forms of collaboration across policy, organisational, and operational levels that collectively shape tourism ecosystem management in Tanjung Lesung. These interactions illustrate how collaborative governance operates as a multi-level process rather than a single institutional arrangement.

In practice, Tanjung Lesung demonstrates how multilevel collaboration evolves through partially synchronised yet asymmetrical processes. Policy-level engagement remains largely procedural, with SEZ/PSN regulations providing formal mandates but limited mechanisms for incorporating local feedback or ecosystem-specific adaptations. Organisationally, coordination forums and MoUs between PT BWJ, district agencies, and BUMDes facilitate resource pooling and joint planning, though sectoral silos persist. Operational collaboration proves most dynamic, where Pokdarwis groups and MSMeS networks actively co-produce ecotourism innovations, homestay standards, and disaster resilience practices that gradually influence higher-level priorities (Sumarmi et al., 2026).

Findings confirm Ansell & Gash (2008) preconditions operate unevenly across levels, with operational collaboration strongest per Emerson et al. (2012). Policy proceduralism limits transformative potential (Hooghe & Marks, 2003)

A Proposed Model of Multi-Level Collaborative Governance

Synthesising the findings across governance levels, this study proposes a Multi-Level Collaborative Governance Model for tourism ecosystem management and restoration (Figure 2). This study proposes a multi-level collaborative governance model to explain how tourism ecosystem management is shaped through interactions across governance levels. The model conceptualises governance as a vertically interconnected system consisting of three analytical levels—policy, organisational, and operational—linked through core collaborative mechanisms that enable coordination, learning, and adaptive management.

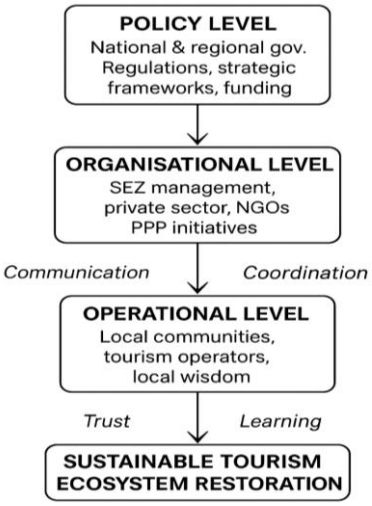


Figure 2. Conceptual Model of Multilevel Collaborative Governance in the Management of the Tanjung Lesung Tourism Ecosystem

At the policy level, national and regional governments provide strategic direction through regulations, development visions, and policy frameworks for tourism and ecosystem management. This level defines macro-level objectives and institutional mandates that guide tourism development within special economic zones. However, policy effectiveness depends on how these strategic directions are translated and operationalised at lower levels. The organisational level functions as a bridging arena between policy formulation and on-the-ground implementation. Key actors at this level include the special economic zone authority, sectoral agencies, and coordinating institutions responsible for aligning policy objectives with organisational capacities and resources. This level plays a critical role in facilitating cross-sector coordination, managing inter-institutional relationships, and translating policy goals into operational programmes.

At the operational level, collaboration occurs through direct engagement among local communities, private sector actors, non-governmental organisations, and academic institutions. This level is responsible for implementing ecosystem restoration initiatives, sustainable tourism practices, and community-based programmes (Sumarmi et al., 2026).

Operational actors also generate context-specific knowledge and practical insights that are essential for adaptive governance but are often weakly integrated into higher-level decision-making (Folke et al., 2005).

Across all governance levels, the model identifies four core collaborative mechanisms—communication, trust, coordination, and learning—that function as cross-cutting enablers of effective governance. Communication facilitates information exchange and mutual understanding, trust strengthens commitment and legitimacy, coordination aligns roles and resources, and learning enables feedback loops between practice and policy. The interaction of these mechanisms allows governance processes to evolve adaptively in response to ecological and institutional complexity.

The model suggests that effective tourism ecosystem management emerges not from isolated collaborative arrangements but from sustained interaction and feedback across governance levels. By emphasising vertical integration and institutional learning, the proposed model contributes to collaborative governance theory and offers practical insights for strengthening ecosystem-based tourism governance in special economic zones and similar multi-actor contexts.

CONCLUSION

This study demonstrates that tourism ecosystem management within Special Economic Zones should be understood not merely as an environmental or tourism governance issue, but as a broader challenge of development governance requiring sustained collaboration across multiple institutional levels. Using the Tanjung Lesung Special Economic Zone as an empirical case and employing Soft Systems Methodology (SSM), this research reveals that development outcomes are shaped by the quality of interactions among policy, organizational, and operational actors rather than by individual institutional performance. Although collaborative arrangements have emerged across these governance levels, fragmented authority, weak vertical coordination, overlapping mandates, and limited integration of local knowledge continue to constrain ecosystem restoration and sustainable regional development. Conversely, strong collaboration at the community level has fostered collective ownership, adaptive learning, local innovation, and resilience, demonstrating that participatory governance is an essential driver of long-term development.

The study contributes theoretically by proposing the Multi-Level Collaborative Governance (MLCG) Model as an integrated framework for development administration. Unlike conventional collaborative governance models that primarily emphasize inter-organizational partnerships, the MLCG model conceptualizes development governance as a dynamic process linking strategic policy direction, institutional coordination, and community-based implementation through continuous communication, trust, coordination, and institutional learning. The model therefore extends collaborative governance theory by positioning cross-level interaction as the principal mechanism through which complex socio-ecological development challenges can be addressed in decentralized governance systems.

From a practical perspective, the findings suggest that strengthening sustainable tourism development requires institutional reforms that enhance policy coherence, establish permanent cross-sector coordination mechanisms, empower local communities as co-producers of development, and integrate ecosystem restoration into regional development strategies. Beyond tourism, the proposed model provides a transferable governance framework for managing complex development programs in Special Economic Zones and other place-based development initiatives characterized by multiple stakeholders, ecological vulnerability, and institutional complexity.

Future research should validate the model across different regional development settings using comparative and longitudinal approaches to further examine its applicability and policy impact.

Limitation

This study presents three primary limitations. First, reliance on document analysis and cross-sectional interviews (n=30) limits longitudinal tracking of MLCG implementation dynamics. Second, single-case focus on Tanjung Lesung constrains generalizability despite contextual richness. Third, SSM's interpretive nature introduces researcher subjectivity despite triangulation. Future research should employ Social Network Analysis to quantify actor interactions, longitudinal designs to assess MLCG evolution, and comparative studies across Indonesian SEZs (Mandalika, Labuan Bajo) to test model transferability. Action research with SEZ practitioners would validate practical applicability.

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HOW DO RESTAURANT MANAGERS UTILIZE DIGITAL TRAINING TOOLS FOR DEAF AND HARD-OF-HEARING EMPLOYEES?

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Abstract: Restaurants increasingly rely on digital training; however, deaf and hard-of-hearing (DHH) employees still face barriers in noisy, fast-paced kitchens where spoken instruction is difficult to follow. This interpretive qualitative study examines how 30 restaurant managers in Egypt implement, adapt, and sustain accessible digital training for DHH employees under service pressure. Guided by the job demands-resources (JD-R) model and analyzed through reflexive thematic analysis, the study identifies four interconnected patterns. First, managers use visual and replayable tools, including captioned standard operating procedure videos, photo sequences, tablets, and workstation prompts, to reduce ambiguity and support self-paced rehearsal. Second, they engage in managerial bricolage by localizing corporate materials, improving Arabic captions, simplifying task steps, and distributing short refreshers through messaging applications. Third, caption errors, English-first interfaces, limited device access, and unstable connectivity can turn digital tools from job resources into additional operational demands. Fourth, peer mentoring, WhatsApp micro-coaching, and protected off-peak practice help convert digital content into confidence, task mastery, and psychologically safer learning. The findings extend hospitality disability employment research by shifting attention from hiring and inclusion climate to the day-to-day learning architecture through which inclusion is enacted in mainstream restaurants. They also extend JD-R by showing that inclusive digital training is a contingent job resource whose buffering value depends on localization and adaptation, access and quality management, and peer mentoring and coaching. Practically, the study shows how managers can convert mainstream videos, tablets, messaging applications, and AI-assisted captioning into workable inclusion practices for DHH employees in high-pressure restaurant operations.

Keywords: disability inclusion, digital training technologies, deaf and hard-of-hearing employees, restaurant management, job demands-resources, artificial intelligence

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INTRODUCTION

Employees with disabilities represent an underutilized talent pool (Jamin et al., 2024). About one in six people worldwide live with a disability; however, hospitality organizations still struggle to provide equitable access to employment and career development (Ramukumba, 2024). In this labor-intensive industry, disability inclusion has shifted from being a peripheral social responsibility issue to a strategic priority linked to workforce resilience, service quality, and brand legitimacy (Manoharan et al., 2024; Lu et al., 2025).

However, studies show that people with disabilities are often concentrated in low-skill roles, face precarious contracts, and receive limited, non-individualized support at work (Manoharan et al., 2024; Scerri et al., 2026). According to Ramukumba (2024), disability research in hospitality and tourism has primarily focused on tourists with disabilities and accessible service design, while employment-related issues remain comparatively underexplored. Within the employment field, scholars have mainly concentrated on macro policies, employer attitudes, and guest responses to disability employment, rather than on the everyday practices through which managers enable employees with disabilities to learn complex service tasks and handle demanding frontline conditions (Manoharan et al., 2024; Lu et al., 2025). As a result, there are calls for context-sensitive studies of mainstream workplaces (Jamin et al., 2024; Scerri et al., 2026).

Globally, persons with disabilities represent about 15% of the population, and their labor force participation rate remains 30% lower than that of persons without disabilities, which highlights the continuing gap between inclusion commitments and actual work opportunities (Ramukumba, 2024). At the same time, hospitality learning systems are under pressure to do more with fewer resources. Recent industry evidence shows declining learning budgets and reduced time for ongoing training, even as operators prioritize speed, efficiency, and technology-enabled learning. In hospitality and restaurant operations, this pressure has accelerated investment in digital tools, including learning management systems, replayable microlearning, visual task guidance, and mobile messaging platforms (Tavitiyaman et al., 2024; Peng et al., 2024).

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However, restaurants remain high-strain learning environments in which time pressure, communication load, space constraints, task complexity, task change, and infrastructure limitations shape what training can achieve, especially for DHH staff who cannot depend on spoken briefings in noisy kitchens. We selected the job demands-resources (JD-R) model as the guiding framework because the central issue in this study is not only whether training enhances ability, motivation, and opportunity, but whether managers can mobilize resources that buffer operational demands and prevent strain during service. In this context, an ability-motivation-opportunity AMO lens is useful for explaining performance-oriented human resource (HR) practices. Still, JD-R offers a stronger fit because it explains how accessible digital tools can operate as job resources, how those resources can fail under pressure, and how this balance shapes both learning and well-being in frontline restaurant work (Demerouti et al., 2001; Bakker & Demerouti, 2007; Bakker et al., 2023). In disability employment research, this distinction matters because prior hospitality studies explain why inclusion is important and which barriers persist. Still, they rarely show how managers build accessible training systems in everyday operations. To the best of our knowledge, AI- or digital-based training for employees with disabilities remains underexplored in hospitality, particularly in restaurant settings where communication barriers are amplified by speed and noise (Manoharan et al., 2024; Jamin et al., 2024; Lu et al., 2025). We therefore examine how restaurant managers in Egypt adapt digital training for DHH employees and show that inclusive digital training becomes valuable through three mechanisms: localization and adaptation, access and quality management, and peer mentoring and coaching. Accordingly, this study is guided by two research questions:

RQ1: How do restaurant managers implement and adapt digital training technologies to make onboarding and ongoing learning accessible for DHH employees?

RQ2: How do these technologies and managerial mechanisms operate as job resources that buffer job demands and shape both positive and negative outcomes for employees, teams, and service performance?

The study contributes to theory in three ways. First, it extends hospitality disability employment research from hiring and inclusion climate to the day-to-day learning architecture through which inclusion is enacted in mainstream restaurants. Second, it advances JD-R by showing that digital training is a contingent job resource rather than a generic organizational input; its buffering value depends on how managers localize content, secure usable access, and embed peer coaching under service pressure. Third, it explains managerial bricolage as a form of resource crafting through which managers repair misfits between corporate training systems and frontline realities. These contributions also offer a practice-ready explanation of how restaurants can convert digital training investment into substantive disability inclusion.

The rest of the paper is organized as follows. Section 2 reviews disability inclusion in hospitality employment and develops the JD-R foundation for technology-enabled training, alongside related work on accessibility and hospitality. Section 3 details the interpretivist, multi-site qualitative design, including sampling, interview procedures, and analytic approach. Section 4 reports the four themes and synthesizes them into the emerging JD-R framework of inclusive digital training for DHH employees. Section 5 interprets the findings by elaborating on the framework and propositions, then presents theoretical and managerial implications, and concludes with limitations and future research.

LITERATURE REVIEW

Theoretical foundation

JD-R explains how job demands consume employees' physical and psychological energy and, when sustained, can generate strain, whereas job resources support goal attainment, stimulate learning, and protect well-being (Demerouti et al., 2001; Bakker & Demerouti, 2007; Bakker et al., 2023). We use JD-R because restaurant training for DHH employees unfolds under intense operational pressure, where noise, speed, and communication complexity can quickly turn even well-designed tools into extra work. This makes the demand-resource balance central to the phenomenon under study.

An AMO lens can explain how practices enhance employees' ability, motivation, and opportunity to perform. Still, it is less able to show how accessible training tools buffer strain, fail under peak pressure, and redistribute workload across managers and peers. JD-R, therefore, offers the stronger theoretical fit for examining both the enabling and the burdensome sides of digital training in frontline restaurant settings.

Employees with disabilities and technology-enabled training in hospitality

Employees with disabilities encounter learning challenges in hospitality because training often relies on brief spoken instructions, informal coaching, and noise-sensitive cues. Technology-enabled training can improve accessibility by converting operational knowledge into multimodal, self-paced resources such as captioned task videos, annotated visuals, and replayable step sequences that employees can revisit during or after shifts (Berke et al., 2019; Alsalamah, 2020; Leung et al., 2022). However, the accessibility value of these tools depends on caption accuracy, interface usability, language fit, and the realities of service environments (Kuhn et al., 2024). Recent hospitality research also suggests that employees' digital capabilities shape whether technology contributes to inclusion, indicating that digital tools become meaningful only when workers can use them confidently and effectively in practice (Huang et al., 2026). To the best of our knowledge, hospitality research has not yet examined in depth how AI- or digital-enabled training is adapted for employees with disabilities in restaurant operations, particularly for DHH employees. Caution is advised when using automatic speech recognition (ASR)-based captions: performance varies across vendors and environments, and live or streaming modes can reduce accuracy. Organizations should test caption accuracy within their specific acoustic and language contexts before using ASR as an accommodation (Kuhn et al., 2024). Accessibility research also shows that DHH users' preferences for caption placement, segmentation, and readability influence usability during quick interactions, emphasizing user-informed design over standard defaults (Berke et al., 2019). Immersive approaches such as virtual reality

(VR) can enhance restaurant training outcomes (Leung et al., 2022). Still, research rarely examines accessibility for people with disabilities, leaving uncertainty about which features promote inclusion within real service flows.

Disability research in hospitality and tourism

Disability-at-work research contrasts medical perspectives (which view disability as an individual limitation) with social perspectives (which see disability as rooted in workplace barriers, routines, and systems). In hospitality, recent research increasingly aligns with the social model, urging firms to redesign HR systems and daily work practices to enable employees with disabilities to participate and advance on equal terms (Jamin et al., 2024; Manoharan et al., 2024). Early hospitality research on disability employment primarily examined whether firms hire and integrate employees with disabilities and why managers may hesitate to do so (Table 1). For example, HR-focused work in hotels has shown that gaps between policy and practice (e.g., limited accommodations, fragmented support, and uneven supervisory skills) hinder integration, even when organizations claim to promote inclusion (Gröschl, 2007).

Subsequent studies mapped employer concerns, recruitment approaches, and perceived barriers in the leisure and hospitality sector, emphasizing that many obstacles stem from managerial uncertainty and limited knowledge of inclusion, rather than job incompatibility (Houtenville & Kalargyrou, 2012; Jasper & Waldhart, 2013). Comparative data further indicated that service firms might express stronger intentions to hire people with disabilities but still worry about customer reactions and operational disruptions (Houtenville & Kalargyrou, 2015).

Table 1. Previous literature review of employees with disabilities in hospitality and tourism (Sources: Created by authors)

Study	Context and service	Method / data	Key constructs / theory	Main outcomes	Gap relative to this study
Gröschl (2007)	Hotels; integrating persons with disabilities	Empirical HR-focused study	HR policy/practice lens	Identifies policy/practice gaps in integrating employees with disabilities	Predates today's digital training stack; no focus on DHH accessibility, digital features, or AMO/JD-R pathways
Houtenville & Kalargyrou (2012)	Hospitality employers; disability hiring decisions	Employer-focused empirical study	Employer attitudes; business-case logics	Explains motivators and barriers shaping disability hiring	Front door focus (hiring) rather than how managers build accessible training ecosystems via digital tools
Jasper & Waldhart (2013)	Hospitality industry; disability employment perspectives	Empirical study	Employer/workplace inclusion issues	Evidence on perceptions and barriers in hospitality disability employment	Limited attention to day-to-day training /onboarding practices, digital accessibility, or DHH communication barriers
Houtenville & Kalargyrou (2015)	Hospitality employers; disability hiring perceptions/behavior	Empirical employer study	Attitudes/intentions; perceived barriers	Extends evidence on what drives/blocks inclusive hiring	Does not explain how inclusion is produced through training routines, especially tech-enabled and manager-adapted practices
Luu (2019)	Hotels employing workers with disabilities	Quantitative field data	Disability-inclusive HR; leadership resources	Links inclusive HR/leadership to improved employee outcomes	Does not specify which digital training features (captions, microlearning, messaging) drive AMO/JD-R mechanisms for DHH roles
Hui et al. (2021)	One international hotel; intellectual disability employment	Qualitative: interviews; focus groups	Supported employment; managerial practices	Identifies operational and social inclusion challenges; practical lessons	Not DHH; not restaurant/kitchen context; not focused on digital training affordances under constraints
Köseoglu et al. (2021)	Tourism/hospitality; disability hiring as CSR	Qualitative interviews (HR managers)	CSR; disability employment	Shows how CSR logics shape disability hiring narratives/practices	CSR lens rather than micro-level training design; little on digital accessibility features and AMO/JD-R pathways
Manoharan et al. (2024)	Hospitality disability employment research landscape	Systematic review	Thematic mapping; inclusion barriers/enablers	Notes employment stream is thinner; calls for workplace/process evidence	Review-level; does not unpack how digital training features affect AMO/JD-R for DHH staff in restaurants
Jamin et al. (2024)	Hospitality/tourism inclusion as an ecosystem	Integrative review; agenda	Ecosystem framing	Identifies multi-actor roles and major research gaps	Not empirical; doesn't show how managers adapt corporate digital tools (captions/language/device access) in daily training
Lu et al. (2025)	Tourism work; thriving with disability	Conceptual/empirical framing	Thriving / capabilities-oriented inclusion	Reorients inclusion toward thriving and meaningful work	Does not examine manager-level digital training adaptation/bricolage in restaurants or DHH-specific communication barriers
Huang et al. (2026)	Hotels; employees' digital skills and perceived inclusion	Cross-sectional survey of 607 hotel employees; PLS-SEM and set-theoretic mediation	Digital skills; psychological capital; perceived inclusion; social cognitive theory	Shows that employees' digital skills are positively associated with perceived inclusion, with psychological capital playing a mediating role	Not disability-specific; does not examine accessible training design, DHH communication barriers, restaurant operations, or manager adaptation of digital tools through JD-R processes
Scerri et al. (2026)	Hospitality employment; inclusive social innovation	Conceptual/typology-building	Social innovation; inclusive employment practices	Develops typologies/approaches to inclusion	Broad practice focus; limited detail on specific digital affordances shaping AMO/JD-R pathways for DHH frontline foodservice roles

A second stream shifted toward employee experiences and relational inclusion, showing that inclusive climates and leadership matter for well-being. Quantitative field evidence linked disability-inclusive leadership and climate to better outcomes for employees with disabilities (e.g., lower perceived discrimination and improved job attitudes), moving beyond hiring narratives toward the quality of everyday work life (Luu, 2019). Related hospitality research also shows that employees' day-to-day experiences are shaped by the distinctive features of specific service environments, reinforcing the need for context-sensitive analysis of workplace conditions and support systems (Marghany et al., 2025). More broadly, recent hotel research shows that employees' digital skills can strengthen perceived inclusion, suggesting that inclusion in hospitality is shaped not only by leadership and climate but also by workers' confidence in engaging with digital systems (Huang et al., 2026). Other studies documented gaps in perception between managers and frontline employees regarding disability employment and the practical tensions that emerge in team settings, reinforcing that inclusion is enacted in daily coordination, not only in HR policy statements (Hui et al., 2021).

Researchers also framed disability hiring through the lens of corporate social responsibility (CSR) logics. They identified structural barriers and stakeholder expectations; however, this line remains largely oriented toward organizational intentions and external legitimacy rather than toward micro-level training design (Köseoglu et al., 2021).

Qualitative work in foodservice examined moments of truth in customer interactions involving employees with disabilities, underscoring how frontline encounters can generate both dignity and vulnerability. However, it still leaves open the question of how managers prepare employees to handle these interactions through training systems. Across this literature, major reviews converge on a common limitation: hospitality research remains thin on process evidence of how inclusion is produced through day-to-day managerial practices, especially in operationally intense settings (Manoharan et al., 2024; Jamin et al., 2024). Complementary conceptual developments push the field from access to employment toward quality and thriving at work for workers with disabilities in tourism, thereby raising the bar for what inclusive systems must deliver (Lu et al., 2025).

Work on disability-inclusive social enterprises also highlights multi-actor pathways for sustaining inclusive employment. Still, it does not specify how mainstream hospitality managers translate corporate tools into accessible, role-specific learning in practice (Scerri et al., 2026). Digital training now sits at the center of this unresolved problem. Hospitality firms increasingly use apps, platforms, and mobile devices to standardize onboarding and performance support. Still, research on technology adoption and performance cautions that effects vary by context (including job level and cultural setting) and depend on how tools fit local work practices (Guo et al., 2023). However, disability employment studies rarely examine whether digital training is accessible, which digital features matter (e.g., caption accuracy, visual task sequencing, replayability, and quiet text-based coaching), and how managers adapt these features under real-world constraints (e.g., bandwidth, device access, language/localization). This gap is evident among DHH employees in restaurants, where noisy kitchens render spoken instruction unreliable and where training-as-talk can unintentionally reproduce exclusion. Therefore, prior research explains why inclusion matters and what barriers persist. However, it still under-specifies how managers build accessible training ecosystems that convert digital investments into AMO-enhancing resources while reducing communication-related job demands for employees with hearing disabilities.

MATERIALS AND METHODS

Research design

We used semi-structured interviews to examine how managers in Egyptian restaurants employ digital technologies to train and coach DHH employees. We focused on how managers select tools, adapt them to local constraints, and embed them in routine training tasks, such as onboarding, station sign-off, refresher coaching, and performance feedback.

Sampling and recruitment

We used purposive sampling to recruit managers who could provide recent, experience-based accounts of accessible training rather than general opinions. We required at least six months in a site-level role with training responsibilities because this threshold increased the likelihood that participants had completed full onboarding cycles, managed routine operational pressures, and worked with both corporate and local training systems. We also required at least one recent training episode with a disabled employee, usually a DHH employee, within the previous 12 months, so that the accounts reflected current tools, workflows, and specific incidents rather than distant recollections or hypothetical views. We excluded managers who did not meet these criteria because they could not speak directly to the phenomenon under study.

We recruited across Greater Cairo and Giza, Alexandria and Beheira, and Upper Egypt cities, including Minya, Luxor, and Assiut, to capture meaningful variation in restaurant density, infrastructure conditions, chain presence, and access to disability-support networks within Egypt. Greater Cairo and Giza offered large urban restaurant clusters and stronger access to corporate systems, Alexandria and Beheira added coastal and second-tier market conditions, and the Upper Egypt sites helped us examine how managers adapted training under relatively thinner institutional and digital support. Access was secured through three routes: corporate gatekeepers in multi-unit chains, professional contacts in independent restaurants, and nongovernmental organization (NGO) and interpreter networks that support disability-inclusive restaurant employment. This multi-channel strategy improved site access across cities and helped us reach managers who were actively involved in onboarding, coaching, and performance support for DHH employees.

We followed an information power logic to assess sample adequacy and stopped data collection when successive rounds no longer yielded new second-order concepts across outlet types and managerial levels. The final sample comprised 30 managers: 19 store managers, 5 assistant managers, 3 training supervisors, and 3 area managers. Twenty participants worked in Greater Cairo and Giza, seven in Alexandria and Beheira, and three in Upper Egypt.

Most participants worked in quick-service restaurants, followed by fast-casual outlets, cafés, and casual dining restaurants. The sample included 20 men and 10 women, which broadly reflected the male-dominated pattern of site-level operational management in the participating restaurant segments rather than a deliberate gender quota. All managers had experience training DHH employees, and 11 also supervised mixed-disability teams. Table 2 summarizes the respondent profile and the main training technologies discussed across the sample.

Table 2. Respondent profile (Source: Created by authors)

ID	Gender	Role	Outlet format	Location	Disability focus	Main training technologies discussed
R01	Woman	Store manager	quick-service restaurant (QSR)	Cairo	DHH only	Captioned standard operating procedure (SOP) videos; WhatsApp ASR
R02	Woman	Store manager	QSR	Cairo	DHH only	SOP videos; shared tablet microlearning
R03	Woman	Assistant manager	Fast-casual	Cairo	DHH; mobility	WhatsApp groups; checklists
R04	Woman	Store manager	Café	Cairo	DHH only	Tablet-based barista modules
R05	Woman	Store manager	QSR	Cairo	DHH only	Captioned fryer/assembly clips
R06	Woman	Training supervisor	QSR	Giza	Mixed (DHH, mobility)	Chain learning management system (LMS); WhatsApp
R07	Woman	Store manager	Fast-casual	Giza	DHH only	Tablet SOP; visual timers
R08	Woman	Assistant manager	QSR	Alexandria	DHH only	Captioned SOP playlist
R09	Woman	Store manager	Café	Alexandria	DHH; visual	Tablet; photo-based recipes
R10	Woman	Store manager	QSR	Upper Egypt (Minya)	DHH only	Offline videos on shared tablet
R11	Man	Store manager	QSR	Cairo	DHH only	WhatsApp ASR; captioned videos
R12	Man	Store manager	Fast-casual	Cairo	Mixed (DHH, mobility)	Chain LMS; WhatsApp groups
R13	Man	Assistant manager	QSR	Cairo	DHH only	Point of sale (POS) prompts; microlearning app
R14	Man	Store manager	Café	Giza	DHH only	Short barista clips; timers
R15	Man	Area manager	QSR	Cairo/Giza	DHH only	Group LMS oversight; store tablets
R16	Man	Store manager	Fast-casual	Giza	DHH; mobility	Captioned kitchen workflows
R17	Man	Store manager	QSR	Giza	DHH only	WhatsApp broadcasts; photos
R18	Man	Training supervisor	Casual dining	Cairo	Mixed (DHH, mobility, visual)	Central LMS; augmented reality (AR) trial
R19	Man	Store manager	QSR	Alexandria	DHH only	Video SOPs; haptic timers
R20	Man	Store manager	Fast-casual	Alexandria	DHH only	Tablet checklists; WhatsApp
R21	Man	Store manager	QSR	Alexandria	DHH only	Captioned assembly and service clips
R22	Man	Area manager	QSR	Alexandria/Beheira	Mixed (DHH, mobility)	Regional learning management system (LMS); audits
R23	Man	Store manager	Casual dining	Cairo	DHH; cognitive	Tablet menus; photo prompts
R24	Man	Assistant manager	QSR	Cairo	DHH only	Video-led onboarding flows
R25	Man	Store manager	QSR	Giza	DHH only	WhatsApp groups; peer videos
R26	Man	Store manager	Café	Upper Egypt (Luxor)	DHH only	Offline captioned clips
R27	Man	Store manager	Fast-casual	Upper Egypt (Assiut)	DHH; mobility	Tablet SOPs; messaging
R28	Man	Training supervisor	QSR	Cairo	Mixed (DHH, mobility, visual)	National LMS; microlearning
R29	Man	Area manager	QSR	Cairo/Alexandria	DHH only	Multi-site LMS; WhatsApp
R30	Man	Assistant manager	Casual dining	Giza	Mixed (DHH, visual)	Tablet menu training; videos

Interview guide and procedures

We developed a semi-structured interview guide. The guide opened with a brief profile module covering role, tenure, outlet type, branch size, disability mix, and current training technologies. We then moved through four blocks. First, we discussed inclusion and training practices, including the barriers managers aimed to reduce in their outlets. Second, we reconstructed recent onboarding and cross-training episodes step by step and asked managers to explain what they did, what the trainee did, and how understanding was assessed. Third, we created an inventory of technologies in use and discussed how each tool fitted into training. Examples included captioned standard operating procedure videos, microlearning or learning management systems, messaging apps, digital checklists, shared tablets, point-of-sale prompts, and visual or haptic timers. Fourth, we invited reflections on outcomes, barriers, and desired improvements. We used targeted probes to elicit critical incidents, such as miscommunication during peak periods, caption failures, device breakdowns, and instances in which a specific clip or message helped a trainee master a task. Interviews lasted 45 to 75 minutes and were scheduled during off-peak periods. Most interviews took place in a quiet office or a low-traffic corner within the restaurant; a minority were conducted via secure video calls with out-of-city managers. Participants chose Egyptian Arabic or English. Appendix A presents the main interview questions and illustrative probes used across the four interview blocks.

Ethics, transcription, and data management

We provided an information sheet and a brief ethics script explaining the study's purpose, procedures, voluntary participation, and the anonymization of brands and individuals. We obtained written consent before each interview for participation, audio recording, and use of anonymised quotations, and participants could skip any question without penalty.

With permission, we audio-recorded interviews using an encrypted application and took brief field notes on contextual details, without conducting systematic observation that would alter the interview design. We transcribed recordings verbatim in the source language. Bilingual research assistants translated key passages into English for analysis and reporting, and we back-checked 10-20% of the translations for accuracy. All files were stored on encrypted drives, with identifiers and consent forms kept separately, consistent with Consolidated Criteria for Reporting Qualitative Research (COREQ) aligned guidance for sensitive employment settings.

Data analysis and trustworthiness

We analyzed the data using reflexive thematic analysis (Braun & Clarke, 2006), combining inductive coding with JD-R-informed sensitizing concepts. Because our analysis moved iteratively between participants' accounts and theory, the process was abductive rather than purely inductive. First, both researchers familiarized themselves with the Arabic transcripts and field notes. Second, they generated initial codes that captured concrete actions, adaptations, barriers, and perceived outcomes. Third, the team compared codes and organized them into candidate themes related to demands, resources, and local workarounds. Fourth, we reviewed and refined the themes by returning to the transcripts, testing negative cases, and clarifying the boundaries between themes. Fifth, we defined and named the final themes and linked them back to the JD-R lens. To strengthen trustworthiness, we followed the practical criteria outlined by Nowell et al. (2017). We maintained an audit trail of coding decisions and theme revisions, used peer debriefing to challenge early interpretations, checked selected translations for accuracy, and sought brief member reflections from a small subset of participants. These steps supported credibility, dependability, confirmability, and transparency in the analysis.

RESULTS

Across 30 interviews, managers described a shared challenge: turning corporate training materials and disability policies into tools that genuinely help DHH staff master demanding restaurant work. They operated in noisy, space-constrained kitchens with high customer expectations while balancing efficiency and inclusion amid persistent job demands, including time pressure, communication load, task complexity, task change, and infrastructure limitations. Analysis generated four interrelated themes: (1) visual, replayable tools as bridges, (2) managerial bricolage and localization, (3) boundary conditions around language, design, and infrastructure, and (4) peer mentoring with micro-coaching and off-peak practice. These themes show how digital training underpins the emerging inclusion framework by positioning inclusive digital training technologies as job resources.

Visual, replayable tools as a bridge in noisy restaurants

Across formats, managers treated visual and replayable materials as the main entry point for training DHH staff. They contrasted earlier lecture-style briefings with practices centered on captioned SOP videos, stepwise photo sequences, and illustrated checklists. R3 summarized this shift: "Before, we talked, and they watched our lips; now the video shows every step, so they can follow without guessing." Visualization turned verbal instructions into concrete sequences that could be rehearsed, repeated, and refined at the workstation. Replayability emerged as equally crucial. Managers emphasized that many DHH trainees needed time to build confidence with sequencing, timing, and coordination under pressure. R11 commented: "If they forget a step, they rewind the clip, not the supervisor. That keeps dignity and saves time for everyone." Managers encouraged trainees to watch clips before and after shifts, treating microlearning modules as portable memory aids that reduced anxiety when menus changed or promotions introduced unfamiliar items. Several managers also noted that artificial intelligence (AI)-assisted captioning and translation enabled them to generate faster first drafts of subtitles, which they then reviewed to ensure accuracy for food terms and timing cues. Managers also highlighted the value of embedding visual prompts directly into the workflow. Tablets near fryers, dessert stations, or coffee machines allow staff to view short loops that show the correct sequence of actions. R7 explained: "During the rush, there is no time for big explanations; they just check the tablet and continue." These arrangements reduced dependence on spoken reminders and interpretation during peak periods and signalled that visual tools were a shared resource rather than a special accommodation. This theme shows that visual and replayable tools operate as immediate job resources because they reduce ambiguity, support self-paced rehearsal, and lower dependence on spoken instruction in noisy service settings. The finding extends accessibility and hospitality training research by showing that the value of captioned and replayable content lies not only in information delivery but also in its ability to buffer communication demands at the point of work (Alsalamah, 2020; Guo et al., 2023; Kuhn et al., 2024).

Managerial bricolage and localization of mainstream tools

The second theme examines how managers adapt mainstream technologies to address local constraints and disability-related needs. Corporate teams usually supply generic videos and PDFs, often in English. Store-level managers then cut, annotate, and re-order these materials to highlight critical steps and simplify language. R14 described: "Head office sends a long video; we trim it, slow some parts, add Arabic subtitles, and print key frames for the wall." Bricolage also shapes learning pathways, with DHH staff first assigned visually rich, tightly defined tasks before progressing to multi-step roles. Messaging applications, particularly WhatsApp, became informal learning platforms. Managers created groups that brought together supervisors, Deaf employees, and, at times, interpreters or NGO partners. They circulated short reminder videos, annotated photos, and emoji prompts before busy periods. R9 noted: "At night, I send a thirty-second clip about tomorrow's offer; in the morning, they already know the sequence." Physical and temporal bricolage complemented these practices, as managers negotiated off-peak micro-lab times and improvised mounts for phones when corporate tablets were

scarce, keeping the emerging framework workable in everyday restaurant conditions. This theme shows that digital inclusion is managerial and relational rather than purely technological. Managers created value through localization and adaptation, which supports recent hospitality evidence that technology improves practice only when it fits local workflows, service rhythms, and workforce realities (Guo et al., 2023; Tavitiyaman et al., 2024; Elmohandes et al., 2026).

Boundary conditions: Arabic user experience (UX), caption quality, and access gaps

The third theme surfaces boundary conditions that limit the inclusive potential of digital training. Managers repeatedly identified caption quality as the primary bottleneck. Automatically generated subtitles often distorted food terms or timing cues, creating errors when DHH staff followed them literally. R5 recalled: "The caption said 'sauce later' when it should be 'sauce first'; our Deaf colleague followed it exactly, and the burger was wrong." Where the head office invested in careful translation and proofreading, misunderstandings fell, and managers were more willing to delegate complex tasks. Language and interface design posed further challenges. Many tools defaulted to English menus, small fonts, or cluttered layouts designed for office workers rather than busy kitchens. To cope, managers produced simplified Arabic instructions in the form of laminated cards or infographics and placed them beside official devices. Infrastructure gaps compounded these issues: limited tablet availability, unreliable Wi-Fi, and power-outlet shortages meant that staff sometimes queued for devices or lost access during peak periods. R22 explained: "When the internet drops, the app is useless, so we fall back to gestures and memory." Partnerships with NGOs and interpreters were invaluable during recruitment and induction. However, they rarely provided funding for ongoing support, leaving store teams to shoulder day-to-day inclusion work with uneven digital scaffolding. This theme clarifies that inclusive digital training can also strain when content quality, language fit, or access to infrastructure breaks down. In JD-R terms, this is the point at which a putative resource stops buffering demands and begins to generate additional workload, uncertainty, and technostress (Tarafdar et al., 2007; Alfehaid et al., 2024; Ye & Chen, 2024).

Peer mentoring, WhatsApp micro-coaching, and off-peak practice

The final theme shows how digital tools enabled ongoing peer mentoring and micro-coaching that reinforced formal training. Many restaurants adopted buddy systems, pairing experienced DHH staff or supportive hearing colleagues with newcomers. Digital clips served as shared reference points during these interactions. R8 described: "We watch the video together once, then I stand next to him and repeat the moves; if he is unsure, we watch again." This combination of visual modelling and side-by-side practice created a safe environment for questioning, error correction, and gradual skill refinement. WhatsApp and similar platforms amplified these relationships outside scheduled sessions. Peers exchanged short reminders, photos of correctly assembled items, and encouraging messages after busy shifts. R19 noted: "When a new Deaf colleague nails the dessert order, we send a thumbs-up video in the group; he knows he is progressing." Managers deliberately protected off-peak times for structured practice with digital tools, scheduling short "micro-labs" during slow periods so staff could replay clips and rotate through stations. R27 summarized: "If we only train during the rush, they just survive; off-peak practice with videos is when they really learn." Over time, these routines turned digital tools from onboarding devices into embedded resources for continuous development and resilience.

This theme highlights the social side of digital training. Peer mentoring and micro-coaching translated digital content into confidence, error correction, and psychologically safer learning, which connects inclusive training to the broader literature on learning behaviour and retention in hospitality work (Edmondson, 1999).

Taken together, the four themes explain how inclusive digital training functions within the JD-R model and what new insight this study adds to that framework. In this setting, inclusive digital training technologies are visual, replayable, AI-assisted, and messaging-based tools that make task learning accessible to DHH employees. Localization and adaptation refer to managerial work that aligns corporate content with local language, task flow, and outlet routines. Access and quality management refer to maintaining caption accuracy, usable interfaces, device availability, and connectivity. Peer mentoring and coaching refer to the social practices through which coworkers and supervisors help one another convert digital content into skill mastery. The study extends JD-R by showing that digital training is a contingent resource whose buffering effect depends on these three mechanisms. When they are strong, training supports engagement, retention, service quality, customer value, and productivity. When they weaken, the same system intensifies strain, inconsistency, and supervisory burden.

DISCUSSION

Our results show that disability inclusion in restaurants depends less on hiring intentions and more on how managers make training usable in daily operations. This insight responds to recent calls to study disability employment as an enacted workplace process rather than a policy statement (Jamin et al., 2024; Manoharan et al., 2024). Managers described a persistent problem: they had corporate training assets and, in some cases, disability policies, but they still needed practical methods to help DHH staff learn high-risk tasks quickly in noisy, crowded kitchens. From a JD-R perspective, this setting entails multiple job demands, including time pressure, communication load, space constraints, task complexity, task change, and infrastructure limitations, which can undermine learning if managers do not provide compensatory resources (Demerouti et al., 2001; Bakker et al., 2023). This finding also aligns with hospitality technology research showing that digital investments improve performance only when managers integrate tools into local workflows (Guo et al., 2023; Helal et al., 2026).

Across restaurant formats, managers relied on inclusive digital training technologies as the most direct bridge to learning. They used captioned SOP videos, replayable microlearning loops, photo sequences, workstation prompts, and mobile and messaging-based platforms to reduce dependence on spoken coaching during peak periods. In JD-R terms, these technologies operate as job resources that buffer demanding conditions by reducing ambiguity, enabling self-paced

repetition, and supporting quiet coordination when noise and speed make verbal instruction unreliable (Bakker et al., 2023). Because task complexity and task change are constant in restaurant operations, replayable and updateable content becomes especially valuable for maintaining consistent execution during menu shifts and promotions.

However, technology did not work as a standalone solution. Managers repeatedly described localization and adaptation, in which they edited long corporate videos, strengthened Arabic captions, simplified steps, and distributed short refreshers via messaging to align with local language and operational constraints. They also engaged in access and quality management, addressing caption accuracy, interface readability, device shortages, and connectivity breakdowns that can turn resources into barriers (Kuhn et al., 2024). Peer mentoring and coaching then stabilised learning: buddy systems and micro-coaching helped trainees check understanding, correct errors quickly, and progress safely beyond survival mode. These practices build psychological safety for asking questions and learning from mistakes, which is critical when demands are high and errors are visible to coworkers and customers (Edmondson, 1999).

At the same time, managers highlighted boundary conditions that can turn digital tools into new burdens. Caption errors, English-first interfaces, device queues, and unstable connectivity disrupted learning and pushed teams back toward ad hoc methods. When job resources weaken, job demands dominate, producing negative outcomes such as work anxiety, emotional exhaustion, service inconsistency, and a heavier training-time burden for supervisors and peers. This demand-resource imbalance also increases the risk of technostress when tools require constant troubleshooting during service peaks (Tarafdar et al., 2007; Alfehaid et al., 2024). The four themes provide the empirical base for our framework, which explains when technology-enabled training produces substantive inclusion and operational gains, and when it remains symbolic.

Emerging framework

Our findings suggest that technology-enabled training can move disability inclusion from a policy aim to daily practice in restaurants when managers treat digital tools as inclusion resources rather than as generic training add-ons. Accordingly, we anchor the emerging framework in the JD-R model and specify how inclusive digital training technologies operate as job resources that help restaurants manage persistent job demands in DHH employment contexts.

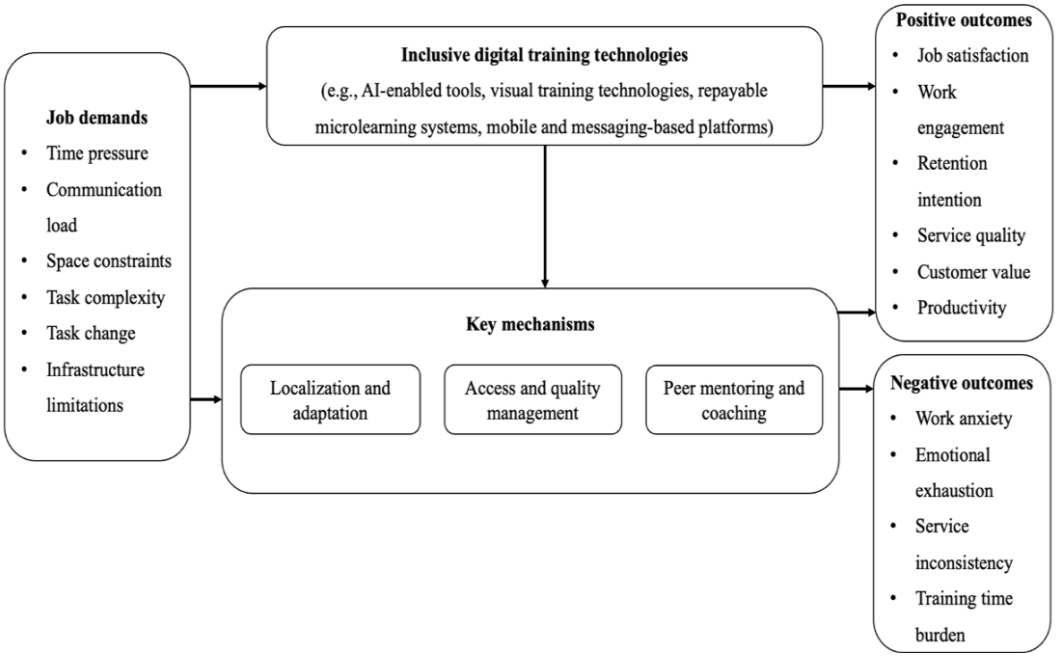


Figure 1. Conceptual framework

As shown in Figure 1, the left side of the model captures salient job demands that concentrate in restaurant operations: time pressure, communication load, space constraints, task complexity, task change, and infrastructure limitations. These demands intensify cognitive load and coordination costs, particularly in noisy kitchens where verbal instruction becomes unreliable, and service errors carry immediate customer-facing consequences. Consistent with the JD-R model, such demands can erode well-being and performance unless managers provide compensatory resources that enable learning and execution under pressure (Hassanin et al., 2023). The central element of the framework specifies inclusive digital training technologies as a bundle of job resources (rather than a single tool): AI-enabled tools, visual training technologies, replayable microlearning systems, and mobile and messaging-based platforms. Managers in our study relied on these technologies to translate verbal, time-sensitive routines into visual, replayable sequences that support self-paced rehearsal before, during, and after shifts, while reducing dependence on spoken reminders during rush periods. When embedded at the point of work (for example, station-based prompts or short task loops), these resources buffer communication demands and time pressure by reducing ambiguity, supporting quiet coordination, and stabilising task sequencing during menu changes and promotions.

Notably, the framework clarifies that technologies become effective through three key mechanisms that managers enact in situ. First, localization and adaptation capture managerial work to tailor corporate materials to local language and workflow

realities, including trimming videos, strengthening Arabic captions, simplifying steps, and converting content into wall-based or station-based visual prompts. Second, access and quality management reflect the operational governance required to keep resources usable in real kitchens, including ensuring caption accuracy, interface readability, device availability, connectivity continuity, and quick fallback options when systems fail. Third, peer mentoring and coaching explain how buddy systems and micro-coaching routines translate digital content into skill mastery through side-by-side practice, error correction, and confidence-building, especially during off-peak micro-labs. These mechanisms determine whether digital training functions as a stable job resource or becomes a fragile add-on that collapses under peak demand conditions.

The right side of the model specifies outcomes. When resources remain strong and mechanisms operate consistently, managers report positive outcomes, including job satisfaction, work engagement, retention intention, service quality, customer value, and productivity. However, when access breaks down, or content quality is unreliable (e.g., caption errors, English-first interfaces, device queues, unstable Wi-Fi), the same system can exacerbate strain, leading to negative outcomes such as work anxiety, emotional exhaustion, service inconsistency, and increased training time for supervisors and peers. In JD-R terms, these negative outcomes reflect a demand-resource imbalance, in which troubleshooting and compensating for tool failures add hidden work that intensifies strain during already demanding service periods (Tarafdar et al., 2007; Hassanin et al., 2023). Building on the emergent framework, we translate its pathways into propositions for future testing and practical application in restaurants that employ DHH staff. The propositions explicitly draw on the JD-R model, treating inclusive digital training technologies and supportive practices as job resources that buffer against high job demands and enable sustainable performance (Demerouti et al., 2001; Bakker & Demerouti, 2007; Bakker et al., 2023; Hassanin et al., 2023). Mechanism 1, localization and adaptation, explains how managers convert generic corporate content into usable training in specific restaurants. When managers trim and reorder procedures, strengthen local-language captions, and embed short, station-based learning materials into routines, DHH employees can rehearse steps with greater role clarity and lower ambiguity under real service conditions. Poor localization can recreate barriers, even when technology is available, by making content linguistically or operationally misaligned.

Proposition 1a: Localization and adaptation are positively associated with DHH task mastery.

Proposition 1b: Localization and adaptation mediate the relationship between inclusive digital training technologies and substantive training effectiveness.

Proposition 1c: Job demands weaken the positive effect of localization and adaptation on substantive training effectiveness.

Mechanism 2, access and quality management, captures how managers sustain resource reliability in busy kitchens. Accurate captions, readable interfaces, device availability, and stable connectivity determine whether digital tools function as resources or become friction. When access and quality break down, managers and peers absorb compensatory hidden work, increasing strain and undermining outcomes, consistent with technostress logic (Tarafdar et al., 2007).

Proposition 2a: Access and quality management are positively associated with substantive training effectiveness.

Proposition 2b: Access and quality management strengthen the relationship between inclusive digital training technologies and substantive training effectiveness.

Proposition 2c: Low access and quality management are positively associated with training time burden.

Mechanism 3, peer mentoring and coaching, explains how teams convert digital materials into capability through buddy systems, micro-coaching, and protected off-peak practice. These practices provide social support and rapid feedback, which can offset communication constraints during peak periods and reduce the likelihood that trainees merely survive the rush.

Proposition 3a: Peer mentoring and coaching are positively associated with the intention to retain DHH.

Proposition 3b: Peer mentoring and coaching mediate the relationship between the effectiveness of substantive training and service quality.

Proposition 3c: High job demands strengthen the positive effect of peer mentoring and coaching on DHH work engagement.

Theoretical implications

This study advances hospitality disability research by shifting attention from hiring intentions to the daily learning system that makes inclusion feasible in high-pressure restaurant work (Jamin et al., 2024; Manoharan et al., 2024). While prior work documents barriers and employer concerns, it provides limited process evidence of how managers develop training arrangements that remain workable during service peaks. Our findings address this gap by theorising inclusion as an operationally embedded training system in which restaurants must continuously translate policy and corporate content into accessible task execution.

Second, the study extends the JD-R model by treating inclusive digital training technologies as context-specific job resources rather than as a generic input (Demerouti et al., 2001; Bakker & Demerouti, 2007; Bakker et al., 2023). In restaurants, job demands are concentrated by high speed, noise, limited space, and frequent changes in menu routines, which can intensify strain for DHH staff when training relies on speech. We show how inclusive digital training technologies, including visual training technologies, replayable microlearning systems, and mobile and messaging-based platforms, buffer these demands by increasing role clarity and enabling self-paced rehearsal at the point of work. This articulation strengthens JD-R's explanatory power in hospitality by linking digital training directly to the buffering function that the theory assigns to resources.

Third, the framework clarifies how resources become effective through three mechanisms that managers enact in situ. Localization and adaptation convert generic content into locally usable routines; access and quality management protect

resource reliability; and peer mentoring and coaching sustain learning through guided practice and feedback. By specifying these mechanisms, we move beyond adoption narratives in hospitality technology research and explain why the same platforms yield uneven outcomes across outlets (Guo et al., 2023). We also demonstrate that inclusion is not only motivational but also infrastructural and procedural, requiring the ongoing maintenance of captions, interfaces, and device access (Kuhn et al., 2024).Finally, the study makes a theoretical contribution by integrating negative outcomes into the study of technology-enabled inclusion. When resources are poorly configured or unstable, they do not merely fail to help; they can increase strain and create additional work for managers and peers, consistent with technostress arguments (Tarafdar et al., 2007; Ye & Chen, 2024). This insight positions training time burden and service inconsistency as consequences of demand-resource imbalance rather than simple implementation errors. Conceptually, managerial bricolage functions as a form of resource crafting that repairs the misfit between corporate systems and frontline realities, extending JD-R discussions of how workers and managers actively shape resources to protect performance and wellbeing (Tims et al., 2013).

Managerial implications

Managers can use the framework to move from symbolic inclusion to daily, workable training for DHH staff by treating inclusive digital training technologies as core job resources that buffer restaurant job demands rather than as optional accommodations. The priority is to map the primary needs in each unit (time pressure, communication load, space constraints, task complexity, task change, and infrastructure limitations) and then embed visual, replayable training content at the point of work. Managers in our study relied on tablets, short clips, and workstation prompts to support learning during peak periods when spoken coaching is ineffective, particularly in noisy kitchens.

This approach aligns with evidence that digital tools improve frontline outcomes only when managers integrate them into local workflows (Guo et al., 2023) and with JD-R's claim that resources reduce ambiguity and protect performance under high demands (Demerouti et al., 2001; Bakker & Demerouti, 2007; Bakker et al., 2023). Second, restaurants should institutionalize localization and adaptation as routine managerial practices. Managers can trim long corporate videos, simplify step sequences, and upgrade local-language captions so DHH employees can rehearse tasks accurately during menu changes and promotions. Without this localization, available technology can still reproduce barriers through linguistic and operational misfit (Kuhn et al., 2024). Third, leaders should professionalize access and quality management. Managers should adopt a simple checklist to verify caption accuracy, interface readability, device availability, and offline backups when connectivity drops. These practices reduce the hidden work that emerges when staff must troubleshoot tools during service peaks, a pattern consistent with technostress research (Tarafdar et al., 2007; Hassanin et al., 2023).

Finally, managers should institutionalize peer mentoring and coaching through buddy systems, messaging-based micro-coaching, and protected off-peak micro-labs. These routines create faster feedback loops, support safe error correction, and build confidence beyond rush survival. Explicit messaging norms (brevity, visual prompts, and role clarity) also help prevent communication overload from turning coordination tools into additional demands. When managers align these resources with operational realities, restaurants are more likely to see higher engagement, retention intention, service quality, customer value, and productivity; when resources weaken, teams risk work anxiety, emotional exhaustion, service inconsistency, and increased training-time burden (Bakker et al., 2023; Habobati et al., 2023; Ye & Chen, 2024).

Limitations and future research

This study has several limitations. First, the sample was purposive and manager-centered, which means the findings reflect information-rich cases rather than statistical representation and may understate tensions that DHH employees themselves experience. Second, although the multi-city design improved contextual variation, the sample remained concentrated in urban and chain-dominated settings, with fewer cases from Upper Egypt and independent outlets. Future research should therefore test whether the framework travels across ownership forms, labor markets, and accessibility infrastructures. Third, the study relied on interview accounts rather than longitudinal performance records or sustained observation, so we cannot determine how digital training practices evolve or how they perform across repeated peak-service cycles. Future research should more explicitly examine contextual moderators, including outlet format, technology maturity, language localization, disability-support ecosystems, and infrastructure reliability. Mixed-method, longitudinal, and comparative designs could also test whether the three mechanisms identified here explain variation in task mastery, work engagement, retention intention, and service quality across settings.

CONCLUSIONS

This study examined how restaurant managers implement, adapt, and sustain digital training for DHH employees in demanding restaurant environments. The findings show that technology supports substantive inclusion only when embedded in everyday work practices. Visual and replayable resources, including captioned standard operating procedure videos, photo sequences, workstation prompts, and mobile microlearning, reduce dependence on spoken instruction and support self-paced learning. Managers also adapt corporate materials by improving Arabic captions, simplifying task sequences, and sharing short reminders through messaging applications. However, caption errors, English-first interfaces, limited device access, and unstable connectivity can turn digital tools into additional job demands.

Peer mentoring, micro-coaching, and protected off-peak practice are therefore essential for developing confidence, task mastery, and psychologically safer learning. The study extends the JD-R model by showing that inclusive digital training is a contingent job resource. Its value depends on three mechanisms: localization and adaptation, access and quality management, and peer mentoring and coaching. When these mechanisms are strong, digital training can improve

engagement, retention intention, service quality, customer value, and productivity. When they are weak, technology may increase anxiety, emotional exhaustion, service inconsistency, technostress, and training burden. For practice, restaurants should provide accurate local-language captions, readable interfaces, sufficient devices, offline alternatives, and short visual guides, supported by buddy systems and scheduled practice. Overall, inclusive digital training becomes effective when managers and coworkers continuously adapt, maintain, and socially embed it in frontline restaurant work.

Appendix A. Main interview questions

1. Please describe your role, your outlet, and your current responsibilities for training and supporting DHH employees.
2. How is training for DHH employees typically organized in your outlet, and what barriers are you aiming to reduce through these training practices?
3. Please tell us about a recent onboarding or cross-training episode involving a DHH employee, step by step, including what you did, what the employee did, and how you assessed understanding.
4. Which digital tools or training technologies were used in that process, and how did each one fit into training, coaching, or day-to-day task support?
5. How did you adapt the training content, language, pacing, or delivery to make it understandable and workable in daily restaurant operations?
6. What barriers, breakdowns, or misunderstandings occurred during training or service, and how did you respond to them?
7. What outcomes did you observe for the employee, the team, and service performance?
8. What improvements, resources, or changes would help make digital training more accessible and sustainable for DHH employees in your outlet?

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List of abbreviations: AI: Artificial intelligence; AMO: Ability-motivation-opportunity; AR: Augmented reality; ASR: Automatic speech recognition; CSR: Corporate social responsibility; DHH: Deaf and hard-of-hearing; GenAI: Generative artificial intelligence; JD-R: Job demands-resources; LMS: Learning management system; NGO: Nongovernmental organization; PLS-SEM: Partial least squares structural equation modeling; POS: Point of sale; QSR: Quick-service restaurant; SOP: Standard operating procedure; UX: User experience; VR: Virtual reality

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FEAR OF MISSING OUT (FOMO) IN GENERATION Z TOURISTS: THE ROLE OF CONTENT INFLUENCERS AND DESTINATION POPULARITY

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Abstract: The influence of influencer-generated content plays a significant role in shaping travel behavior, particularly among Generation Z. Influencer content depicts ideal travel experiences at popular destinations, creating a fear of missing out (FOMO) that encourages followers to visit those destinations to avoid missing out. This study aims to analyze the role of influencer content in shaping FOMO and destination popularity among Generation Z travelers. Specifically, this study analyzes how the originality, uniqueness, quality, and quantity of influencer content can create FOMO both directly and through destination popularity. To the authors' knowledge, this study is the first to apply the SOR model to analyze influencer content in influencing travel behavior, specifically from the perspective of destination popularity and FOMO in the tourism industry. The study involved 455 respondents who were Generation Z travelers, using structural equation modeling (SEM) to evaluate the relationship between influencer content, FOMO, and destination popularity. The results show that content uniqueness is proven to be a major factor triggering FOMO, even if the destination is not yet popular, while content quality has a significant influence on FOMO only through the mediation of increasing destination popularity. Furthermore, the more content available (quantity), the greater the psychological urge to always follow certain information or moments about trending or viral destinations, which in turn strengthens the feeling of FOMO among Generation Z travelers. Meanwhile, the originality of the content does not affect FOMO or destination popularity. The results of this study support the understanding that stimuli in the form of quality, quantity, and uniqueness of content created by influencers can encourage Gen Z travelers to develop curiosity about viral or trending destinations on social media, thereby creating a psychological response called FOMO, which ultimately encourages tourists to visit these popular tourist destinations. Tourist destination managers can utilize SOR theory to design more effective marketing strategies by focusing on stimulus elements that can trigger FOMO and increase the popularity of destinations among Generation Z audiences. Tourism destination managers can improve their marketing strategies by collaborating with influencers to create unique, high-quality, and consistent content. In this way, they can increase the popularity of their destinations and leverage the power of FOMO to attract more tourists.

Keywords: FOMO, destination popularity, content influencers, SOR, Generation Z

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INTRODUCTION

Generation Z travelers are -highly engaged with social media, which influences their travel behavior and decisions (Thi Bich Dao & Do, 2024). This group is described as a generation that grew up with digital technology, relying heavily on content generated by fellow travelers in their travel planning and viewing it as a trusted source of information about destinations (Purwanegara et al., 2024). Generation Z often uses online reviews, social media posts, and influencer recommendations to make their travel choices (Daşkın & Tumati, 2024; Hammad, 2024). When planning a trip, Generation Z looks for information through online sources, not through travel agents or traditional brochures (Damanik et al., 2022). This shift from conventional methods marks a larger trend and opportunity in the tourism industry, where tourism providers must adapt to the new dynamics shaped by the influence of social media on Generation Z travelers (Vancia et al., 2023). In facing this opportunity, it is important for tourism destination managers to understand the behavior of Generation Z tourists in using social media for their travel planning, thus helping them create effective strategies in providing interesting information and in accordance with the preferences of Generation Z tourists. One of the characteristics of Generation Z travelers is their tendency to plan trips and choose destinations based on the appearance shown in social media posts and the level of trust in the influencers they follow (Chang et al., 2023; Viet Tran & Thanh Khoa, 2025). Influencers play a role in promoting tourist destinations through content deemed relevant and authentic, thus influencing the opinions and behavior of potential tourists (Ding et al., 2023; Kilipiri et al., 2023). Influencer content must be presented engagingly so that it can influence Generation Z tourists' decisions in choosing destinations (Fan et al., 2022; Warintarawej et al., 2024), creating

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viral travel trends that encourage Generation Z travelers to visit the same destinations (Puiu et al., 2022). Previously little-known destinations become popular in a short time due to the domino effect of influencer content uploads (Barbe & Neuburger, 2021). The sudden surge in popularity of tourist destinations due to influencer content is often not matched by the destination's readiness in terms of management and environmental carrying capacity (Li et al., 2022). This creates a paradox, popularity is increasing rapidly, but the sustainability of the destination is actually threatened (Puiu et al., 2022). It is important to analyze factors that influence popularity, such as content shared by influencers on social media, so that stakeholders in the tourism sector (such as destination managers, travel agencies, and other related parties) can plan more appropriate marketing strategies, anticipate the surge in tourists, and adjust resources and infrastructure to the increasing demand (Firstianto et al., 2024). Therefore, a thorough understanding of the dynamics of destination popularity, as influenced by social media, is crucial for effective decision-making and tourism destination management.

In addition, the popularity of a destination is a benchmark for the level of interest and visits by tourists to a tourist destination (Lau & Koo, 2020), thus triggering feelings of Fear of Missing Out (FOMO) in Generation Z tourists (Szawłoga et al., 2024). The feeling of FOMO makes Generation Z tourists feel the need to visit popular destinations to stay on top of trends. (Pettersen-Sobczyk, 2023; Tan et al., 2023; Przybylski et al., 2013). However, Generation Z, driven by FOMO, visits destinations only because of temporary trends, not based on authentic tourism experiences. This creates a spatial pattern of quickly moving from one hotspot to another following content trends (Szawłoga et al., 2024). As a result, tourist arrivals become unstable. Newly popular destinations often experience a sudden surge in visitors, followed by a decline as the trend shifts to other destinations. This phenomenon leads to rapid changes in travel routes and a redistribution of tourists between regions. Visitation patterns become volatile and shift easily, making destination popularity vulnerable and unstable. Therefore, influencer-based marketing strategies need to be tested for their long-term effectiveness (Wibowo et al., 2021). The need to understand how influencer content can create FOMO through destination popularity can be crucial so that digital promotion strategies not only produce a momentary surge but also create sustainable popularity (Hammad, 2024). Therefore, this research helps destination managers formulate strategies that align social media trends with the destination's carrying capacity. Without proper understanding, popularity can lead to negative impacts such as overtourism, environmental damage, and a decline in the quality of the tourist experience.

The Stimulus–Organism–Response (SOR) model developed by Mehrabian & Russell (1974) is used in this study to provide a conceptual framework for understanding how external factors can influence consumer behavior (Jeong et al., 2022). The SOR model serves as a basic framework for understanding consumer behavior, integrating how environmental stimuli interact with an individual's internal processes to produce behavioral responses (Dheawara Zemafi & Tulus, 2024). Previous research shows that this model is recognized in various fields, reflecting its ability to explain consumer dynamics related to sustainability, technology adoption, marketing strategies, and tourists' emotional engagement with destinations (Kim et al., 2018). The SOR theory is used to understand the influence of influencer content on FOMO (Fear of Missing Out) through the popularity of tourist destinations. In this study, content produced by influencers functions as a stimulus (S) consisting of various dimensions, namely uniqueness, originality, quality, and quantity of content. Unique content that attracts attention, originality that differentiates it from others, attractive visual quality, and consistent content quantity can influence the audience psychologically. The audience (Generation Z), as an Organism (O), responds to this stimulus based on their psychological characteristics, namely curiosity and the desire to connect with trends that are viral or popular on social media (Koç et al., 2023). In this case, FOMO is a psychological response (R) that arises because the audience is afraid of being left behind or not following current developments related to popular tourist destinations (De Souza et al., 2025). Audience response is evident in the increased interest in visiting the tourist destinations promoted by influencers, thus increasing the popularity of those destinations. Thus, the SOR theory describes how stimuli provided by influencers can trigger an emotional response (FOMO) in audiences, which then leads to a decision to visit the destination.

Previous research findings revealed that influencer content characteristics such as informativeness, credibility, and relevance to followers' needs significantly influence travel intention (Kılıçarslan & Caber, 2026), and the protagonist's perspective (the view presented by the influencer) is also effective in increasing visit intention because the audience feels like they are experiencing the experience- (Ran et al., 2026). Influencer-created content also presents experiences in a unique, original, and high-quality manner (Ong et al., 2022). Other research indicates that uniqueness, quantity, and quality are the most important content characteristics for social media users in stimulating interaction and increasing their desire to follow influencer advice (Rodrigues et al., 2024). There is a research gap in these studies, which only focus on influencer perspectives and their influence on visit intention, while ignoring their influence on FOMO and destination popularity. Other studies have shown that destination trends or popularity are measured by directly classifying reviews from various platforms into sentiment polarities (i.e., positive, negative, and neutral ratings) (Liu et al., 2026), while FOMO is an important predictor in triggering travel motivation and visits to trending tourist destinations (Tan & Wu, 2025). However, these studies did not comprehensively analyze the factors influencing destination popularity that can trigger FOMO. Therefore, this study fills a research gap that has not been conducted by previous researchers, namely by comprehensively analyzing influencer content (dimensions of uniqueness, originality, quality, and quantity) in creating feelings of FOMO through destination popularity by applying the SOR model for Generation Z tourists.

MATERIALS AND METHODS

Hypothesis Development

Original content on social media, especially that created by influencers, can increase FOMO and drive consumer purchase intent (Raafat et al., 2023). Individuals who actively follow influencers tend to experience FOMO due to the urge

to emulate the lifestyle and interesting experiences displayed in the influencer's content (Dinh & Lee, 2021). The level of FOMO individuals feel toward original content varies depending on their personality (Lin & Jian, 2022). Therefore, the hypothesis of this research is depicted in Figure 1 below:

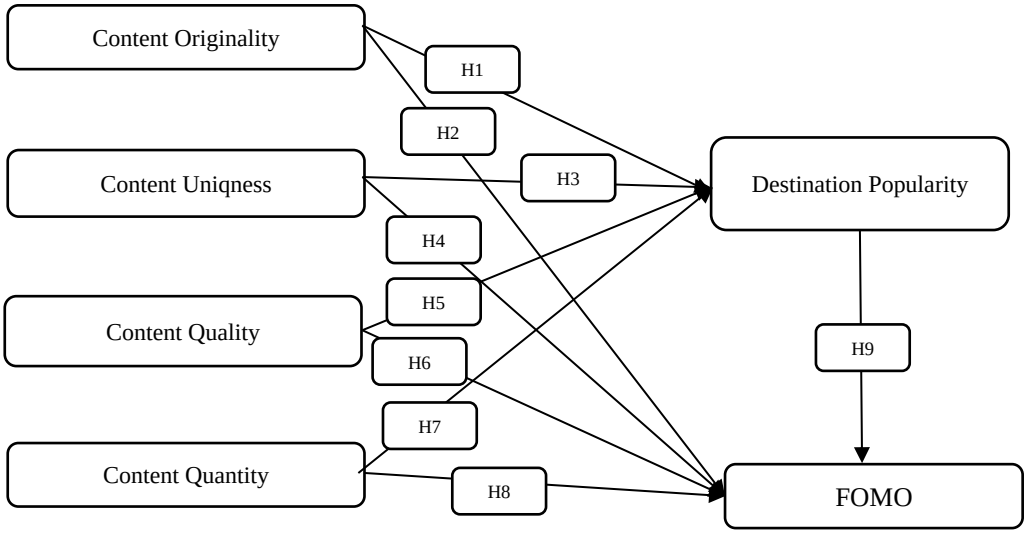


Figure 1. Research Hypothesis Diagram

Figure 1 shows that the research hypothesis is:

H1. There is a significant influence of content originality on FOMO.

Engaging and original content on social media increases audience engagement and drives interest in visiting a destination, supporting the notion that originality plays a crucial role in shaping destination popularity (Omeish et al., 2024). Authentic narratives that highlight a destination's uniqueness can build an attractive image for potential tourists. This originality increases audience attention and makes the destination more recognizable, even during a crisis (Antunes et al., 2022).

H2. There is a significant influence of content originality on destination popularity.

Influencer content typically features personal storytelling and clear visuals, creating a compelling narrative that encourages audiences to engage and experience the experience being shared (Saini et al., 2025). This phenomenon is particularly evident in the travel context, where idealized experiences portrayed by influencers trigger FOMO, prompting audiences to immediately plan trips. The authenticity and uniqueness of the content reinforce FOMO, prompting audiences to engage in similar experiences to stay in tune with their social circles (Vo et al., 2023).

H3. There is a significant influence of content uniqueness on FOMO.

Unique content contributes to the formation of a strong and positive destination image among young audiences (Saulīte & Ščeulovs, 2022). This is in line with Tandon, who emphasized that FOMO is related to an individual's psychological state and is triggered by interactions with unique content on social media (Tandon et al., 2021).

H4. There is a significant influence of content uniqueness on destination popularity.

In particular, quality, informative, credible, and well-produced content strengthens the destination image and can increase FOMO (Fear of Missing Out) by signaling exclusivity, novelty, and timely opportunities, thereby accelerating the decision-making process of Gen Z travelers who are constantly curating experiences through social media platforms (Sakulsom, 2026).

H5. There is a significant influence of content quality on FOMO.

When content demonstrates informativeness, source credibility, and social proof through authentic narratives and high production values, it enhances perceived destination image and social influence, which in turn drives intention and exploratory interest toward the destination, contributing to popularity metrics such as visit likelihood, sharing, and recommendations (Xue et al., 2024)

H6. There is a significant influence of content quality on destination popularity.

Content on platforms like TikTok and Instagram frequently appears and dominates Gen Z feeds, where trending sounds, fast-paced storytelling, and visually cinematic scenes create a strong destination image and a sense of urgency to visit before missing out (Fong et al., 2024).

H7. There is a significant influence of content quantity on destination popularity.

The perception formed through unique content can be in the form of an interesting and emotional narrative, popularity, and experiences that are more relevant to Generation Z, so this content is more effective than traditional marketing strategies (Bejoc et al., 2025). Unique content created and shared by social media users builds credibility and attracts the attention of potential visitors, making the destination more popular thanks to its visual appeal and the experiences it offers (Liu et al., 2021).

H8. There is a significant influence of content quality and quantity on FOMO and destination popularity

Continuously viewing a variety of quality content on social media can increase FOMO, encouraging social media users to share in popular experiences and trends (Manthiou et al., 2024). High-frequency, high-quality content can increase anxiety, as social media users often compare their experiences and opinions with what others post online. The implication is that influencers or content managers need to focus not only on creating high-quality content but also on maintaining consistent posting frequency

and engagement to keep the content engaging and relevant to their audience. Content frequency and quality create a mutually reinforcing effect, so feelings of FOMO continue to increase, leading to increased popularity (Bejoc et al., 2025).

H9. There is a significant influence of destination popularity on FOMO

Relevant content on social media has a significant influence on Generation Z's travel behavior, with 73% of users stating that such content influences the popularity of a destination (Das, 2025). Content on social media not only drives the rapid spread of travel trends but also increases Generation Z's attention and interest in certain destinations, even influencing their intention to visit them (Bejoc et al., 2025; Das, 2025).

The population in this study was all tourists who had visited destinations in Bandung Regency, aged 19–26. Bandung Regency, located in West Java Province, Indonesia, has various niche tourism destinations, including nature, culture and history, culinary, religious, educational, water tourism, and adventure (Darwis et al., 2024; Lusianingrum & Pertiwi, 2023; Widodo & Octaviany, 2019). A study shows that the use of social media can increase visibility, such as through the Instagram account @disbudpar.kabbdg (Culture and Tourism Office of Bandung Regency), which actively promotes tourism in Bandung Regency by using technology such as videos, images, and hashtags to increase the popularity of niche tourism in Bandung Regency (Wahyuni et al., 2021). In addition, previous research also shows that content created by influencers can shape tourist behavior, so it is important to involve influencers in marketing campaigns and make destinations in Bandung Regency famous (Salamah et al., 2022). To obtain a representative sample, a purposive sampling technique was used with a nonprobability sampling method (Dodgson, 2017). A total of 455 Gen Z travelers were sampled in this study.

This sample size was selected based on general SEM guidelines, which recommend a minimum of 200 respondents to achieve valid and reliable results (Sarstedt et al., 2020).

Data collection was conducted using a Likert-scale questionnaire (1-5) and distributed online and offline. The collected questionnaires were then verified to ensure completeness and accuracy of the data before further analysis. The following are the measurement items used in this study, as shown in Table 1:

Table 1. Measurement Items

Constructs		Indicators	Source
Content Originality	**CO1**	The authenticity of content created by influencers about tourist destinations is not a copy of each other.	(Ong et al., 2022)
	CO2	The authenticity of content created by influencers about tourist destinations is based on social media trends.	(Rodrigues et al., 2024)
	CO3	The authenticity of content created by influencers makes me interested in visiting the destination.	(Ong et al., 2022)
Content Uniqueness	**CU1**	Content created by influencers about tourist destinations has its own unique characteristics.	(Rodrigues et al., 2024)
	CU2	Content about tourist destinations created by influencers is different from other content.	
	CU3	Content created by influencers about tourist destinations is highly creative.	(Rodrigues et al., 2024)
Content Quality	**CQL1**	Influencers' content about tourist destinations provides important information.	(Ong et al., 2022)
	CQL2	Influencers' content about tourist destinations has good and attractive image quality.	
	CQL3	Influencers' content about tourist destinations often appears on social media.	(Ong et al., 2022)
Content Quantity	**CQT1**	Content about tourist destinations is often created by influencers.	
	CQT2		
Destination Popularity	**PD1**	Tourist destinations go viral on social media because of content created by influencers.	(Koç et al., 2023)
	PD2	The more often information about tourist destinations appears, the more interested I am and want to visit them.	
	PD3	The more often information about tourist destinations goes viral on social media, the more interested I am and want to visit them.	
FOMO	**F1**	The influencers' content about travel destinations makes me feel like I have to visit there soon.	(De Souza et al., 2025)
	F2	I don't want to miss out on information about tourist destinations that are going viral on social media.	
	F3	I was disappointed when I couldn't visit a tourist destination that was going viral on social media.	
	F4	When I visit a tourist destination, I feel like other people should know by uploading my content on social media.	

Data Analysis

After data collection, analysis was conducted using the SEM method, which involves several stages, starting with the measurement model, which is the analysis stage used to test how well the indicators or measurement variables describe the construct or latent variable to be measured. This stage aims to ensure the validity and reliability of each indicator used in the study. Reliability testing uses the Cronbach's Alpha coefficient, with values above 0.70 considered reliable.

The results of this validity and reliability test determine whether the research instrument can be used in the overall SEM analysis (Hair et al., 2023). For the measurement model, convergent and discriminant validity tests were also conducted. The analysis continued with structural model testing to identify causal relationships between variables.

SmartPLS 4 statistical software was used to process the data and produce relevant outputs, such as parameter estimation, model fit, and hypothesis testing (Moreno-Manzo et al., 2024).

RESULTS AND DISCUSSION

Respondent Profile

Based on the survey results of 455 respondents as shown in Figure 2, the gender composition shows that the majority of respondents are women, namely 285 people (63%), while men numbered 170 people (37%). In terms of occupation, most respondents are students, 358 people (79%), and the rest are employees, 97 people (21%). Regarding social media use, TikTok is the most frequently used platform among respondents, at 45% (205 people), followed by Instagram at 43% (200 people). Meanwhile, Facebook is used by 40 people (9%), and Twitter is in last place with the fewest number of users, namely 10 people (2%). This data shows that the majority of respondents are women of productive age in the student and college categories and actively use visual and short-video-based social media, such as TikTok and Instagram, as sources of information and entertainment.

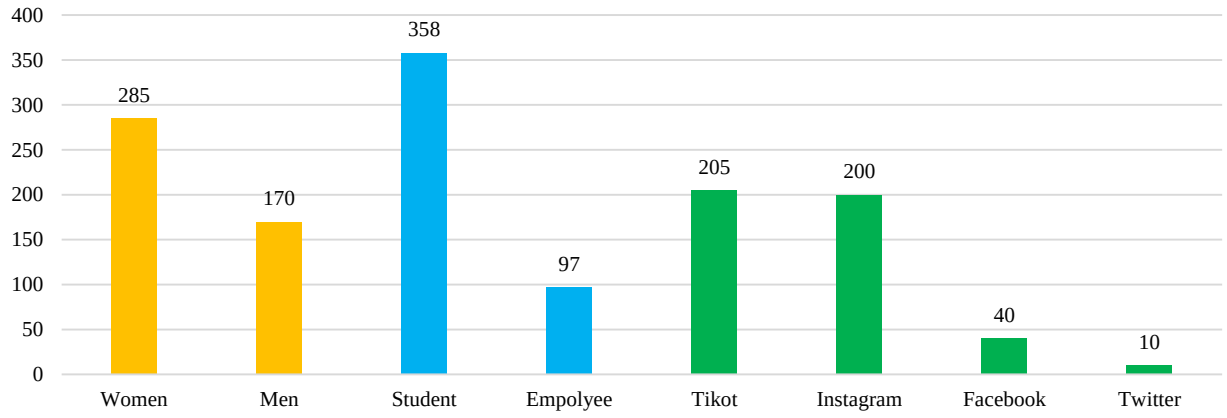


Figure 2. Respondent Profile

There are two stages in testing this research model: the outer model and the inner model, or structural model. The outer model is used to test the validity and reliability of indicators used to measure latent variables, namely convergent validity and discriminant validity. Meanwhile, the inner model, or structural model, focuses on the relationships between variables, testing the strength and significance of these relationships using R^2, path coefficients, and path significance.

Outer Model

The initial step in the research was to conduct reliability and validity tests to ensure that the indicators consistently and accurately reflect their respective latent constructs (Hair et al., 2022). The following are the results of the measurement model in this study. Table 2 shows that all constructs in this study meet the criteria for good reliability and convergent validity. The outer loading values for all indicators in this study are above 0.70, indicating that these indicators are valid in representing the latent constructs (Hair et al., 2023). Additionally, the Cronbach's Alpha and Composite Reliability (CR) values for each construct exceed the threshold of 0.70, indicating good internal consistency, meaning the indicators used can be trusted to measure the construct. Furthermore, the Average Variance Extracted (AVE) value for all constructs is greater than 0.50, meeting the requirements for convergent validity, indicating that more than 50 percent of the variance in the indicators is explained by the latent construct.

Table 2. Measurement model evaluation

Latent Variables	Indicators	Loadings	Cronbach's Alpha	CR	AVE
Content Originality	CO1	0.865	0.761	0.731	0.647
	CO2	0.796			
	CO3	0.826			
Content Uniqueness	CU1	0.806	0.815	0.891	0.560
	CU2	0.851			
	CU3	0.838			
Content Quality	CQL1	0.849	0.792	0.788	0.535
	CQL2	0.906			
	CQL3	0.808			
Content Quantity	CQT1	0.703	0.778	0.871	0.654
	CQT2	0.902			
Destination Popularity	PD1	0.785	0.748	0.758	0.731
	PD2	0.826			
	PD3	0.879			
FOMO	F1	0.774	0.799	0.766	0.692
	F2	0.709			
	F3	0.723			
	F4	0.852			

This confirms that the relationship between indicators and constructs in this study is valid and reliable. The measurement model assessment in this study uses the heterotrait-monotrait ratio (HTMT) to evaluate discriminant validity. HTMT is used to measure the correlation between two constructs that are measured reflectively, namely constructs that cannot be measured directly but are represented by certain indicators. If the HTMT value exceeds 0.90, it indicates low discriminant validity, meaning the constructs are not clearly distinct from each other, and the indicators used do not exclusively represent the construct (Hair et al., 2023).

Table 3 in this study shows the HTMT value for each construct, and overall, the HTMT value obtained is below the threshold of 0.90, which confirms that the discriminant validity in this study has been achieved satisfactorily. Namely, the constructs measured have clear differences, and the indicators used exclusively represent the construct.

Table 3. Heterotrait-monotrait (HTMT)

Latent variables	Content Originality	Content Quality	Content Quantity	Content Uniqueness	FOMO	Destination Popularity
Content Originality						
Content Quality	0.701					
Content Quantity	0.678	0.650				
Content Uniqueness	0.700	0.695	0.508			
Destination Popularity	0.402	0.649	0.580	0.660		
FOMO	0.372	0.163	0.464	0.188	0.412	

Structural Model

Evaluation of the structural model yielded positive findings. First, the Variance Inflation Factor (VIF) values ranged from 1.016 to 2.263, indicating no significant multicollinearity, as they were all below the threshold of 5 (Hair et al., 2019). Second, the Q^2 results between 0.081 and 0.309 indicate predictive relevance, with values above zero, confirming the model's ability to predict endogenous constructs (Hair & Alamer, 2022). Third, the analysis results obtained an R-square value of 0.575 for the FOMO variable and 0.511 for the destination popularity variable.

This can be interpreted as meaning that the content influencer variable, consisting of content originality, content uniqueness, content quality, and content quantity, can influence the FOMO variable by 57.5%, while the remaining 42.5% is influenced by other variables outside the research model. In addition, the content influencer variables in the form of content originality, content uniqueness, content quality, and content quantity also have an influence on destination popularity by 51.1%, while the remaining 48.9% is influenced by other variables outside the research model. The overall model structure in this study can be seen in Figure 3 below:

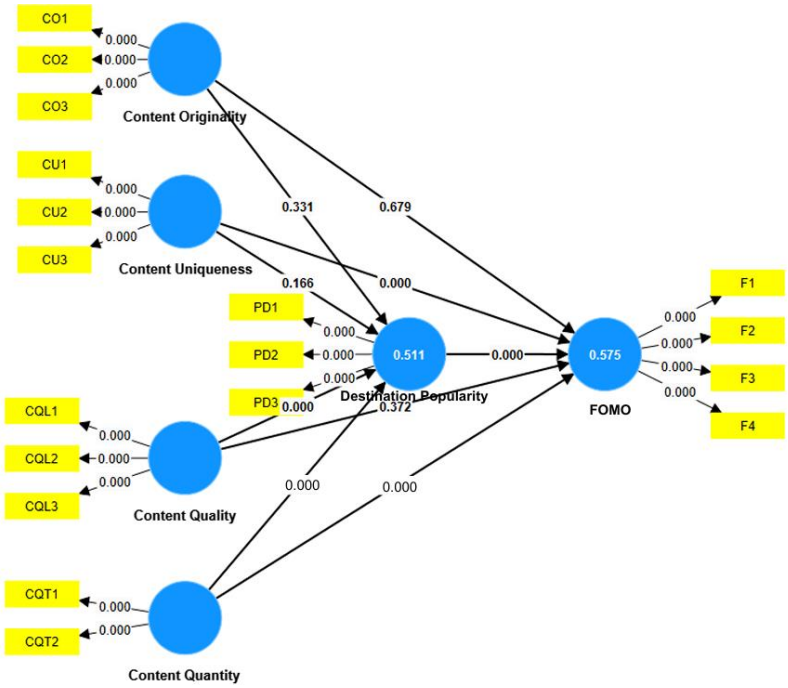


Figure 3. Result Model

Significance Test

The significance test in SEM PLS is conducted to determine whether the relationship between latent variables in the model can be considered statistically significant. This process uses bootstrapping, where data is resampled to calculate the path coefficient and its standard error. The results are reported as a t-statistic or p-value. A relationship is considered significant if the p-value is smaller than the predetermined significance level. A significant path coefficient indicates that

the relationship between the latent independent and dependent variables has strong statistical support; thus, the proposed hypothesis can be accepted. The following are the bootstrapping results of this research model:

Table 4. Results of Bootstrapping Test of Research Model

Effect	Original sample (O)	Sample means (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Content Originality -> FOMO	-0.033	-0.025	0.079	0.414	0.679
Content Originality -> Destination Popularity	0.088	0.087	0.090	0.972	0.331
Content Uniqueness -> FOMO	0.396	0.389	0.111	3.581	0.000
Content Uniqueness -> Destination Popularity	0.134	0.139	0.097	1.387	0.166
Content Quality -> FOMO	-0.088	-0.094	0.099	0.893	0.372
Content Quality -> Destination Popularity	0.501	0.497	0.090	5.563	0.000
Content Quantity -> FOMO	0.324	0.359	0.103	3.221	0.000
Content Quantity -> Destination Popularity	0.331	0.394	0.098	3.132	0.000
Destination Popularity -> FOMO	0.492	0.497	0.083	5.921	0.000

Hypothesis testing used the bootstrapping method with a 95% confidence level and a t-value greater than 1.96 (Hair et al., 2022). The results, as shown in Table 4, indicate that the relationship between Content Originality and FOMO has a t-statistic of 0.414 and a p-value of 0.679, thus rejecting the hypothesis. The relationship between Content Originality and Destination Popularity also has a t-statistic value of 0.972 and a p-value of 0.33, so the hypothesis is rejected. Then the relationship between Content Uniqueness and Destination Popularity has a t-statistic value of 1.387 and a p-value of 0.166, which also experienced a rejection of the hypothesis. Similarly, the relationship between Content Quality and FOMO has a t-statistic value of 0.893 and a p-value of 0.372, so the hypothesis is rejected.

Furthermore, the relationship between Content Uniqueness and FOMO, with a statistical t-value of 3.581 and a very low p-value (0.000) indicates that this relationship is significant, so the hypothesis is accepted. The relationship between Content Quality and Destination Popularity shows a statistical t-value of 5.563 and a p-value of 0.000, which is very significant, so the hypothesis is accepted. Then, the relationship between Content Quantity and FOMO also has a statistical t-value of 3.221 and a significant p-value (0.000), which means the hypothesis is accepted. The relationship between Content Quantity and Destination Popularity also shows a statistical t-value of 3.132 and a very significant p-value (0.000), so this hypothesis is accepted. The last relationship, namely between Destination Popularity and FOMO, also has a statistical t-value of 5.921 and a p-value of 0.000, which is very significant, so the hypothesis is accepted.

This study also examines the indirect relationship between content influencer variables (content originality, content uniqueness, content quality, and content quantity) and FOMO through destination popularity, with the following results:

Table 5. Results of Indirect Effects

Effect	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Content Originality -> Destination Popularity -> FOMO	0.043	0.041	0.044	0.976	0.329
Content Uniqueness -> Destination Popularity -> FOMO	0.066	0.072	0.055	1.213	0.225
Content Quality -> Destination Popularity -> FOMO	0.247	0.247	0.063	3.932	0.000
Content Quantity -> Destination Popularity -> FOMO	0.253	0.268	0.072	2.940	0.000

The indirect effect analysis used the bootstrapping method with a 95% confidence level and a t-value greater than 1.96 (Hair et al., 2022). Table 5 is the result of the study, which shows that Content Originality does not have a significant influence on FOMO, either directly (t-statistic = 0.414, p-value = 0.679, see Table 4) or indirectly through Destination Popularity (t-statistic = 0.976, p-value = 0.329, see Table 5). Meanwhile, the relationship between Content Uniqueness and FOMO was found to be significant directly (t-statistic = 3.581, p-value = 0.000, see Table 4), but not significant indirectly through Destination Popularity (t-statistic = 1.213, p-value = 0.225, see Table 5). Then, the relationship between Content Quality and FOMO has an insignificant direct relationship (t-statistic = 0.893 and p-value = 0.372, see Table 4) but is significant indirectly through Destination Popularity (t-statistic = 3.932 and p-value = 0.000, see Table 5). Meanwhile, the relationship between Content Quantity and FOMO has proven to be significant both directly (t-statistic = 3.221 and p-value = 0.000, see Table 4) and indirectly through Destination Popularity (t-statistic = 2.940 and p-value = 0.000, see Table 5).

This research makes an important contribution to the understanding of tourist behavior, particularly regarding the influence of influencer content on feelings of FOMO and destination popularity. The results of this study indicate that not all elements of influencer-created content have a significant influence on these two factors.

Specifically, the uniqueness of influencer-created content proved to be a key factor in eliciting feelings of FOMO in Generation Z tourists, even if the destination was not previously popular. This phenomenon demonstrates Generation Z's tendency to seek authentic, exclusive, and distinctive experiences, suggesting that unique content can trigger FOMO without necessarily relying on destination popularity. This is supported by previous research that found that unique

digital content can significantly influence FOMO, as individuals seek to avoid feelings of isolation from the experiences depicted in the content (Maar et al., 2023). Furthermore, content quality was shown to have a significant influence on destination popularity, indicating that content presented in a professional, informative, and visually appealing manner can increase destination popularity. However, this study found that content quality does not directly influence FOMO, but rather through the mediation of destination popularity. In other words, while high-quality content can increase destination attractiveness, its effect on FOMO is only apparent if the destination becomes more popular.

These findings suggest that perceived destination popularity significantly influences FOMO among Generation Z travelers. This result is consistent with previous studies by Kim & Kim (2024) and Oan-Oon & Choibamroong (2025), which demonstrate that destination popularity plays an important role in shaping travel decisions.

This study also shows that content quantity has a significant influence on FOMO and destination popularity. The more content available, the higher the FOMO felt by Generation Z travelers. Abundant content creates a psychological urge to stay on top of certain information or moments. Furthermore, greater content availability can also increase destination popularity, indicating that the presence of consistent and abundant content can increase destination visibility, create a greater desire to visit, and make it more well-known, as found by Bermúdez et al. (2023) and Viet Tran & Thanh Khoa (2025). This finding is consistent with the characteristics of Generation Z, who are responsive to high volumes of information on social media and often make impulse-based decisions due to repeated exposure. On the other hand, the results of this study found that content originality had no significant influence on FOMO or destination popularity. This suggests that Generation Z travelers are more responsive to content with a familiar visual or narrative style. Content that is similar to content that has already gone viral or follows trending visual aesthetics tends to be more accepted and trusted by audiences, even if the content is not entirely original. This finding supports the results of the study by Ulucan (2024), which shows that content that aligns with visual trends is more likely to go viral and increase destination popularity. Therefore, while authentic content can increase influencer credibility, its impact on FOMO and destination popularity is not as strong as content that follows existing visual trends.

This study also contributes to a deeper theoretical understanding of FOMO and destination popularity. Previous research conducted by Rajput & Gandhi (2025) showed that the popularity of trending destinations can create FOMO, which plays a significant role in determining travel decisions, especially among Generation Z, who are heavily influenced by social media. This finding is reinforced by the results of this study, which show that the higher the popularity of a destination, the stronger its influence on FOMO among Generation Z tourists.

This phenomenon indicates that destinations experiencing high popularity through social media will attract more tourists to visit. This illustrates the curious characteristics of Generation Z, where destinations that are widely informed on social media provide a strong incentive to visit those destinations.

If they cannot experience the experiences offered by the destination, they will feel disappointed. Therefore, tourism destination managers must design more effective marketing strategies by utilizing the uniqueness, quality, and quantity of content to increase destination popularity and create FOMO among the audience.

This study also uses the Stimulus Organism and Response (SOR) theory, where the results of the study show that the Stimulus (S), which refers to influencer content published through social media, includes visual quality, originality, quantity, and uniqueness of the content displayed (Ong et al., 2022; Rodrigues et al., 2024), does not always give rise to a sense of curiosity and a desire to connect with trending tourist destinations that are viral or popular on social media (Koç et al., 2023), and creates a psychological response (R) that appears in the form of feeling afraid of being left behind or not following existing developments, related to popular tourist destinations (De Souza et al., 2025).

The results of this study indicate that the stimulus in the form of original content created by influencers on social media is unable to provide a boost of curiosity about destinations that are currently viral or popular, so it cannot create a fear of missing out (FOMO) if you do not visit the popular destination. Therefore, destination managers can utilize marketing through influencer content shared through social media by focusing on paying attention to the uniqueness, quality, and quantity of content rather than considering the originality of the content in increasing the popularity of tourist destinations, which ultimately can create FOMO among Generation Z tourists.

CONCLUSION

This study provides in-depth insights into the influence of influencer content on FOMO feelings and destination popularity, particularly among Generation Z travelers. Based on the Stimulus-Organism-Response (SOR) theory, the findings of this study indicate that influencer content published through social media, which includes elements such as uniqueness, quality, and quantity, acts as a stimulus that influences the organism (Generation Z tourist) to respond with FOMO feelings and increased interest in the destination. The uniqueness of the content is the main factor that triggers FOMO, even if the destination is not yet popular, while the quality of the content significantly influences FOMO by mediating the increase in destination popularity. In addition, a greater amount of content creates a greater psychological urge to stay up to date on certain information or moments about trending or viral destinations, which in turn strengthens FOMO feelings among Generation Z travelers. In contrast, the originality of the content does not significantly influence FOMO or destination popularity, indicating that Generation Z is more responsive to content that follows popular visual trends.

The results of this study support the understanding that stimuli in the form of quality, quantity, and uniqueness of influencer content can encourage Gen Z tourists to have curiosity about destinations that are currently viral or trending, thus creating a psychological response in the form of FOMO, which ultimately encourages tourists to visit these popular tourist destinations. Therefore, tourist destination managers can utilize SOR theory to design more effective marketing strategies by

focusing on stimulus elements that can trigger FOMO and increase the popularity of destinations among Generation Z audiences. Overall, this study emphasizes the importance of tourism destination managers and influencers working together to create high-quality, engaging, and consistent content. An effective marketing strategy should involve the use of engaging visual content, increased posting frequency, and content selection that aligns with emerging trends.

Therefore, destination managers should consider the popularity of a destination as a crucial element in building FOMO, which can increase tourists' interest in visiting. Furthermore, it is important to understand that the FOMO effect created must be carefully managed, given the potential negative impacts of overtourism or environmental damage.

Therefore, destination managers need to plan marketing strategies that not only aim to increase short-term popularity but also ensure the sustainability of the destination and provide a quality tourism experience for tourists.

Research Limitations

This study has some limitations that should be considered. Firstly, it used a cross-sectional approach, which limits the understanding of how tourist motivations and experiences develop over time. Future research could use a longitudinal approach to explore changes in tourist behavior over time, particularly in relation to the impact of FOMO and destination popularity. Secondly, this study relied solely on a questionnaire for data collection, which could lead to perceptual bias. Future studies could incorporate mixed methods to reduce this bias and offer more detailed insights into tourist experiences. Thirdly, this study did not distinguish between the influence of different social media platforms, despite the fact that each platform has its own unique characteristics in terms of content and user interaction. Future research should examine the differences in how various social media platforms influence the promotion of tourist destinations.

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Abbreviation List: FOMO (Fear of Missing Out), HTMT (Heterotrait-monotrait), SOR (Stimulus Organism and Response), AVE (Average Variance Extracted)

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THE IMPACT OF INTEGRATED MANAGEMENT SYSTEMS ON ENVIRONMENTAL RESPONSIBILITY AND COMPLAINT ELIMINATION IN THE HOTEL SECTOR OF THE VISEGRAD FOUR COUNTRIES

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Abstract: This article examines the relationships between the implementation complexity of integrated management systems, environmental responsibility, and operational efficiency in hotels within the V4 countries. The aim was to analyse the impact of procedural complexity on the willingness to adopt environmental standards and to evaluate whether integrated quality management systems contribute to reducing customer complaints. The research was conducted in 2025 on a sample of 312 hotels in Slovakia, the Czech Republic, Poland, and Hungary using the Computer-Assisted Web Interviewing (CAWI) method, achieving a response rate of 65.27%. Spearman's rank correlation coefficient and the Independent Samples t-test were applied to verify the proposed hypotheses. The statistical analysis confirmed a strong negative correlation ($\rho = -0.742$; $p < 0.001$) between implementation complexity and the level of environmental activity, indicating that administrative burden represents a major barrier to the adoption of sustainable management practices. At the same time, hotels with an established quality management system recorded significantly fewer customer complaints (1.82 per 100 guests) than non-certified hotels (4.18 per 100 guests). The findings demonstrate that integrating quality and environmental management systems generates measurable operational and reputational benefits while highlighting the importance of simplifying implementation procedures. The study contributes to the literature on Green Quality Management in the Central European hospitality sector and provides practical recommendations for hotel managers seeking to improve service quality, strengthen environmental responsibility, and enhance long-term competitiveness through integrated management approaches. The findings also provide empirical evidence supporting the wider adoption of integrated management systems as a strategic tool for sustainable hotel development in the V4 region.

Keywords: destination loyalty, environmental practices, service quality, sustainable tourism, visitor satisfaction

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INTRODUCTION

The current global accommodation services sector has been undergoing a period of radical paradigmatic transformation over the last five years. Traditional management models, which historically focused exclusively on volume maximization and immediate profit, are currently being replaced by sophisticated models built on digital agility, an ethical approach, and environmental integrity (Buhalis, 2020). In the specific socio-economic space of the Visegrad Group (V4) countries, this process is amplified not only by post-pandemic recovery and the energy crisis but primarily by increasing legislative pressure from the European Union in the areas of ESG (Environmental, Social, and Governance) reporting and taxonomy requirements for sustainability (Bani-Melhem et al., 2022). Today, 3* to 5* category hotels in this region face competition not only in price or location but, above all, in the ability to demonstrate systemic quality linked to authentic environmental responsibility, which is becoming a key determinant of the modern traveller's purchasing behaviour. Despite the proclaimed support for green innovations and digital transformation, the practice of Central European hospitality exhibits a phenomenon defined by the academic community as "implementation paralysis" or resistance to systemic change. Hotel management in the V4 region often perceives the introduction of certified management systems (such as ISO 9001 or ISO 14001) not as a strategic investment in efficiency, but as a bureaucratic burden and an administrative barrier that consumes critical personnel and financial resources (Yeh et al., 2017; Vargová & Matušíková, 2025). This study, therefore, responds to the existing scientific gap in understanding the causal relationship between the perceived procedural complexity of these systems and the actual willingness of enterprises to implement environmental standards. In an era of online reviews and user-generated content, guest feedback has become a critical source of information for improving service quality and maintaining hotel competitiveness (Xiang et al., 2015). At the same time, digital transformation and smart tourism technologies enable hotels to respond more effectively to customer expectations and continuously improve service quality (Buhalis, 2020). Consequently, the ability to

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eliminate operational deficiencies and customer complaints through rigorous systemic management has become a decisive factor for the long-term competitiveness and reputation of hotel facilities in the Central European region.

THEORETICAL BACKGROUND

Integrated Management Systems (IMS) and Process Synergy

The traditional concept of Total Quality Management (TQM) has gradually evolved into Integrated Management Systems (IMS), which combine several international management standards into a single coherent framework. The core of these systems is typically the ISO 9001 standard (quality management), which is commonly integrated with ISO 14001 (environmental management) and ISO 45001 (occupational health and safety), enabling organisations to improve process efficiency, reduce duplication, and strengthen overall organisational performance (Zeng et al., 2007).

According to Zeng et al. (2007), the successful implementation of integrated management systems reduces process duplication and improves organisational coordination. However, their effectiveness depends largely on top management commitment, organisational capabilities and the successful integration of management practices into everyday organisational processes. Innovation in the hospitality industry depends not only on the implementation of formal management systems but also on organisational conditions that support employees' intrinsic motivation, empowerment and innovative behaviour. Hotels that foster these organisational capabilities are better positioned to implement new managerial practices and improve their competitiveness (Khalifa et al., 2023).

Green Quality Management (GQM) and Barriers in the V4 Countries

The concept of "Green Quality Management" (GQM) currently represents the most advanced approach to managing hotel services, where quality control tools are directly linked to environmental sustainability goals (Buhalis et al., 2023). Despite clear benefits in terms of energy optimisation, waste reduction and customer loyalty, the implementation of GQM still faces significant organisational and economic barriers. Early evidence by Mensah (2006) showed that although many hotels recognise the importance of environmental management, the adoption of structured environmental practices varies considerably according to hotel characteristics and available organisational resources. Garay & Font (2012) demonstrated that the successful implementation of environmental initiatives in accommodation enterprises depends largely on managerial commitment and the effective integration of sustainability practices into everyday business operations. Similarly, Vargová & Matušíková (2025) found that tourism enterprises perceive environmental innovations as beneficial for competitiveness, but their implementation is constrained by high implementation costs, technical requirements and the need for specialised knowledge. Consistent with these findings, Yeh et al. (2017) argue that hotels often hesitate to adopt green management practices because managers perceive substantial organisational and economic barriers and because the benefits of environmental initiatives are not always immediately reflected in customer perceptions or short-term business performance. Robinot & Giannelloni (2010) additionally demonstrated that customers do not always recognise or value environmental initiatives unless these are effectively communicated and integrated into the overall service experience.

Psychological Factors: Authenticity versus Greenwashing

Current academic discourse increasingly emphasizes the distinction between genuine, systemic implementation of sustainable solutions and their superficial marketing presentation. Hotels that implement environmental initiatives only superficially risk being perceived as engaging in greenwashing, which may undermine customer trust and reduce the credibility of sustainability claims (Garay & Font, 2012). Authentic sustainability practices have become an increasingly important factor influencing guests' perceptions and service evaluation. Beresecká et al. (2024) further demonstrated that the labelling and communication of accommodation services significantly influence guests' emotional perceptions and the overall evaluation of hospitality services, highlighting the importance of transparent and credible communication.

In the Central European context, Lőrincz et al. (2022) also highlight the growing importance of sustainability-related attributes in shaping customer perceptions of hospitality services. Olya et al. (2021) demonstrated that hotels' sustainability practices positively influence guests' satisfaction and loyalty, particularly when guests are familiar with these environmental initiatives. Similarly, Thai & Nguyen (2022) found that green hotel practices enhance customer satisfaction and strengthen the hotel's green image, which subsequently encourages positive customer behaviours and greater engagement with the hotel. Therefore, integrating quality management with environmental management systems enables hotels to communicate sustainability initiatives as an authentic part of their value proposition, thereby increasing the perceived value of the service.

Complaint Elimination via Standard Operating Procedures (SOPs)

Customer complaints in the hospitality industry represent an important source of information for improving service quality and maintaining customer satisfaction. They provide managers with valuable feedback regarding operational deficiencies, service inconsistencies, and unmet customer expectations, enabling continuous quality improvement. According to Kandampully et al. (2015), an effective quality management system serves as a preventive and stabilising mechanism that minimises operational errors through clearly defined Standard Operating Procedures (SOPs), thereby supporting consistent service quality despite operational challenges. Standardised operating procedures reduce service variability, facilitate employee training, and ensure that critical service processes are performed consistently regardless of staff turnover. In the digital environment, customer complaints expressed through online reviews have become an increasingly important indicator of service quality and organisational performance, significantly influencing hotels' reputation and competitiveness (Xiang et al., 2015). Consequently, the systematic collection, analysis, and elimination

of recurring complaints should be regarded as an integral component of integrated quality management. By combining standardised operational procedures with continuous customer feedback, hotels can reduce service failures, improve guest satisfaction, and strengthen their long-term competitive position.

Regional Trends and Digital Transformation in the Hospitality Industry

Within Poland, the ISO 14001 standard is becoming a key differentiation tool for competitiveness in the international market (Fonseca & Domingues, 2018). In Hungary, increasing attention has been devoted to integrating sustainability attributes into hotel services, as guests increasingly value environmentally responsible accommodation and holistic sustainability practices (Ásványi & Chaker, 2023). Recent studies indicate that the implementation of smart technologies and digital solutions supports more efficient destination and tourism management by simplifying operational processes and improving decision-making (Gajdošík, 2019). Previous research indicates that investments in environmental sustainability and systematic quality management can strengthen hotels' long-term competitiveness and organisational performance (Singjai et al., 2018; Kandampully et al., 2015).

Zeng et al. (2007) demonstrated that the successful implementation of integrated management systems depends largely on top management commitment, organisational capabilities and the effective integration of management practices into everyday organisational processes. Based on the synthesis of the aforementioned literature, we formulated two primary hypotheses that address the identified research gaps.

Hypothesis 1 (H1), is grounded in the findings of Khalifa et al. (2023), Yeh et al. (2017), and Vargová & Matušíková (2025), who identify administrative and organisational barriers as key inhibitors of environmental innovation and the implementation of management systems.

Hypothesis 2 (H2), which assumes that quality management leads to a reduction in customer complaints and environmental deficiencies, stems from the theoretical framework of Kandampully et al. (2015) regarding the stabilising role of Standard Operating Procedures (SOPs) in service quality. In this context, the development of a methodological model for the digital passportization of tourism in Slovakia appears to be a critical step. Such a system would enable the standardized digital recording of hotel attributes, including their environmental and quality certifications, thereby facilitating more efficient management and benchmarking within the sector.

For this reason, the aim of the study was to find out through the following research questions:

RQ1: To what extent does the perceived administrative and procedural complexity of integrated management systems act as a barrier to the implementation of environmental responsibility standards in hotels within the V4 region?

RQ2: Is there a statistically significant difference in the frequency of customer complaints between hotels that have implemented a quality management system and those that operate without such a system?

MATERIALS AND METHODS

The aim of the research was to analyse the relationships between the complexity of management system implementation, environmental responsibility, and operational efficiency expressed through the complaint rate in the hotel sector of the V4 countries. Based on the theoretical framework and anticipated barriers in the service sector, the following hypotheses were established:

Hypothesis 1 (H1): We assume that the complexity of implementing integrated quality management systems significantly influences the rate of adoption of environmental standards within the management of hotel facilities.

Hypothesis 2 (H2): We assume that the implementation of quality management positively affects the elimination of deficiencies in environmental responsibility, leading to an overall reduction in the number of customer complaints.

The survey was conducted in 2025 to obtain a representative perspective of the Central European hotel market. Out of a total of 478 contacted hotels, 312 entities participated in the research. To ensure high data quality, the sample was categorized by hotel standard (stars) across all V4 countries:

Poland (PL): 115 hotels in total, consisting of 54 (3*), 48 (4*), and 13 (5*) facilities.

Czech Republic (CZ): 85 hotels in total, consisting of 42 (3*), 33 (4*), and 10 (5*) facilities.

Hungary (HU): 62 hotels in total, consisting of 31 (3*), 24 (4*), and 7 (5*) facilities.

Slovakia (SK): 50 hotels in total, consisting of 25 (3*), 19 (4*), and 6 (5*) facilities.

In summary, the final sample (n = 312) comprised 152 three-star hotels (3), 124 four-star hotels (4), and 36 five-star hotels (5)*. The distribution of the sample by country and their share in the total research is presented in the following Table 1.

Table 1. Research sample distribution and response rate by country (Source: own processing)

Country	Number of Contacted Hotels	Number of Returned Questionnaires (n)	Response Rate within Country	Share of Total Sample
Poland (PL)	180	115	63.89 %	36.86 %
Czech Republic (CZ)	130	85	65.38 %	27.24 %
Hungary (HU)	90	62	68.89 %	19.87 %
Slovakia (SK)	78	50	64.10 %	16.03 %
TOTAL	478	312	65.27 %	100.00 %

Data were collected using a structured questionnaire (CAWI), which was distributed to hotel managers. The variables were quantified as follows:

1. Perceived Complexity: Measured using a 5-point Likert scale (1 – minimum complexity, 5 – high complexity), encompassing financial, temporal, and personnel aspects.
2. Environmental Activity: An index score based on the presence of green certifications (e.g., ISO 14001, EU Ecolabel) and internal eco-policies.
3. Management Quality: Binary classification (certified quality management system vs. informal management).
4. Customer Feedback: The average number of official complaints recorded per 100 guests during the monitored period.

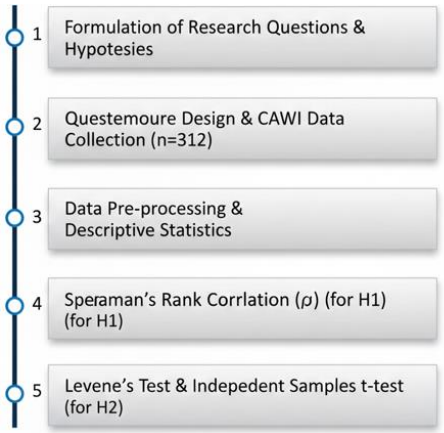


Figure 1. Display of methodological progression (Source: own processing)

The primary data obtained were subjected to statistical analysis using IBM SPSS Statistics software. The analytical procedures were selected based on the nature of the variables and the distributional characteristics of the dataset:

For Hypothesis 1 (H1): Spearman's rank correlation coefficient (ρ) was employed to test the relationship between implementation complexity and environmental activity. This non-parametric test was chosen because the data regarding perceived complexity are ordinal in nature (5-point Likert scale) and do not meet the assumption of a normal distribution.

For Hypothesis 2 (H2): An Independent Samples t-test was used to compare the means of two independent groups (hotels with a certified management system vs. those without). Prior to the t-test, Levene's Test for Equality of Variances was performed to verify homoscedasticity, ensuring the reliability of the comparison between the groups.

The methodological progression of this study, as illustrated in Figure 1, follows a structured multi-stage framework designed to ensure high internal validity1. The process began with the identification of specific research gaps within the V4 hotel sector, leading to the formulation of two research questions and corresponding hypotheses.

Data collection was executed through a targeted CAWI survey of 312 hotels, ensuring a representative sample across all V4 countries. For data analysis, we employed a combination of non-parametric tests (Spearman's ρ) to evaluate implementation barriers (H1) and parametric tests (Independent Samples t-test) to quantify operational efficiency gains (H2), following rigorous checks for homoscedasticity via Levene's test.

RESULTS AND DISCUSSION

In this chapter, we present the statistical evaluation of the primary data obtained from the research conducted in the V4 countries. The analysis focuses on the verification of two established scientific hypotheses using a sample of n=312 hotel facilities in the 3–5 categories

The objective of testing H1 was to identify the degree of dependence between the perceived complexity of implementing integrated management systems (independent variable) and the level of adoption of environmental standards (dependent variable). Given the ordinal nature of the data, Spearman's rank correlation coefficient (ρ) was applied.

Table 2. Correlation analysis of environmental activity dependence on procedural complexity (Source: own processing)

Statistical Indicator	Value (V4 total)	Interpretation of Result
Spearman's Coefficient (ρ)	-0.742	Strong negative correlation
Coefficient of Determination (R2)	0.551	High degree of influence (55.1%)
Significance Level (p-value)	< 0.001	Statistically highly significant
Standard Deviation	0.48	High degree of respondent consensus

The results in Table 2 confirm a strong indirect linear dependence. The coefficient of determination $R^2 = 0.551$ suggests that the perceived complexity of processes explains more than half of the variability in the rate of adopting environmental innovations. Based on $p < 0.001$, we can conclude that hypothesis H1 is confirmed. For hotel management in the V4 region, the administrative and temporal complexity of certification represents a barrier that significantly inhibits pro-environmental behavior. Within H2, we examined the effectiveness of quality management systems in eliminating operational deficiencies. We compared the average incidence of complaints per 100 guests between hotels with an implemented system and those without. Regarding the sample structure, it is important to note that certified management systems predominated especially in the 5-star category (all 36 facilities) and 4-star hotels (98 facilities), while informal

management prevailed in the 3-star hotel segment. The statistical analysis in Tables 3 and 4 demonstrated that hotels with an implemented quality management system achieve, on average, 2.36 fewer complaints per 100 guests compared to hotels without a system. This 56.5% difference in the error rate confirms the high operational efficiency of process management. This phenomenon is most prominent in the 4-star and 5-star segments, where standard operating procedures (SOPs) are more deeply integrated into daily operations. Given the significance level of $p < 0.001$, we accept hypothesis H2.

Table 3. Descriptive statistics of complaints by the presence of a management system (Source: own processing)

Hotel Group	Number (n)	Mean Complaints	Standard Deviation
With a quality management system	177	1.82	0.65
Without a quality management system	135	4.18	1.24

Note: The group with a system consists primarily of higher-standard hotels (4* and 5*), suggesting a correlation between hotel category and procedural discipline.

Table 4. Independent samples t-test parameters (H2) (Source: own processing)

Parameter	Value	Interpretation
t-statistic	-11.84	Significant difference in means
Degrees of freedom (df)	310	Corresponds to the research sample size
Significance level (p)	< 0.001	The difference is statistically certain

The results provide clear evidence of the economic and reputational value of management systems. While H1 identifies bureaucracy as the primary obstacle to sustainability, H2 demonstrates that overcoming this barrier—particularly in the higher-standard segment (4* and 5*) - leads to significant cost savings associated with guest compensation and strengthens brand reputation in the saturated V4 market.

It appears that although the administrative burden is perceived negatively, its systemic mastery directly correlates with higher operational integrity. The results obtained reveal a specific pattern of managerial behaviour within the hotel segment of the V4 countries. We observe a critical clash between the effort to modernize services and persistent structural barriers defined by the subjective perception of procedural complexity.

The "Administrative Brake" Phenomenon in Environmental Management

The confirmation of hypothesis H1 uncovers problematic areas of current managerial practice in the Central European region. The identified strong negative correlation ($\rho = -0.742$) suggests that environmental responsibility in V4 hotels is not yet perceived as an inherent part of quality management, but rather as an external administrative burden. In the context of the studied region, this phenomenon can be attributed to a certain "historical debt" in the culture of process management. While in Western Europe, standards such as ISO 14001 are accepted as effective tools for optimizing operating costs and resources, managers in the V4 region primarily interpret them through the prism of bureaucracy. The coefficient of determination ($R^2 = 0.551$) clearly indicates that up to 55% of the variability in the implementation of environmental standards is conditioned by the perceived complexity of processes.

This phenomenon is particularly significant in the 3-star hotel segment, which represents 48.7% of our sample (n=152) and often lacks dedicated personnel for the ESG (Environmental, Social, and Governance) area.

Consequently, the key to accelerating sustainable tourism is not merely tightening regulations, but radically simplifying implementation frameworks. A promising solution to this 'administrative brake' is the implementation of digital passportization systems. By modeling tourism data digitally, the administrative burden associated with certification and reporting could be significantly reduced, allowing hotel managers to focus on the actual implementation of sustainable practices rather than on manual documentation.

Quality as an Economic Shield Against Increasing Complaints

The verification of hypothesis H2 provides a fundamental counterargument to concerns regarding implementation complexity. Although the introduction of Quality Management Systems (QMS) is perceived as complex, its impact on operational stability is demonstrable. The profound difference in the average number of complaints (1.82 for certified hotels vs. 4.18 for non-certified) confirms that investment in systemic management represents a highly effective form of risk management in the V4 context. We explain this significant difference by the high degree of standardization.

Our analysis showed that while 5-star hotels in the V4 region utilize the benefits of certification extensively, clearly defined Standard Operating Procedures (SOPs) are absent in lower categories.

At a time when the V4 labour market faces acute fluctuation, SOPs serve as a key stabilizing element. The modern guest in the 3-star to 5-star hotel segment demands a consistent level of service; our data confirm that process-driven hotels can eliminate human factor failures, which are the primary source of complaints in the hospitality industry.

Synergy of Quality and Ecology: An Integrated Approach as the Way Forward

A surprising, yet logically following finding is that hotels that successfully overcame the complexity barrier (H1) automatically achieve the best results in guest satisfaction (H2). The modern customer in the V4 region is undergoing a knowledge transformation; they no longer complain only about primary deficiencies (e.g., a "cold dinner") but have become highly sensitive to environmental lapses, such as the excessive use of single-use plastics. This finding is consistent

with Ülkü (2025), who demonstrated that hotel managers still prioritize service quality over sustainability objectives, although the long-term competitiveness of hotels depends on achieving an appropriate balance between these two dimensions. An Integrated Management System (IMS) thus protects the hotel from two critical risks simultaneously: operational error rates and reputational damage in the area of greenwashing. The future success of hotel facilities in the V4—from family-owned 3-star pensions in the Tatra Mountains to luxury Warsaw hotels—will depend on the ability of managers to perceive ecology not as isolated "extra work," but as an integral part of the overall promise of quality.

CONCLUSIONS

The aim of this study was to examine the relationships between the implementation of management systems, the perceived complexity of processes, and their impact on environmental responsibility and guest satisfaction within the hotel sector of the V4 countries. The empirical analysis of the sample of 312 hotels yielded key insights that advance both theoretical understanding and managerial practice within the hospitality industry. The research confirmed both established hypotheses. First, a high perceived complexity of implementation acts as a significant barrier preventing hotels from transitioning to sustainable business models (H1). This reveals that administrative paralysis remains a primary obstacle to green innovation in Central Europe, as complex documentation requirements distract hotel operators from adopting functional ecological initiatives. Second, it was demonstrated that hotels that overcame this resistance and implemented a formal quality management system exhibit a 56.5% lower rate of customer complaints (H2). This substantial reduction in operational errors underscores that process standardization acts as a stabilizing mechanism for service quality.

This synergistic effect proves that quality and ecology are not in conflict but form a common foundation for increasing competitiveness in the region. From a practical perspective, these findings yield several critical managerial implications. Hotel executives must focus on the reduction of administrative burden by prioritizing process digitalization, which can effectively lower perceived system complexity and free up operational capacity for environmental measures.

In this context, hotel managers are encouraged to actively participate in emerging systems of digital passportization. Adopting these methodological frameworks for the digital evidence of service quality enhances procedural transparency and offers a distinct competitive advantage in the V4 digital marketplace. Furthermore, standardization of operating procedures (SOPs) serves as a vital cost-saving tool, ensuring service stability even amidst the high employee turnover typical of the Central European hospitality sector. To maximize operational efficiency, ecological measures should be integrated directly into daily quality checklists, ensuring that sustainable behavior becomes a routine operational habit rather than an additional administrative burden. Ultimately, this study contributes to the development of Green Quality Management theory within the specific context of the transitioning economies of Central Europe. By illustrating how quality standards directly mitigate operational risks while fostering environmental responsibility, the research provides a holistic framework for regional hospitality management. To build upon these findings, future research should focus on the longitudinal monitoring of hotels over extended periods (5 years or more) to systematically measure the long-term return on investment (ROI) of environmentally oriented quality management systems and evaluate the sustained durability of these integrated processes.

Limitations of the study

Despite the robustness of the data obtained and the high statistical significance of the results, it is essential to consider certain methodological limitations when interpreting the findings:

- Self-reporting Bias: The primary data were generated through surveys administered to hotel managers. As noted by Podsakoff et al. (2003), self-reported survey data are susceptible to common method bias and social desirability bias, potentially leading respondents to overstate socially desirable behaviours, including their commitment to environmental responsibility. Similarly, Kandampully et al. (2015) warn that managers might underreport the incidence of complaints to protect the enterprise's reputation.
- Abstraction of Cost Indicators: The variable "implementation complexity" was operationalized as a subjective managerial attitude. This study encounters a limitation defined by Vargová & Matušíková (2025)—the absence of objective financial data (e.g., actual audit costs in EUR), which prevents a precise quantification of the investment's break-even point.
- Heterogeneity of the V4 Legislative Environment: Although the V4 countries share a common geopolitical space, differences in national regulatory frameworks and institutional support mechanisms may influence hotels' willingness to adopt environmental standards beyond the legal minimum (Vargová & Matušíková, 2025). These external factors were not explicitly incorporated into our analytical model and may therefore have affected the observed relationships.
- Sectoral Constraints: The research focused on the 3-star to 5-star hotel segment (with a significant representation of 3 and 4 categories, comprising 88.5% of the sample). According to Gajdošík (2019), these categories exhibit a higher degree of procedural discipline; therefore, the results cannot be automatically generalized to the budget accommodation or pension segments.
- Cross-sectional Nature of the Data: This study is based on a cross-sectional research design, which does not allow the long-term effects of integrated management systems on organisational performance to be assessed. Future longitudinal studies are therefore needed to evaluate the sustainability of these effects over time.

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Abbreviation List: CAWI – Computer-Assisted Web Interviewing; CZ – Czech Republic; ESG – Environmental, Social and Governance; EU – European Union; GQM – Green Quality Management; H1 – Hypothesis 1; H2 – Hypothesis 2; IMS – Integrated Management Systems; ISO – International Organization for Standardization; PL – Poland; QMS – Quality Management System; ROI – Return on Investment; RQ1 – Research Question 1; RQ2 – Research Question 2; SK – Slovakia; SOP – Standard Operating Procedure; SPSS – Statistical Package for the Social Sciences; TQM – Total Quality Management; V4 – Visegrad Four Countries.

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TRENDS AND PATTERNS IN SOCIAL MEDIA AND ECOTOURISM RESEARCH: A BIBLIOMETRIC ANALYSIS

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Abstract: The main aim of this study to conduct a bibliometric analysis and to identify the publication trends, major contributions, thematic structures and future directions in field of social media and ecotourism. Between 2011 and 2025, 301 publications were gathered from Scopus database on social media and ecotourism have been identified.The VOSviewer and the R softwares were utilised for all the analyses. According to the results, the number of studies in this domain has grown over the previous few years. Also, the results co-occurrences analysis revealed that social media and its impact on ecotourism have continued to be the primary areas of study. This study may create a base for the emerging topic of social media and ecotourism by evaluating pertinent articles, allowing future scholars to analyse the usage and advantages of social media in ecotourism. This study will help the academicians and researchers to understand the gaps in the existing literature and prospective study paths, which would help them perform future investigations. The analysis results add to a comprehensive knowledge of social media and ecotourism research development. The findings further indicate that Sustainability (Switzerland), the Journal of Sustainable Tourism and the Journal of Outdoor Recreation and Tourism are the leading outlets in this domain, while China, Australia and the United States emerge as the most productive contributing countries. Bibliographic coupling, citation and co-citation analyses further map the intellectual foundations of the field and identify the authors, countries and sources that anchor its scholarly conversation. The thematic map distinguishes motor, basic, niche and emerging themes, with tourist behaviour, sustainable tourism development and the tourism industry emerging as the most promising directions for future enquiry.

Keywords: social media, ecotourism, tourism, bibliometric analysis, VOSviewer, bibliometrix, rstudio, thematic maps

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INTRODUCTION

Social media (SM) has grown into an integral component of our everyday life. Individuals utilise it for different reasons, including gathering or sharing information, awareness about any commodity, location, incident, or business. It allows users to communicate with other people worldwide (Williams et al., 2012).

It can be termed as a collection of internet-based applications building on ideological and technical platforms of Web 2.0, and enable the development and sharing of user generated content (Kaplan & Haenlein, 2010). Individuals generate, distribute, and exploit a wide scope of online sources of data, particularly, social media, to inform other people about the things, services, and brands present in the market (Murugesan, 2007). Examples of social media platforms are contemporary social networking sites such as Facebook, photo and video sharing sites such as Flickr and YouTube, and professional networking sites such as LinkedIn, micro-blogging sites such as Twitter and many others.

The utilisation of SM is one of the most prevalent internet activities. Worldwide, there were around 4.26 billion users of social media in 2021 (Dixon, 2023). Recent advances in information and communication technology (ICT) have boosted the appeal of SNSs. This spike has had a significant influence on consumer behaviour and decision-making, notably in the areas of trip planning and purchasing travel-related items and services (Buhalis, 1998). Furthermore, ecotourism is visiting relatively intact natural places to appreciate the beauty of natural landscapes, learn about animals,

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and experience unique local cultures while ensuring the preservation of the environment in those locations (Lee & Jan, 2019). With an increasing awareness of the need of sustainable tourism growth, ecotourism serves as a panacea for mitigating negative consequences and a crusader for eco-friendly activities (Li et al., 2021). This type of tourism is distinguished by its responsible approach, which contributes significantly to the global tourist sector while minimising its influence on socio-cultural factors and natural resources (Walsh & George, 2019; Sharma & Arora, 2024). Nowadays, ecotourism is regarded as among the fastest expanding market categories in the travel industry, with a promising future, especially in light of rising visitor demand for the ideal natural experience throughout the world.Web2.0 has been used to demonstrate ICT applications in ecotourism. Planeta.com is a good example of Web2.0 in ecotourism since it uses User Generated Content (UGC) to encourage interaction, cooperation, and information exchange among users who have a common purpose that aligns with the core values of ecotourism (Chai, 2008).

Social media and the internet have revolutionised all aspects of social life, including relationships, use, interactions, and economy. Integrating these technologies remains a huge challenge for individuals, notably enterprises, and, in the tourist industry, destinations (Özdemir & Çelebi, 2015). Due to the rapid advancement of technology and its extensive incorporation into the global network, destination management organisations (DMOs) must adapt and integrate tools and methods to improve the efficiency and efficacy of destination marketing. This is critical in addressing the issues given by the competitive landscape of the modern tourist business (Soteriades, 2012; Sharma et al., 2024).

There were significant changes in the diffusion of information about tourism products, and the introduction of SNSs has influenced traveller planning and consumption habits (Buhalis & Law, 2008). The information available on these websites is usually used to plan the trips by tourists. They visit the internet to research destinations, seek information about their trips, and they plan sufficiently. Social media platforms are regarded as the most successful marketing instruments used by operators of ecotourism to boost visitor awareness and to promote ecotourism (Sarkar & Lecturer, 2016; Sharma & Arora, 2025). Both the internet and social media have effectively impacted the nature and extent of the ecotourism sector. Not only ecotourism service providers, but also ecotourism travellers, utilise various social sites based on their demands. They choose different social media channels for different goals.

Bibliometric studies have been utilized regularly in academia to investigate the evolution, progress, and significance of numerous academic topics (Apriliyanti & Alon, 2017). As ecotourism has risen as a prominent field of study during the last two decades, the increase in study on ecotourism has prompted a reassessment of what is now known about this domain. Existing studies on ecotourism and social media have been conducted in different contexts like social media's role in the development of ecotourism (Bindu et al., 2018; Gaffar et al., 2022), social media and ecotourism destinations' intentions(Chi, 2021; Sharma et al., 2023), ecotourism promotion through social media (Clark et al., 2022; Chen et al., 2021; Alaflak et al., 2025; Sharma, Khatri, Khan, et al., 2023). Also, numerous studies conducted bibliometric analysis linking social media with tourism (Nusair et al., 2019), social enterprise (Ali et al., 2022), psychology (Zyoud et al., 2018) and many more. Furthermore, there are many studies like Khanra et al. (2021); Liu & Li (2020); Nordin & Jamal (2020); Hasana et al. (2022); Esparza-Huamanchumo et al. (2024); Kropinova et al. (2023) which have been conducted on ecotourism bibliometrics. However, the research that highlights the evolution and present scenario of ecotourism and social media study is still at its nascent stage. Also, this is the first attempt to provide the science mapping, performance and network analyses of the social media and ecotourism research. So, to fill these research gaps this study addressed the below listed research questions.

Q1- What is the current publication trend in the field of social media and ecotourism?

Q2- Who are the key contributors in the domain of social media and ecotourism?

Q3- What are the mature and emerging themes in the domain of social media and ecotourism?

The rest of the article is divided into seven parts: Section 2 will cover the methodology that the authors chose to include in order to explore the phenomenon, Section 3 will include the results, Section 4 will cover the discussion of the results, Section 5 will cover the conclusion, Section 6 will cover the implications of the research, and finally Section 7 will cover the limitations of the research.

RESEARCH METHODOLOGY

Data Collection

The current research utilised the Scopus that provides a wide range of academic literature. The database is especially applicable and also helpful in targeted studies like bibliometric research. The terminology utilized in this study was a blend of two cross-disciplinary components: social media and ecotourism. To make sure that all aspects of social media and ecotourism were addressed in this study, the keywords linked with each domain were included.

The search string "Ecotourism" OR "Nature-based tourism" OR "eco-tourism" OR "Sustainable tourism" AND "Social media" OR "Social media networking" OR "Social media platforms" OR "Facebook" OR "Instagram" OR "YouTube" OR "SNSs" OR "Social networking sites" OR "Twitter" was finalized.159 published publications were revealed by this search string in the subjects of "Business, management and accounting, Environmental science, Arts and Humanities, Multidisciplinary, Economics, Econometrics and Finance and Social sciences" from journals as well as conference proceedings. Our data retrieval procedure and search approach is summarised in Figure 1. Furthermore, any search engine, including Scopus, is susceptible to providing inaccurate bibliometric and bibliographic data due to the quoting of the original articles in later manuscripts (Baker et al., 2021). Thus, processing such data directly without data cleansing poses the risk of producing inaccurate analysis. As a consequence, we had to go through several steps to clean and organize the data. As indicated by Donthu et al. (2021), we searched for "bibliographic and bibliometric data, as well as visualization and

interpretation of the results". We removed a total of four records that lacked author and title names. An overview of the complete research design followed in this study, from database selection to the reporting of results, is presented in Figure 2.

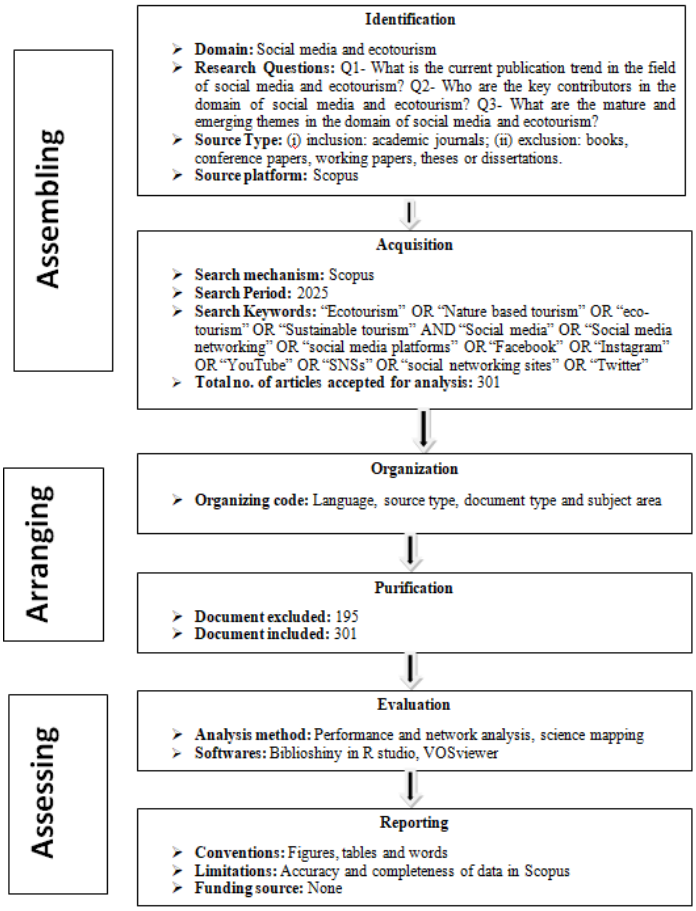


Figure 1. SPAR-4-SLR Protocol adapted from Paul et al. (2021) (Source: Authors' Own)

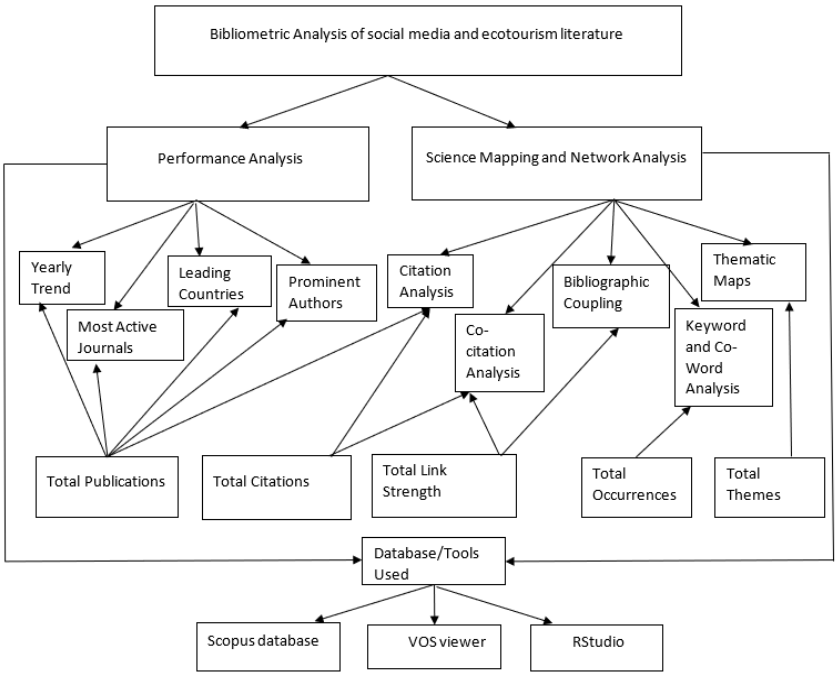


Figure 2. Overview of the study (Source: Author's Own)

Analysis Techniques

The data was analysed using "VOSviewer software and Bibliometrix package from R software". VOSviewer is utilized to create maps of authors or journals on the basis of the co-citation information, or maps of keywords on the basis of co-

occurrence information. It is a bibliometric network generation and visualisation tool. These networks all can be established through the use of citation, bibliographic coupling, co-citation, or co-authorship relationship and may be made out of journals, researchers, or single articles. VOSviewer displays a bibliometric map in a variety of ways, each highlighting a distinct facet of the map (van Eck & Waltman, 2010).Furthermore, "Bibliometrix is a package for the R statistical programming language for quantitative research in scientometrics and bibliometrics" (Pritchard, 1969). Bibliometrix includes a variety of analytical techniques that are appropriate for practitioners via Biblioshiny. It primarily works with data from "WoS, Scopus, and Dimensions". So, the VOSviewer and Bibliometrix were appropriate for data analysis for the current study.

RESULTS

Q1: Current publication trend

The publication trend in the domain of social media and ecotourism reveals a dynamic and rapidly growing research area, as evidenced by the bibliometric data extracted from the Scopus. This section elaborates on no. of publications, top publishing countries, the journals with the greatest no. of publications, and authorial dimensions of publication trends to provide a comprehensive understanding of the research evolution. A consolidated summary of these four dimensions is presented in Table 1.

Table 1. Current trends

Year Analysis		Source Analysis		Authors Analysis		Countries Analysis	
Year	**Documents**	**Source**	**Documents**	**Authors**	**Documents**	**Countries**	**Documents**
2025	62	Sustainability Switzerland	52	Pickering, C.M.	5	China	46
2024	67	Journal of Sustainable Tourism	20	Gretzel, U.	4	Australia	36
2023	45	Journal of Outdoor Recreation and Tourism	14	Nam, Y.	4	United States	34
2022	27	Current Issues in Tourism	7	Han, W.	3	Indonesia	31
2021	33	Geojournal of Tourism and Geosites	7	Mangachena, J.R.	3	United Kingdom	23
2020	28	Tourism Management	7	Wang, Y.	3	Malaysia	21
2019	9	Ecological Indicators	5	Wood, S.A.	3	South Korea	17
2018	7	International Journal of SustainableDevelopment and Planning	5	Zada, M.	3	Spain	17
2017	10	African Journal of Hospitality Tourism and Leisure	4	Abidin, Z.	2	India	15
2016	3	Environment Development and Sustainability	4	Ardoin, N.M.	2	Italy	13
2015	4	Sustainability Switzerland	52	Pickering, C.M.	5	China	46
2014	4	Journal of Sustainable Tourism	20	Gretzel, U.	4	Australia	36
2013	3	-	-	-	-	-	-
2012	1	-	-	-	-	-	-
2011	3	-	-	-	-	-	-

Distribution of publication year

The latest trends in the social media and ecotourism field have been discussed by taking into consideration the amount of exploratory articles and longer periods of publication between 2011 and 2025.

The comparison of yearly production of publications since 2011 to 2025 shows that the trend is distinctively rising, indicating the growing academic concern on the role of social media in ecotourism. Publications on the subject are still very few, with 3 papers in 2011, as this is a fledgling interdisciplinary area. Nevertheless, the publications have been increased significantly, with 67 publications in 2024 and 62 publications in 2025, which points to the continuous growth and developmental motion of this research field. This tendency implies that the impact of social media on the ecotourism industry is a new priority in the academic discussion, and it is predetermined by the general tendencies in digital communication and sustainable tourism activities. The results are depicted in Figure 3.

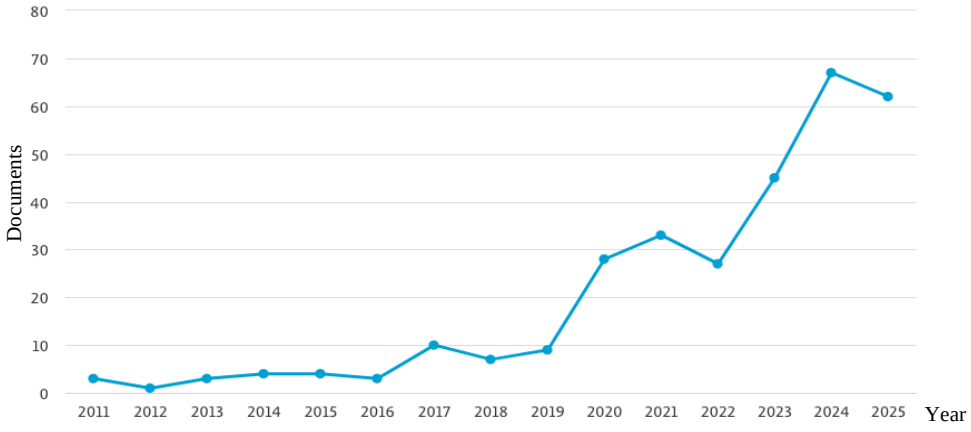


Figure 3. Documents by year (Source: Authors' own elaboration based on Scopus data)

Coverage of research regions

The geographical distribution of research input is in 57 countries, which proves the international sense of social media in ecotourism research. Asia-Pacific and North America China has the highest number of 46 publications, Australia (36) and the United States (34) come next, and this indicates excellent research on the subject. This distribution represents the strategic significance of the ecotourism and social media utilization in these areas, which could be explained by their wide range of ecotourism attraction sites and well-developed digital infrastructure. The participation of such countries as Indonesia, the United Kingdom, Malaysia, and South Korea only stresses the international interest and multidisciplinary cooperation that shaping the field. The results are depicted in Figure 4. Country-level bibliometric mapping of this kind has been shown to be an effective way of profiling the international structure of a research field (Merigó et al., 2016).

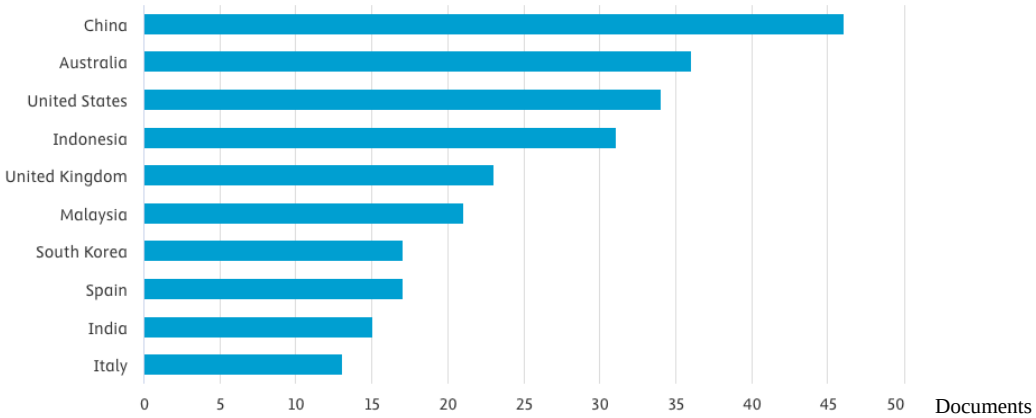


Figure 4. Documents by country (Source: Authors' own elaboration based on Scopus data)

Distribution of publication sources

The sharing of the research findings is focused on major academic journals, and the number of published articles is 301 in 76 journals. Sustainability Switzerland presents the highest number of publications (52 papers), then there is the Journal of Sustainable Tourism (20 papers), and the Journal of Outdoor Recreation and Tourism (14 papers). This concentration indicates that the scholars give preference to the journals that are related to the sustainability and tourism management as they are closer to the themes of the importance of social media on ecotourism. The popularity of these journals also shows that they are the most important sources of knowledge development and the promotion of discussions in this niche. The results are depicted in Figure 5.

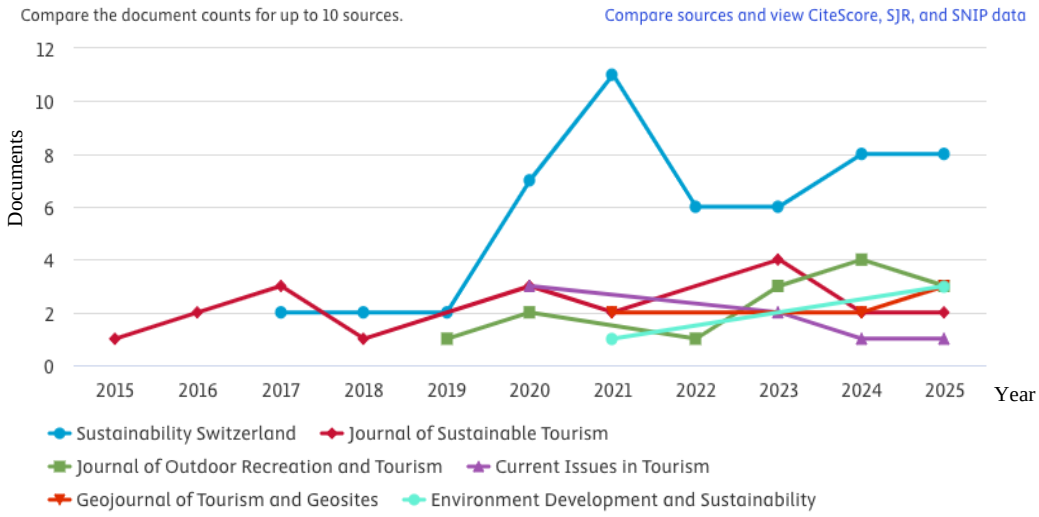


Figure 5. Documents by source (Source: Authors' own elaboration based on Scopus data)

Distribution by authors' contribution

The discipline is informed by a set of powerful authors of this genre, whose contribution has been of great importance to the literature surrounding social media and ecotourism. Pickering, C.M. is the leader of 5 publications, Gretzel, U. and Nam, Y. are the leaders of 4 publications each. Their repeated contributions can be attributed to their long-term involvement and leadership of thoughts in the field by these authors. Han, W., Mangachena, J.R., Wang, Y., Wood, S.A., and Zada, M. (Mangachena & Pickering, 2021) are also other prominent contributors with each having their fair share to add to the developing discourse. The presence of these dominating writers points to a cooperative academic network that facilitates research innovation. The results are depicted in Figure 6.

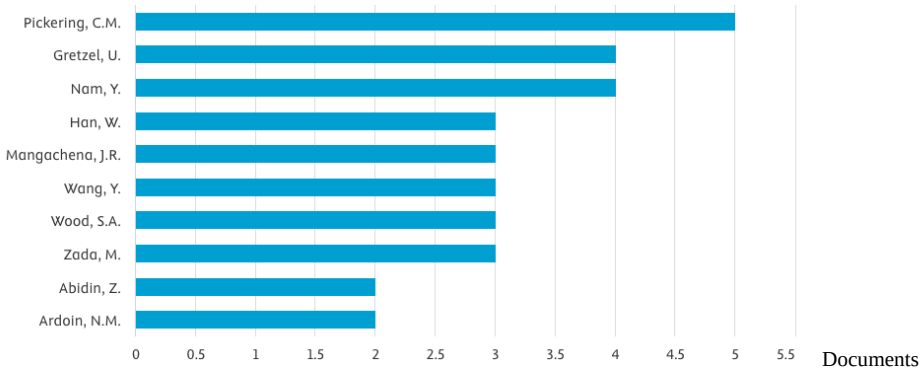


Figure 6. Top 10 prominent authors contributing to social media and ecotourism domain retrieved from Scopus
(Source: Authors' own elaboration based on Scopus data)

Q2- The key contributors in the domain of social media and ecotourism

The identification of key contributors in the social media and ecotourism domain provides insight into the intellectual structure and collaborative networks that drive research in this field.

Using bibliographic coupling, citation analysis, keyword co-occurrence, and co-citation methods, this section elaborates on the influential authors, countries, and journals shaping the discourse.

Bibliographic Coupling

It is also used to match two publications referring to the same document as similar references suggest that the two publications have much in common in terms of intellectual capital (Shin & Perdue, 2019). This is applied to two publications that cite the same document as one similar reference implies that the publications share a large portion of intellectual capital.This analysis is better implemented over a specific period of time and is oriented towards a classification of articles into thematic groups based on shared references. The bibliographic coupling analysis can be used to determine the interrelatedness of the research through the identification of bi-directional publications that share common references, meaning that the publications share common intellectual foundations. Among the authors in the period under investigation, Nam Y. stands out as the most influential, with a link strength of 450, and the next author, Hysa B., Karasek A., and Zdonek I. (Hysa et al., 2021) all have a link strength of 406. This implies that these authors make significant contributions to the literature foundations and are the focus of thematic groupings in the subject. At the country level, the United States shows the highest link strength (2375) meaning that it produces and has a high level of intellectual output and influence, then it is followed by Australia (2308) and United Kingdom (2153). These nations are centers of academic life, which promote research partnerships and theme building. Sustainability (Switzerland) has the highest level of influence with a link strength of 491 which shows that the journal is one of the main dissemination tools of the influential research articles. The complete bibliographic coupling results for authors, countries and sources are reported in Table 2.

Table 2. Bibliographic coupling

Authors	Link Strength	Countries	Link Strength	Sources	Link Strength
Nam Y.	450	United States	2375	Sustainability (Switzerland)	491
Hysa B.	406	Australia	2308	Journal of Sustainable Tourism	360
Karasek A.	406	United Kingdom	2153	Journal of Outdoor Recreation and Tourism	234
Zdonek I.	406	China	1622	Tourism Geographies	114
Joo Y.	327	Denmark	1138	Tourism Management	110
Seok H.	327	South Africa	943	Current Issues in Tourism	85
Chung H.C.	231	France	596	Land	85
Chung N.	231	South Korea	536	Journal of Cleaner Production	52
Wood S.A.	193	New Zealand	531	ISPRS International Journal of Geo-Information	43
Fisher D.M.	191	Italy	498	Journal Of Hospitality and Tourism Technology	42

Citation analysis

References and citation allow us to establish intellectual relationships (Appio et al., 2014). In the citation analysis method, the number of citations of a published document is a measure of that document that has gained recognition in the academic field. Citation analysis measures the academic standpoint and acknowledgement of both authors and nations by counting the regularity of reference. Wood S.A. is the most influential writer with 748 references in 4 sources which proves a great acknowledgement and influence in the social media and ecotourism studies. Once again, the United States is first among the countries with the highest number of 1382 citations of 26 publications, emphasizing its prevalence in the creation of the most widely acknowledged research. Wang M., Pickering C. and Kang M. are other influential authors with citation counts of 94-101 and this indicates the contribution they have made to the field of knowledge. The patterns of citation display a cluster of influential research in certain areas and in a group of scholars that influences the academic discourse and determines the research priorities. The detailed citation counts for the leading authors and countries are presented in Table 3.

Table 3. Citations Analysis

Authors	TP	TC	Countries	TP	TC
Wood S.A.	4	748	United States	26	1382
Wang M.	2	101	United Kingdom	15	521
Pickering C.	2	94	Australia	25	448
Kang M.	2	11	Italy	10	419
Papafitsoros K.	2	10	China	20	287
Schofield G.	2	10	South Korea	11	145
Han W.	3	6	Spain	9	117
Wang Y.	3	6	South Africa	5	77
Pickering C.M.	3	2	Greece	5	14
Mangachena J.R.	2	1	Taiwan	5	10

Co-occurrence of keywords

Co-word analysis is based on the frequency of co-occurrence of keywords i.e. the number of articles that two keywords co-occur in (Whittaker, 1989). This analysis was developed to address such an analytical dilemma because it finds and visualises associations of two keywords based on the strength of the association between them (Callon et al., 1991). It is often applied to analyse the idea network of the research topics and the trends within a particular field as the keywords are the expressions, which describe the nature of a research work (Callon et al., 1991; Ding et al., 2001). However, due to term changes throughout time, co-word analysis has a shortcoming in terms of stability.

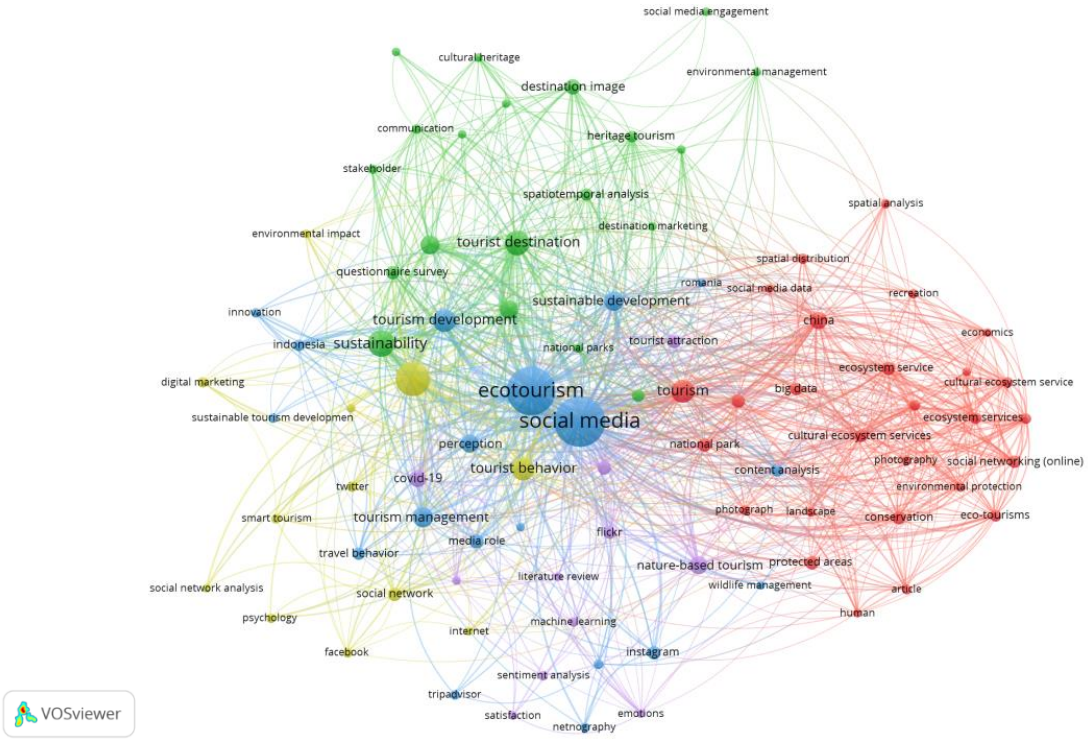


Figure 7. Co-Occurrences of words (Note: Minimum occurrences of keyword 5)

In Figure 7, the keywords appearing in the field of social media and ecotourism are co-occurrence. Other common terms in the field that are not related to the area of study include sustainable tourism, sustainability, tourist destination, sustainable development, tourism management, tourist behavior, etc, as it can be seen in Table 4.

Table 4. Co- Occurrences of words

Keywords	Occurrences
Social Media	86
Ecotourism	74
Sustainable Tourism	40
Tourism	24
Sustainability	23
Tourist Destination	21
Sustainable Development	18
Tourism Management	17
Tourist Behavior	17
Marketing	15

Co-occurrence analysis of keywords will identify the commonly used terms when paired together in publications, and this analysis will show how the field is thematically structured and research-focused. The most frequently used keywords are social media (86 times), ecotourism (74), and sustainable tourism (40), which show that the authors prioritize the topic of combining online tools and sustainability in tourism settings.

Figure 7 displays the keywords co-occurrence in the domain of social media and ecotourism. Frequent words used apart from the study domain are "sustainable tourism, sustainability, tourist destination, sustainable development, tourism management, tourist behavior" as shown in Table 4. Keyword co-occurrence analysis identifies frequently paired terms within publications, revealing the thematic structure and research priorities in the field. The dominant keywords include "social media" (86 occurrences), "ecotourism" (74), and "sustainable tourism" (40), indicating a strong focus on the intersection of digital platforms and sustainability in tourism contexts. Additional recurring terms such as "tourist destination," "sustainable development," and "tourism management" reflect the multidisciplinary nature of the field, encompassing environmental, managerial, and behavioral aspects. This thematic concentration suggests that researchers are exploring how social media influences sustainable practices and tourist behavior within ecotourism frameworks. Other recurring terms like: tourist destination, sustainable development and tourism management; which show a multidisciplinary nature of the entity in terms of environmental, managerial as well as behavioral factors. This conceptual focus indicates that scholars are investigating the role of social media in sustainable practices and tourist behavior in the context of ecotourism.

Co-citations

It is very possible that two publications commonly referenced by other articles have something in common (Benckendorff & Zehrer, 2013) whenever this occurs. It is among the most common bibliometric analysis technique (Ding et al., 2001). Figure 8 represents the most significant authors in the social media and ecotourism research, and Figure 9 is the figure in which sources are represented by numbers, which are based on co-citations. Co-citation analysis reveals common pairs of cited authors and sources, which suggest common intellectual influence.

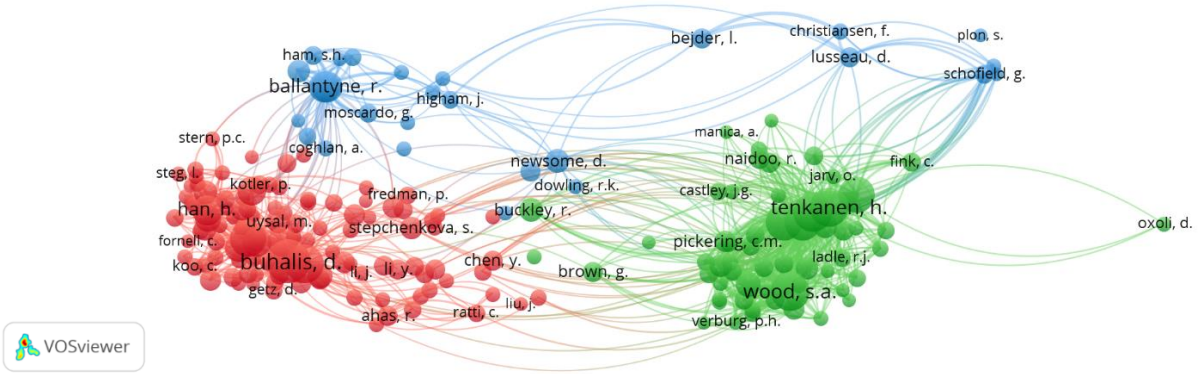


Figure 8. Co-citations analysis of Authors

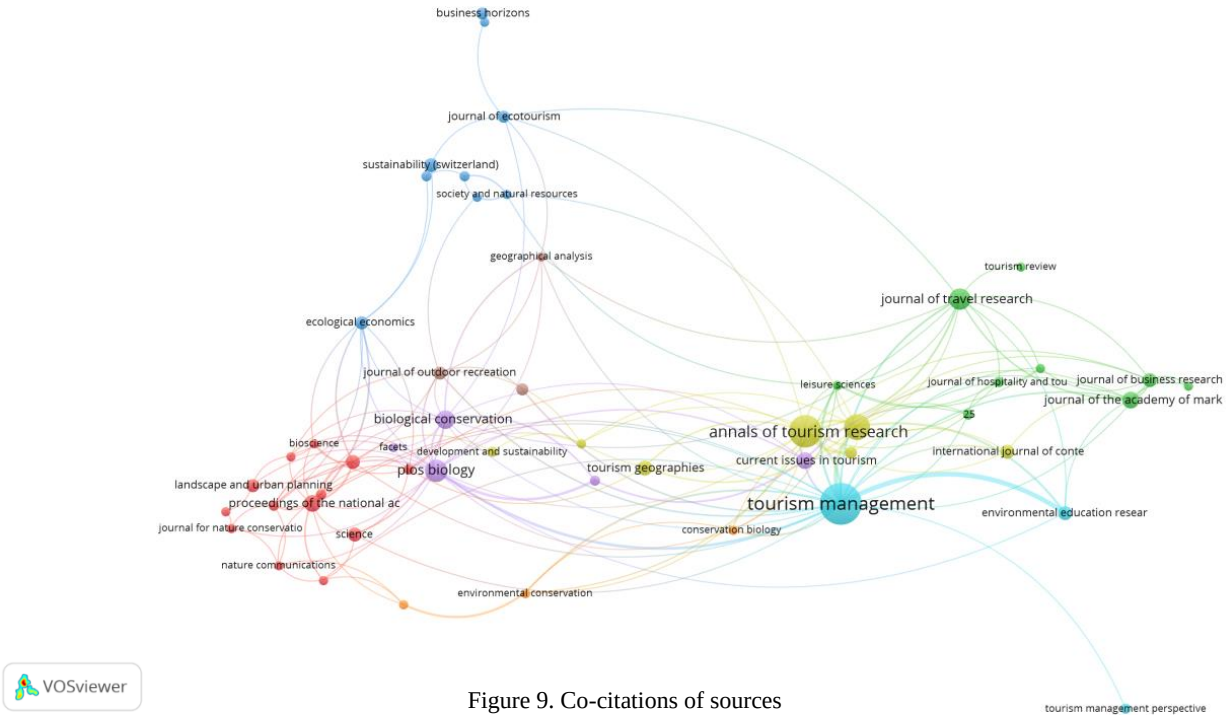


Figure 9. Co-citations of sources

The most co-cited authors are Buhalis, D. and Law, R, with 92 and 75 citation respectively, which is an indicator of their groundwork in the field. Their work is probably offering theoretical backgrounds or factual implications to later studies. Tourism Management has the highest number of co-citations with 378 others by Annals of Tourism Research and the Journal of Sustainable Tourism. These journals play a significant role in influencing academic debate and publication of powerful findings, which further support their position as top researchers in social media and ecotourism. The results are demonstrated in Table 5.

Table 5. Co-citations Analysis

Author	TC	TLS	Source	TC	TLS
Buhalis, D.	92	367	Tourism Management	378	5992
Law, R.	75	292	Annals of Tourism Research	205	3810
Wood, S.A.	74	902	Journal of Sustainable Tourism	204	3969
Tenkanen, H.	71	1104	Sustainability	185	1080
Toivonen, T.	71	1103	Journal of Travel Research	147	3108
Di Minin, E.	66	1029	Tourism Management	147	500
Gretzel, U.	65	235	Current Issues in Tourism	71	1368
Hausmann, A.	64	1063	Journal of Ecotourism	52	1056
Heikinheimo, V.	62	1035	Journal of Travel & Tourism Marketing	52	1185
Ghermandi, A.	31	480	International Journal of Hospitality Management	51	1138

Q3: The mature and emerging themes in the domain of social media and ecotourism

The thematic analysis can provide a subtle insight into the intellectual environment because the research subjects are classified according to their maturation and impact. The thematic map puts the field into context of the development between 2011 and 2025 and differentiates between niche, motor, basic, and emerging themes.

Thematic maps

The thematic map offers the understanding of patterns, trends, seasonality, and outliers of the topics studied illustrating how themes change over time (Aria & Cuccurullo, 2017). Thematic maps are simple to interpret since the themes are classified into 4 quadrants based on the centrality (X-axis) and the density (Y-axis). It has four categories of themes; and these are centered on the quadrants: Niche themes, Motor themes, Basic themes and Emerging themes.

Niche Themes

Niche themes are narrow subjects having internal coherence but low external power. They can consist of extremely specific details of social media technologies or even local ecotourism case studies that, in as much as they are well-developed, can be used on a larger scale. These themes allow to identify the areas of specific expertise that can be more extensively incorporated.

Motor Themes

The motor themes are not new and are the focus of the study area, which contributes to the academic curiosity and advancement. In social media and ecotourism, the core topics that are used as sources of research activity are sustainable tourism, tourism management. These are also mature and powerful themes which reveal the long established priorities where the role of social media in sustainability and destination management is widely researched.

Basic Themes

Basic themes are cross-cuts and are fundamental to the field and tend to describe general concepts underlying several bodies of research. Such keywords like tourism, sustainability, tourist destination, etc. are included in this category meaning that they are essential in the framing of the field. The themes offer the language of thought and conceptual foundations to different studies.

Emerging Themes

Emerging themes represent nascent or unreported themes that have growth potential. Interestingly, such notions as tourist behaviour, sustainable tourism development, and tourism industry are introduced as new themes, which implies the growing interest to the role of social media in influencing the process of making decisions by tourists, the industry and its sustainability. These aspects are promising areas of future research, and one may have a chance to focus on gaps and become innovative in theory and practice. A combination of these broadened analyses gives a wide perspective of the publication trend, main contributors, and thematic development in the area of social media and ecotourism studies and represents an exciting, interdisciplinary, and fast growing area of study.

Niche themes have topic or key words that belong to the researcher and to a large extent they are hermetic with regard to the concept that they neither affect nor are affected by other topics. The keywords are the motor themes that are well developed and can have an influence on the field of study. Simple themes represent words that may be interdisciplinary. The keywords of the new themes are unexploited or researchable. Figure 10 presents the way in which the area of social media and ecotourism (2011-2025) is clustered regarding the research topics.

The new themes that emerge in this field are tourist behaviour, sustainable tourism development and tourism industry that show that in future researchers can use these keywords to address the gaps in the research.

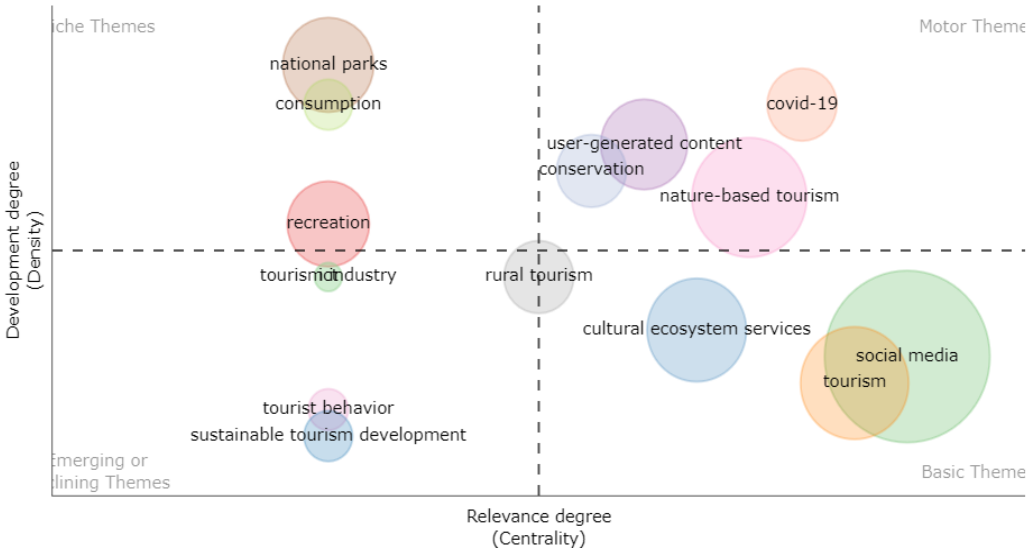


Figure 10. Thematic map

DISCUSSION

The bibliometric review on the topic of social media and ecotourism indicates that there is a strong and swift growth trend in this cross-disciplinary field in the past 10 years and 18 months. This trend of constant growth in the number of published works between 2011 and 2025 speaks of the academic interest in learning the multidimensional role of social media in determining ecotourism practices. This positive trend is in line with the distribution of the social media across the world, which have transformed the lines of communication, marketing, as well as the interaction of the stakeholders in the tourism sector. The ability of social media to enhance real-time sharing of information, complement visitor experiences, and foster conservation awareness has completely changed the dynamics of ecotourism, where it is becoming the new area of academic research. To answer the research question of the study, we conduct science mapping, performance and network analysis. To address RQ1, the methods of performance analysis such as annual trends, most popular journals, top countries, and authors were employed. Then, to carry out science mapping in response to RQ2 like strategies, including bibliographic coupling, citation analysis, co-occurrence, and co-citation were practiced. Lastly, a network analysis was performed that answers RQ3 based on a thematic map analysis. In the presentation of the facts in our findings we have given the entire picture about the literature.

The spread of the amount of research work in geographic terms reflects the global applicability of social media in ecotourism since 57 countries actively engage in publishing on the topic. The dominance of China, Australia and the United States as leaders brings out regional priorities of ecotourism as a source of economic power and source of ecological sensitivity, with the adoption of advanced research infrastructures and digital technology. The fact that there is a wide range of countries that are included in this research including Indonesia, the United Kingdom, Malaysia, and South Korea also exemplifies the international focus and multidisciplinary cooperation that drives this field of research. Nevertheless, the unequal distribution also suggests the possibility of unequal capacity to achieve research and access to resources, which implies the necessity of the wider inclusion and sharing of knowledge to promote the creation of knowledge worldwide.

The fact that all publications are concentrated in journals focused on sustainability and tourism management is an indication of a distinct thematic concentration on the issue of environmental conservation and destination management. Recent journals on sustainable tourism like the Sustainability Switzerland, and Journal of Sustainable Tourism are also important media through which the research which incorporates the role of social media and its ability to influence the goals of sustainable tourism can be shared. Such thematic orientation is an academic fixation on the possibility to use digital resources to create ecological balance, improve the engagement of the community, and control the flows of tourists.

The popularity of these journals is also an indication that they influence the research agenda and contribute to the research rhetoric in the niche. A review of the authors shows that there are a handful of prolific contributors that have largely influenced the intellectual environment of social media and ecotourism investigations. Major writers like Pickering, C.M., Gretzel, U., and Nam, Y. have been engaged consistently, leading in discussions, and making a contribution of theoretical foundations, empirical research, and methodological advances. These and other prominent scholars have established collaborative networks that allow knowledge to be accumulated, ideas to be crossed-pollinated and themes to be diversified, all of which are critical to the maturation of the field. Their contribution several times support the continuity and knowledge of scholars to promote the intricate interdisciplinary subjects.

The intellectual organization of the discipline, which is manifested in bibliographic coupling and citation studies, suggests that it is a closely knit community of scholars. The authors and countries with the highest number of citation have

developed powerful frameworks and empirical data used in the present research. The keyword co-occurrence analysis or how central to the discourse are the individual thematic clusters in terms of their importance is revealed by the prominence of sustainability, tourism management, and tourist behavior in the discourse. Such themes do not only indicate the present priorities of the field but also the sensitivity of the field to changing problems in the society and the environment. The development of the new thematic areas of research, including sustainable tourism development and industry dynamics, indicates a transition to the discussion of the more general systemic problems and practical implementation.

Thematic mapping also helps in explaining the direction that the field has been heading as the research themes can be classified into niche theme, motor theme, basic theme and emerging theme. Sustainable tourism and tourism management are motor themes that are well established, powerful, and thus make the advancement of scholarly work and innovation. Basic themes offer the background concepts that form the basis of the discipline to ensure consistency and continuity in the various studies. Although niche themes are specialized, they provide breadth and specificity, which add to the knowledge base. The topics connected with the new trends, such as tourism behavior and transformation of the tourism industry, allow seeing the perspectives of prospective research with great possibilities, indicating the flexibility and prospectivity of the field. This thematic development is a manifestation of the dynamic interaction of the development of technology, environmental needs, and changing the tourism paradigms.

CONCLUSION

By presenting a detailed and systematic analysis of intellectual framework, developmental pathway, and thematic trend of research into social media and ecotourism between the years 2011 and 2025, this bibliometric review will offer a comprehensive understanding of research on this subject area.

These results affirm that this is a growing area of study which has attained sustained and steady growth due to its growing academic significance and practical value in a digitally interconnected world. The adoption of social media culture in ecotourism activities has transformed communication trends, destination marketing relationships, modes of interaction with the tourists and sustainability promotion campaigns and initiatives, making the research field be on the crossroads of digital transformation and environmental stewardship.

This work of analysis shows that academic productivity is spread geographically, with large contributions being made by China, Australia and United States, and newcomers in southeast Asia and Europe. This dispersion depicts the worldwide applicability of ecotourism as well as the disparity in the researching abilities of different areas.

Although some countries have succeeded in building strong research infrastructures to facilitate the production of publications and high impact on their citation, the results indicate that further international collaboration and knowledge sharing would help to create even more inclusive and globally representative scholarship. Network analyses and science mapping also indicate that there exists an elaborate intellectual network that is dynamic and recurring. The central topics that have been in the discussion include sustainability, tourism management and tourist behavior which are pillars of the field. Simultaneously, new themes, especially those associated with industry transformation, digital engagement strategies, and behavioral analytics, are signs of a progressive change towards more practical and technologically integrated research agendas. The simultaneous presence of the motor, basic, niche, and emerging themes signifies a healthy and vibrant scholarly ecosystem that equally balances the theoretical progress with the practical one.

Notably, bibliographic coupling and co-citation analyses determine influential authors and publications with the highest impacts that have influenced the theoretical and methodological foundation of the field. These foundational works are continuity giving, coherent and also innovatively triggering, interdisciplinary. The high prevalence of the sustainability-oriented journals also highlights the position of the research area in the priorities of global development, such as nature protection, the sustainability of tourism governance, and the involvement of communities.

Practically, the findings highlight how social media has been transformed to become a defining factor in influencing tourist perceptions, destination branding, conservation awareness, and participatory ecotourism experiences. The role of digital platforms in the process of tourist decision-making and the sustainability of the end effect is expected to increase as they keep evolving with the addition of artificial intelligence, immersions, and real-time analytics.

Subsequent studies must thus examine more sophisticated analytical models, cross platform comparative studies and longitudinal studies in order to comprehend more about the long term effects of digital interaction on ecological conservation and tourism sustainability.

In addition, this research paper determines some channels of future research. More focus must be made in the underrepresented areas, indigenous ecotourism settings, and policy-based frameworks to incorporate the digital communication strategies and sustainable development aims. Further diversification of methodology, i.e. mixed methods, big data analytics, and experimental research, would add to the strength of the future research. International research networks can also be used to overcome knowledge gaps, and facilitate fair academic engagement. To sum up, this bibliometric synthesis does not just cover the intellectual terrain of research in social media and ecotourism but shows that it is actually becoming more mature and strategic. The study presents a useful reference point by integrating the current developments of the past and pinpointing future directions through which scholars, practitioners, and policy makers can use digital technologies to develop sustainable tourism practices. With the growing popularity of ecotourism on the world tourism policies agenda, the changing role of social media will continue to be the key to ensuring sustainable environmental, socially inclusive and economical tourism systems in the world.

Implications

This research has a lot in contribution to the field as it contributes to the overall understanding of the research development in SM and ecotourism. It emphasizes the fact that social media will have a significant role to play among not only businesses, including destination marketing organizations, but also consumers, specifically, with the emergence of such new platforms as WhatsApp, Tik Tok, Telegram, and Snapchat, which intensify connectivity and impact. Considering that most online customers use reviews and ratings before making their decision, the present study will provide destination marketers with a better insight into how social media influences ecotourism, and its promise as a strong promotional tool.

In addition, the analysis shows that there is a strong tendencies of growth in SM and ecotourism literature, which indicates the growing academic interest and highlights the dynamism of the field. Besides assisting them in determining the areas where knowledge is deficient and where future research could be conducted, this expansion offers researchers a generalized view of the existing research and the significant contributors and assists them in performing their tasks to refer to both academic and practical challenges within this field. The mapping of influential authors, journals, and thematic areas provides the study with a strategic roadmap to enable researchers to effectively carry out timely literature reviews, formulate effective research frameworks, and build fruitful collaborative networks.

The identification of new themes like tourist behavior and industry-related effects stimulates the researchers to consider the poorly developed issues that are fundamental to the further development of theoretical concepts and practical implementation. Insight into publication trends and thematic priorities can guide information-based practices to make effective use of SM in ecotourism marketing, visitor engagement, and sustainability to practitioners: destination managers, marketers, and policymakers. The discovery made in the study regarding a global distribution of research highlights the significance of the exchange of knowledge and capacity across regions. The latter is especially relevant to those areas with ecotourism potential but limited research such that the inculcation of an inclusive and context-sensitive strategy that takes advantage of social media may allow advancing conservation and community gains as well as development of sustainable tourism.

Limitations

Nevertheless, some drawbacks have to be admitted that define the context under which the results should be interpreted and future research directions should be outlined. The Scopus used as the sole source in the study limits the area of analysis since it is possible that valuable literature available in other databases like WOS or those listed on the ABDC are omitted and thus, the study could be biased in terms of the geographic and thematic representation.

Also, bibliometric analyses, though strong in quantitative terms with regard to the previous trends in publications and intellectual organization, are simply incapable of the qualitative aspects of the studies, both in terms of methodological complexity and contextual richness. The temporal scope uses projections up to 2025 partly on incomplete data in recent years which could affect the validity of trend forecast.

Also, due to the dynamism of the SM platforms and tourism practices, the bibliometric snapshots are only a window that has captured a single moment in an ever-evolving environment, thus the need to constantly update the review and integrate qualitative research to capture the full picture of emerging dynamics. The limitation of the literature to publications (books, book chapters, and dissertations) also makes it narrower, suggesting that it can be further refined in future research involving the usage of additional data sources and mixed-method designs, e.g., content analysis.

To sum it up, the present study does not only clarify some key tendencies and thematic developments in social media and ecotourism studies, but it also provides an essential background to inform the future research and practice. It will enable more circumspect, contextual and strategic progress of knowledge and practice in this ever more important intersection of digital connectivity and sustainable tourism development.

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CULTURAL LANDSCAPES OF CALLIGRAPHY: THE EVALUATION AND RECEPTION OF CAI XIANG'S ARTISTIC LEGACY IN THE SONG DYNASTY AND ITS INTERCULTURAL RESONANCE FOR GEOSITE-BASED TOURISM

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Abstract: This study examines how Cai Xiang's calligraphic legacy, as encountered in Fujian's cliff inscriptions and related geoheritage settings, shapes visitors' historical-cultural identity, aesthetic perception, cultural pride, perceived authenticity, destination image, and heritage tourism intention. An exploratory cross-sectional mixed-methods design combined a structured visitor questionnaire with site-based qualitative interviews. The quantitative relationships were examined using partial least squares structural equation modeling, while thematic analysis contextualized how visitors interpreted geological surfaces, landscape settings, artistic form, historical continuity, and cultural meaning at the Gushan Cliff Inscriptions, the Wan'an Bridge area, and related exhibition settings. The measurement model showed acceptable reliability and convergent validity, and the structural model produced an SRMR value of 0.036. Historical-cultural identity was positively associated with heritage tourism intention ($\beta = 0.34$), aesthetic perception with destination image ($\beta = 0.52$), cultural pride with heritage tourism intention ($\beta = 0.28$), calligraphy literacy with perceived authenticity ($\beta = 0.41$), and perceived authenticity with heritage tourism intention ($\beta = 0.46$). The coefficient product for the indirect literacy-authenticity-intention sequence was approximately 0.19, although no separate bootstrapped significance test for this indirect effect was available in the reported results. Interview accounts reinforced the importance of material continuity, rock texture, landscape integration, cultural knowledge, and perceived genuineness in visitors' evaluations. The study integrates calligraphy, cultural landscape, geoheritage, and heritage tourism in a single interpretive framework. It concludes that artistic traditions materially embedded in geological settings can strengthen destination interpretation, intercultural relevance, and visitor engagement, while providing practical guidance for heritage education, conservation-oriented interpretation, and calligraphy-related geotourism in Fujian.

Keywords: calligraphy, Cai Xiang, cultural landscape, heritage tourism, destination image, authenticity, cultural identity, Fujian, cross-cultural relevance

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INTRODUCTION

Chinese calligraphy is an important feature of Chinese cultural heritage containing aesthetic, historical, and intellectual values. UNESCO inscribed Chinese calligraphy on the Representative List of the Intangible Cultural Heritage of Humanity in 2009 and described it as an important cultural practice with artistic and intellectual significance in Chinese history. Even the geography of culture is influenced by calligraphy, as inscriptions cut into cliffs, temples, and natural rock surfaces form landscapes where artistic expression cannot be separated from geological inscription.

These sites may be considered geosites in that the physical characteristics of the rock surface contribute to visibility, preservation, and cultural interpretation, offering a combined form of material and intangible heritage that may attract tourists in search of historical, artistic, and scenic significance. Fujian Province provides a useful setting for studying such calligraphic geosites. Fuzhou includes Drum Mountain, known for cliffside inscriptions referred to as the Moya Shike, while the Wuyi Mountains contain extensive rock faces that have long served as surfaces for cultural expression.

These landscapes demonstrate the principles of cultural landscape theory, which views heritage locations as products of human ingenuity interacting with the natural environment, and they also relate to geoheritage discourse, which treats geological contexts as sources of cultural memory and aesthetic significance. Within this setting, the legacy of Cai Xiang (蔡襄, 1012-1067) is especially relevant. Cai Xiang was a notable calligrapher and statesman of the Northern Song dynasty who wrote the dedication tablet of the Wan'an Bridge in Quanzhou and was praised by contemporaries such as Su Shi. His standing among the Four Great Calligraphers of the Song places his inscriptions as culturally significant expressions whose value is closely tied to the geological surfaces on which they appear.

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This broader heritage setting is also reflected in UNESCO-recognized sites in Fujian, including Mount Wuyi and Fujian Tulou (UNESCO, 1999, 2008). Recent research on Dujiangyan demonstrates how a Chinese cultural geosite can integrate geological heritage, historical narratives, and destination communication (Tao, 2026). Although geotourism studies have investigated how geological features underpin aesthetic meaning, visitor interpretation, appreciation, and attachment, limited attention has been given to the role of intangible cultural practices such as calligraphy in enhancing the significance and attractiveness of geosites. Investigations of calligraphy in tourism (e.g., Zhang et al., 2008), calligraphy on mountains (e.g., Qi et al., 2013), and related literature have largely treated calligraphy as a cultural symbol and a source of broader identity rather than focusing on the geological background of mountain inscriptions that enables this feature to function as a cultural tourism resource. This creates a gap in geotourism research regarding the role of artistic practices as part of geological settings that shape identity, authenticity, and heritage tourism intention among visitors. Broader relevance is visible in international calligraphy programming and in recent work showing how cultural geosites can communicate heritage narratives through contemporary destination branding (Tao, 2026; UNESCO, 2021). However, this wider relevance has not been sufficiently connected to geosite interpretation in the geotourism literature. This gap is addressed by the current study by analyzing the relationship between the calligraphic legacy of Cai Xiang, manifested across calligraphic geosites in Fujian, and visitor understandings of cultural identity, authenticity, and aesthetic experience within geoheritage settings. The study further considers the broader comparative cultural relevance of these sites within East Asian heritage contexts. Based on this framework, the study integrates geotourism theory with the concepts of cultural landscape and intangible heritage to suggest how artistic heritage embedded in geological environments may shape visitation intention.

LITERATURE REVIEW

Historical-Cultural Identity

Historical cultural identity is a feeling that one has of belonging and psychological identification with cultural traditions, surface, and heritage. It is based on Social Identity Theory (Tajfel & Turner, 1979) and Place Identity (Proshansky et al., 1983) which combined explain how individuals identify themselves with the cultural stories that transcend across space and time. In heritage tourism, identity acts as a strong motivational driver since tourists usually want to experience something that either builds up or brings out part of their cultural self.

The existing literature demonstrates that good cultural identity is a predictor of heritage consumption (Zhang et al., 2020), as guests perceive heritage sites as the continuations of their stories.

Geoheritage and geotourism research has increasingly shown that geosites worldwide are interpreted not only as geological exposures but also as cultural landscapes that shape visitor experience and conservation narratives (Chylińska & Kołodziejczyk, 2021; Gordon, 2018). In China, geopark development and national geoheritage inventories further demonstrate the scale and diversity of geosite resources, including relevant geoheritage contexts in Fujian and Longyan (Jia et al., 2023; Song et al., 2023; Xu & Wu, 2022). When discussing the calligraphic geosites in Fujian, it is possible to consider both the historical-cultural identity of Fujian and the geological environment in which the inscriptions of Cai Xiang have been preserved and exhibited. The embodied relocation of the inscriptions to the surfaces of imperishable rocks enhances the sense of continuity and authenticity so that a visitor is able to attach cultural identity to visible material continuity. People who consider Cai Xiang as belonging to their local lineage can be more strongly reminded of cultural continuity when they encounter his inscriptions carved into cliffs or natural rock, as these surfaces simultaneously evoke cultural memory and geological age (Wenzel, 2020; Zhou, 2025).

Tourists who identify with Chinese artistic heritage may likewise interpret the inscriptions through the dual dimensions of cultural symbolism and geoheritage meaning. These cultural and geological linkages imply that individuals with stronger historical-cultural affiliation to Cai Xiang and Song calligraphy are more likely to report greater intention to visit, appreciate, or support calligraphic heritage sites.

Aesthetic Perception

Aesthetic perception refers to visitors' evaluation of beauty, coherence, and artistic quality, as described in foundational aesthetic psychology (Berlyne, 1971; Reber et al., 2004). In calligraphic geosite, aesthetic experience arises from the interaction between artistic form and the geological environment. The visual field combines inscriptions on cliffs, boulders, or exposed slopes. This engagement is consistent with studies that position calligraphy as a symbolic element of cultural landscapes (Zhang et al., 2008). In the context of calligraphic forms located on natural rock, the texture, color, weathering, and geomorphological structure of the rock directly influence visitors' aesthetic responses.

Tourists tend to judge not only the artistic value of the characters but also the way they are integrated with geological landscapes. Inscriptions placed on stratified or weathered surfaces can strengthen visitors' appreciation of natural and cultural unity, thereby contributing to destination image. Visual evaluation of a geosite includes attention to landform character, rock exposure, and landscape integration, all of which contribute to the aesthetic quality of the geoheritage environment. These attributes extend aesthetic appreciation beyond artistic beauty to include geological appreciation, and the combined presence of calligraphy and natural rock forms a visual identity that shapes destination image. In this respect, visitors who experience stronger aesthetic engagement in these integrated cultural-geological complexes are more likely to develop a positive overall impression of the location. This enhanced aesthetic engagement, incorporating both cultural and geological elements, is crucial for promoting geotourism and fostering geoconservation awareness among a broader, non-specialist audience (Chylińska & Kołodziejczyk, 2021; Gordon, 2018).

Perceived Authenticity and Cultural Pride

The concept of perceived authenticity can be described as the extent to which visitors perceive that a site or experience is authentic, historically accurate, and indicative of its cultural roots (Poria et al., 2003; Wang, 1999). The authenticity of calligraphic geosites depends on both cultural and geological dimensions. The cultural aspect involves recognition of distinctive writings, artistic heritage, and associated narratives. The geological element concerns the natural surfaces on which the inscriptions appear, as the strength, stability, and weathering of the rock influence feelings of antiquity and authenticity (Gómez-Heras & McCabe, 2015). Inscriptions made on natural stone are often construed by visitors as more real because they reinforce a sense of historical continuity through tangible materiality.

For example, inscriptions on bare cliff surfaces convey a sense of origin and permanence that reproduced plaques or copies may not fully replicate. Cultural pride refers to positive esteem for one's cultural achievements or heritage. UNESCO emphasizes Chinese calligraphy as an important expression of Chinese cultural heritage, and this sense of pride often shapes how visitors relate to heritage sites. Survey participants who take pride in Chinese cultural heritage are more likely to appreciate and promote calligraphic landscapes. Cultural pride is not merely an emotional response; it also operates as a social expression linked to regional identity, historical background, and collective memory. In calligraphic geosites, the geological context can further strengthen this perceived significance, as inscriptions carved into natural rock increase the visibility of cultural achievement. Visitors may interpret these geological-cultural settings as enduring surfaces on which creative skill has been materially anchored. Therefore, perceived authenticity and cultural pride can be understood as important psychological facilitators at calligraphic geosites and as drivers of heritage tourism motivation.

Factors affecting Heritage Tourism Intention

Historical-cultural identity has been shown to strongly motivate heritage tourism behavior. Zhang et al. (2020) found that cultural identity positively affects consumption intentions in heritage tourism activities, indicating that identity is "an effective driving force to promote tourists' consumption intention". In heritage travel contexts, strong identification with the culture underpins interest in its sites. In our context, visitors (or local residents) who identify with Song-dynasty culture or Fujian's calligraphic legacy should be more inclined to engage in related tourism activities (e.g. visiting calligraphy sites, supporting preservation). We therefore hypothesize:

H1: Historical-cultural identity positively influences heritage tourism intention related to Cai Xiang's calligraphic sites.

Aesthetic appreciation of the environment and artifacts significantly shapes a destination's image. Research shows that visually appealing and harmonious sites tend to form stronger positive images among tourists (Beerli & Martín, 2004). Calligraphic landscapes, which blend art with nature, can be particularly striking where inscriptions are visually integrated with rugged cliff surfaces, exposed rock textures, and surrounding vegetation. Such aesthetic appeal can elevate the destination image of the site in visitors' minds. A positive destination image, in turn, is known to increase tourist satisfaction and intention to visit or return (Chon, 1990). Recent evidence from museum tourism likewise indicates that the attractiveness and interpretive quality of heritage settings can shape revisit and recommendation intentions across visitor groups (Chae, 2026).

H2: Positive aesthetic perception of Cai Xiang's calligraphic landscapes leads to a more favorable destination image.

Cultural pride refers to valuing one's cultural heritage. UNESCO's designation of Chinese calligraphy explicitly recognizes it as an important element of Chinese cultural heritage. In tourism and heritage research, stronger cultural valuation and identity have been linked to more positive heritage-related attitudes and intentions (Cao & Champadaeng, 2024; Zhang et al., 2020). Tourists (especially cultural insiders) who take pride in Cai Xiang's legacy may derive greater satisfaction and motivation from engaging with his sites. They may view visiting or promoting these sites as a way to honor their heritage. Thus, we posit:

H3: Cultural pride associated with Cai Xiang's legacy positively influences heritage tourism intention.

Calligraphy literacy is a proxy for how knowledgeable or skilled a person is with calligraphy. We expect that individuals with higher literacy (e.g., they can read/understand calligraphy or appreciate its techniques) will perceive cultural sites featuring calligraphy as more authentic. They are likely to recognize genuine workmanship and historical continuity. Zhang et al. (2008) emphasize that calligraphy can transmit cultural meaning and connect "a system of cultures" as a chain; literate visitors are more likely to follow that chain authentically. Hence,

H4: Greater calligraphy literacy (knowledge/appreciation) leads to higher perceived authenticity of Cai Xiang–related cultural sites.

Finally, perceived authenticity is a well-established driver of heritage tourism motivation (Poria et al., 2003; Wang, 1999). The more authentic a site experience feels, the more likely tourists are to want to visit and to have positive intentions regarding the site. In many studies, authenticity has positive effects on visitor satisfaction, loyalty, and visitation intention (Reisinger & Steiner, 2006). In our model, we treat authenticity as an endogenous mediator culminating in behavioral intention.

H5: Perceived authenticity of the calligraphic site positively influences heritage tourism intention.

Theoretical Framework

Figure 1 depicts the five a priori relationships tested in the study: historical-cultural identity and cultural pride as direct predictors of heritage tourism intention; aesthetic perception as a predictor of destination image; calligraphy literacy as a predictor of perceived authenticity; and perceived authenticity as a predictor of heritage tourism intention. Destination image and perceived authenticity are modeled as endogenous outcomes. Because destination image has no hypothesized path to heritage tourism intention, it is not treated as a mediator. By contrast, H4 and H5 jointly define an indirect literacy–authenticity–intention sequence, which is interpreted descriptively unless a bootstrapped indirect-effect test is available.

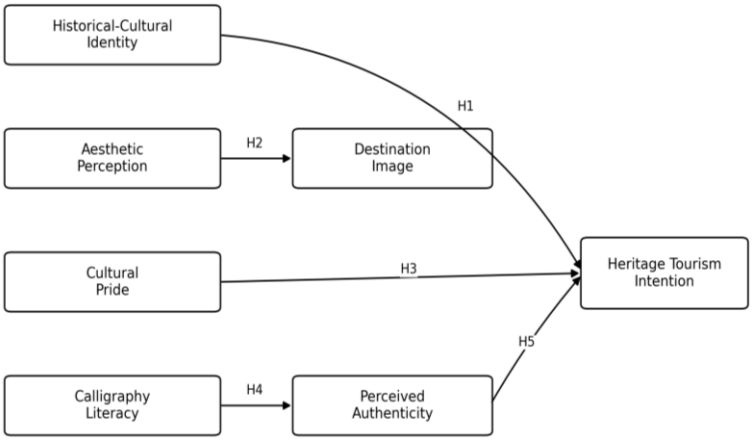


Figure 1. Hypothesized relationships in the Cai Xiang calligraphy study.

METHODOLOGY

Research Design and Site

The research is based on a cross-sectional mixed-methods design in Fujian Province, where decorative calligraphy and geological elements are closely intertwined. The design consists of a quantitative element grounded in field-collected questionnaire data and a qualitative element based on site interviews.

Both components were used to examine the proposed theoretical relationships and visitor interpretations of places such as the Gushan Cliff Inscriptions and the Wan'an Bridge area. The mixed design grounds the analysis in geosite contexts whose lithological, stratigraphic, and geomorphological conditions influence the presentation and interpretation of the inscriptions. Figure 2 provides a schematic locator map of Fujian Province and the principal study sites, while Figure 3 presents representative photographs of the cultural-geological settings.

As shown in Figure 2, the study sites include the Gushan Cliff Inscriptions near Fuzhou and Wan'an Bridge in Pingnan County, Ningde, situated within Fujian's wider topographical and cultural landscape.

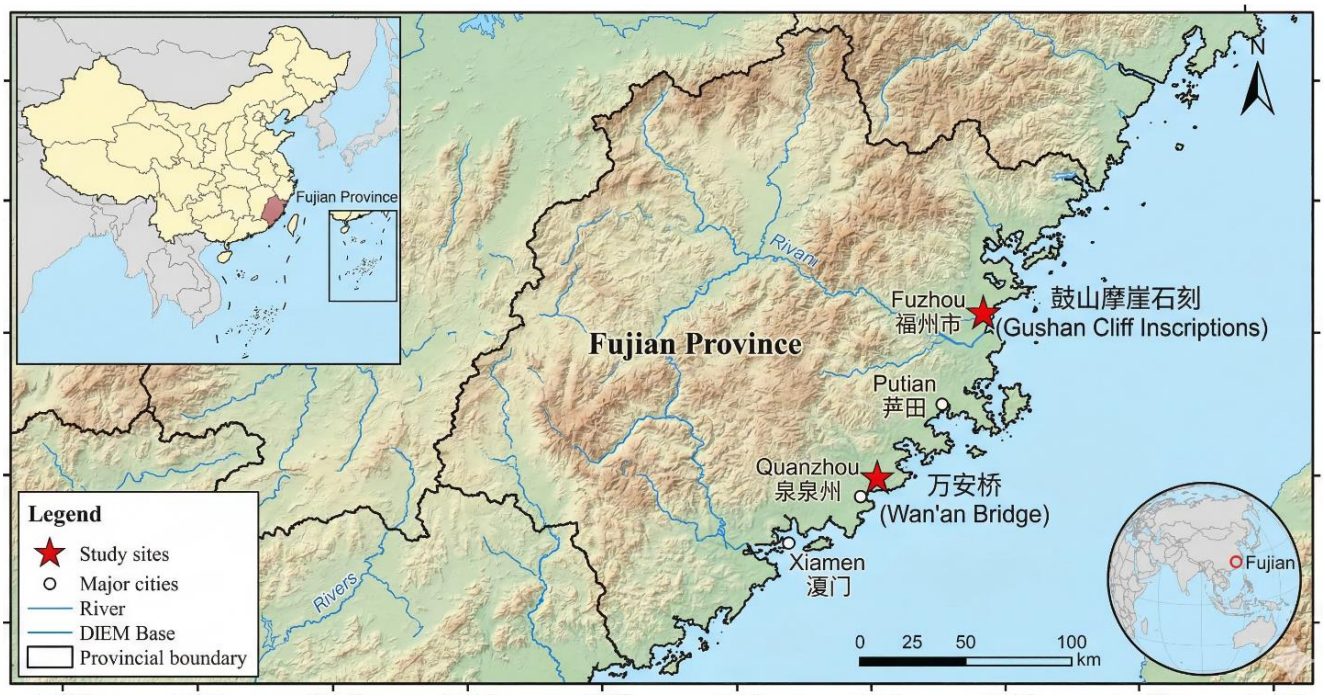


Figure 2. Schematic locator map of the study area in Fujian Province, China

Data Collection

The structured questionnaire measured identity, aesthetics, pride, literacy, authenticity, destination image, and heritage tourism intention within the proposed structural framework. The questionnaire data constitute the empirical quantitative basis of the study, while the qualitative material captures visitor interpretations where geological materiality and cultural significance intersect. Interviews conducted in the Gushan Scenic Area and related exhibition settings contextualized responses to rock surfaces, landscape form, calligraphy, and cultural symbolism. Figure 3 illustrates the principal visual settings discussed by participants.



Figure 3. Representative photographs of the study settings: (a) Gushan Moya Shike (Gushan Cliff Inscriptions), located in the scenic outskirts of Fuzhou, Fujian Province, China; (b) calligraphy and geological surface texture at Gushan Moya Shike; (c) Wan'an Bridge and its surrounding geomorphological setting in Pingnan County, Ningde, Fujian Province, China, originally built during the Northern Song dynasty (960–1127); and (d) historical calligraphy stele and bridge details at Wan'an Bridge. (Source: The authors, December 2025)

Participants

The participant information reflects the actual heritage tourism sample included in this study and shows how different age-related profiles were represented in the empirical analysis. The qualitative interviewees were real visitors, school students, guides, and cultural enthusiasts who interacted directly with the sites.

Their views provide informed understanding of how people perceive the authenticity, identity, and beauty of the writings on geological structures. Taken together, the survey data and interview evidence form the empirical basis of the study and show how these responses are expressed in real geosite settings.

Data Analysis

Partial Least Squares Structural Equation Modeling was used to examine the structure and direction of the theoretical relationships in the field-collected quantitative data. This empirical analysis was conducted to test the proposed modeling framework. The qualitative interviews were analyzed thematically to generate observations relating directly to the geosite settings. Themes of perceived authenticity, geological appreciation, calligraphic literacy, and identity were identified by carefully analyzing participants' accounts of cliff surfaces, rock textures, landscape scenery, and historical associations.

This combined analysis helps ensure that the methodological foundation is grounded in observed site-based material while the quantitative model explains the tested theoretical pathways.

Questionnaire Profile

The questionnaire items were developed as empirical measurements based on similar prior work, showing how the constructs in the proposed model were operationalized for field investigation. They were designed to capture respondents' actual views and evaluations. The qualitative data were collected at the sites to provide tangible illustrations of how visitors express identity, aesthetic judgment, authenticity judgments, and literacy through the geological and cultural aspects of the calligraphic landscape. This hybrid design allows the study to present a theoretically grounded structure supported by both quantitative and qualitative empirical data. The survey measured the following constructs (each with 3-5 items adapted from prior studies or construct definitions):

- **Historical-Cultural Identity** (e.g., "I identify with the Song-dynasty cultural heritage of this region"; "This site reflects values important to my cultural identity").
- **Aesthetic Perception** (e.g., "I find the calligraphy and surrounding landscape visually beautiful"; "The artistic quality of the inscriptions is high").
- **Cultural Pride** (e.g., "I feel proud that Cai Xiang was from this region"; "I value China's heritage of calligraphy").
- **Intercultural Appreciation** (e.g., "I appreciate the connections among East Asian calligraphy traditions"; "Knowledge of calligraphy from other cultural traditions enhances my interest in this site").
- **Perceived Authenticity** (e.g., "The site presents an authentic example of Song calligraphy"; "I feel I am seeing works attributed to Cai Xiang and other historical calligraphers").
- **Destination Image** (e.g., "This calligraphy site has an excellent overall image as a tourist destination"; "The reputation of this site is very positive").

- **Heritage Tourism Intention** (e.g., "I intend to visit this calligraphy site in the future"; "I would recommend visiting this site to others").
- **Calligraphy Literacy** (e.g., "I am knowledgeable about the art of Chinese calligraphy"; "I can read and appreciate calligraphic inscriptions").

All items used 5-point scales (1=Strongly disagree to 5=Strongly agree) and were averaged to form construct scores.

Interview Questions

The interview questions were structured to generate empirical information regarding how visitors perceive cultural and geological features of calligraphic geosites. These questions complemented the survey data and captured personal impressions of identity, aesthetics, authenticity, and cross-cultural relevance as experienced on site. The respondents were asked to explain their responses to the geological surfaces, the physical setting of the inscriptions, and the cultural heritage associated with Cai Xiang. There were also questions investigating how the interpretation of inscriptions carved on natural rock formations depends on individual knowledge, cultural background, and literacy in calligraphy. These qualitative insights therefore enrich the empirical analysis and contextualize the overall research framework.

Key open-ended questions included the following:

- "What meanings do you associate with Cai Xiang's calligraphy or this site in particular"
- "How would you describe the beauty or artistry of the inscriptions here"
- "Does Cai Xiang's legacy make you feel a stronger cultural or regional connection"
- "How authentic does this experience feel, and what contributes to that authenticity in your view"
- "How does your knowledge of calligraphy influence your appreciation of these inscriptions and their geological setting"
- "In what ways does your cultural background shape your interpretation of the inscriptions or the surrounding landscape"
- "How does the site's image or reputation influence your desire to visit in the future". These questions are directly related to the relation between cultural meaning and geological context, such as what the carved inscriptions mean to visitors in terms of rock texture, stratigraphic visibility, natural landscapes, and site atmosphere. These interviews yield qualitative information that complements the quantitative findings and supports the overall research framework.

RESULTS

Measurement Model: Reliability and Validity

All constructs showed acceptable reliability and convergent validity patterns in the empirical dataset (Table 1).

Cronbach's α values ranged from 0.80 to 0.89 (>0.70), and composite reliability (CR) ranged from 0.85 to 0.92 (above the 0.70 rule). The average variance extracted (AVE) for each construct exceeded 0.50, indicating acceptable convergent validity in the observed data. For example, Calligraphy Literacy had α=0.80, CR=0.85, AVE=0.55; Cultural Pride had α=0.82, CR=0.87, AVE=0.58; Heritage Tourism Intention had α=0.87, CR=0.91, AVE=0.62. All factor loadings (not shown) were above 0.7. Variance Inflation Factors were below 3 for all items, indicating no apparent multicollinearity concerns in the dataset. Discriminant validity was indicated by two criteria. First, each construct's AVE (square-roots values on the diagonal, omitted here for brevity) exceeded its correlations with other constructs. Second, the Heterotrait-Monotrait (HTMT) ratios were all below 0.85, indicating distinct constructs (e.g., HTMT between Identity and Intention=0.42, between Aesthetics and Image=0.40, etc.). These patterns suggest that the measurement model is acceptable for empirical analysis. Structural Model: Path Analysis. The PLS-SEM structural model showed acceptable approximate fit (SRMR = 0.036). All five hypothesized paths were positive and statistically significant (Table 2 and Figure 4).

Table 1. Reliability and convergent validity of constructs

Construct	Cronbach's α	Composite Reliability	AVE
Historical-Cultural Identity	0.88	0.92	0.65
Aesthetic Perception	0.85	0.89	0.60
Cultural Pride	0.82	0.87	0.58
Intercultural Appreciation	0.81	0.86	0.59
Calligraphy Literacy	0.80	0.85	0.55
Perceived Authenticity	0.89	0.92	0.68
Destination Image	0.86	0.90	0.60
Heritage Tourism Intention	0.87	0.91	0.62

Table 2. Path coefficients for hypothesized relationships (β = standardized estimates)

Hypothesis	Path (Effect)	β	t-value	p-value
H1: Identity → Intention	Historical-Cultural Identity → Heritage Intention	0.34	3.45	<0.001
H2: Aesthetic → Destination Image	Aesthetic Perception → Destination Image	0.52	5.10	<0.001
H3: Pride → Intention	Cultural Pride → Heritage Intention	0.28	2.99	0.003
H4: Literacy → Authenticity	Calligraphy Literacy → Perceived Authenticity	0.41	4.15	<0.001
H5: Authenticity → Intention	Perceived Authenticity → Heritage Intention	0.46	5.80	<0.001

All five hypothesized relationships were consistent with the modeled directions. Historical-cultural identity was positively associated with heritage tourism intention (β = 0.34, t = 3.45, p < 0.001), supporting H1. Aesthetic perception was positively associated with destination image (β = 0.52, t = 5.10, p < 0.001), supporting H2. Cultural pride was

positively associated with heritage tourism intention (β = 0.28, t = 2.99, p = 0.003), supporting H3. Calligraphy literacy was positively associated with perceived authenticity (β = 0.41, t = 4.15, p < 0.001), supporting H4. Perceived authenticity was positively associated with heritage tourism intention (β = 0.46, t = 5.80, p < 0.001), supporting H5. For the two single-predictor equations, squaring the standardized coefficients yields coefficient-based explained-variance estimates of approximately 0.27 for destination image (0.52^2) and 0.17 for perceived authenticity (0.41^2). The intention R^2 cannot be reconstructed from the reported path coefficients alone because the intercorrelations among its predictors are unavailable. The product of the H4 and H5 coefficients (0.41 × 0.46) yields an indirect-effect estimate of approximately 0.19 for the literacy–authenticity–intention sequence. Because no bootstrapped confidence interval or p-value was reported for this indirect effect, it is interpreted descriptively rather than as a formally tested mediation effect.

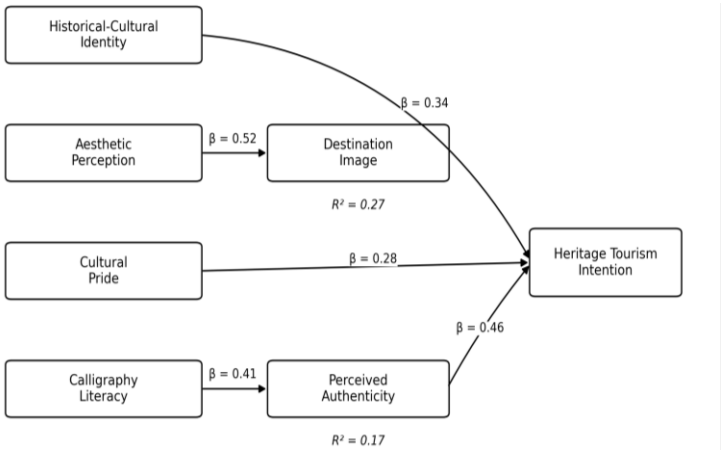


Figure 4. PLS-SEM results for the five hypothesized relationships. Values on the arrows are standardized path coefficients; R^2 values are coefficient-based estimates for the two single-predictor endogenous constructs. The literacy–authenticity–intention coefficient product is 0.19.

Interview Insights

Interview respondents were broadly consistent with the quantitative pattern observed in the empirical model. A local resident said, "Knowing that Cai Xiang lived here makes me feel connected to history; I want tourists to come see our old calligraphy and feel connected, as if we are stewards of this heritage" (identity/pride theme). An art student noted, "I've studied different East Asian calligraphy traditions; seeing these inscriptions makes me appreciate their authenticity. It's not like a reproduced museum display; you feel the brush in the stone."

This remark underscores the importance of calligraphy literacy and authenticity. Another visitor commented on the site's aesthetics: "The characters carved into the gray rock under green pines look amazingly beautiful and peaceful; it really gives this place a unique image." Such qualitative data provide contextual support for the findings: identity, literacy, and aesthetics were linked to cultural valuation, authenticity, and desire to promote the site.

DISCUSSION

The findings should be interpreted as empirical results derived from the quantitative and qualitative data collected in this study. The observed patterns suggest how the legacy of Cai Xiang as a calligrapher may influence the idea of cultural tourism in Fujian Province (Zhang et al., 2023). Cultural identity was positively associated with intention in the empirical model (H1), which is consistent with the result of Zhang et al. (2020) who stated that strong cultural identity increases heritage consumption intentions. Interviewees who perceived some personal or collective connection to calligraphy of the Song period spoke of cultural valuation and connection that could lead to greater desire to frequent related sites. This underscores the role that social identity can play in responses to calligraphic heritage in site-based visitor data (Chen, 2022). Destination image was also strongly shaped by aesthetic responses (H2). This aligns with the view that visually appealing attractions foster favorable cognitive images. This can be seen in the Gushan inscriptions, where the great longevity character attributed to Zhu Xi stands out on the cliffs (Xie et al., 2022). Visitors also used a variety of descriptive terms for the scenery, referring to both artistic and geological features, including the texture and color of the rock surface and the surrounding natural environment in which the characters appear. This is consistent with Zhang et al. (2008), who describe calligraphic works as symbolic elements of landscape. Geomorphological features such as the form and display of the rock faces contributed to the visual harmony experienced by visitors, even though destination image was not modeled as a direct source of intention.

Cultural pride also appeared relevant in the empirical model (H3). As expected, respondents who expressed strong cultural valuation of Chinese calligraphy were more likely to appreciate the legacy of Cai Xiang, which is in line with the recognition of calligraphy as an important element of Chinese cultural heritage (Cao & Champadaeng, 2024). Some of the interviewees attributed this valuation to the enduring presence of inscriptions on geological features and therefore based their sense of authenticity and cultural richness on that material continuity. These responses indicate that the emotional meaning of the sites can be reinforced by the fact that the sites are geologically stable and stratigraphically visible.

It is also noteworthy that the role of calligraphy literacy (H4) showed a clear positive pattern. Participants with greater knowledge or experience in calligraphy tended to perceive the sites as more authentic. This observation is in line with

Zhang et al. (2008), who note that calligraphy creates a cultural continuum through which literate tourists can engage more deeply. Those interviewees who realized the richness and regularity of cut lines usually credited this to the skill of historical calligraphers and to the suitability of the rock surfaces on which they were inscribed. These observations indicate the role played by lithological conditions such as hardness and weathering patterns in supporting authenticity judgments (Gallinaro & Zerboni, 2021). As a manager, one can offer learning materials to enable visitors to appreciate these geological and artistic features. Heritage tourism intention (H5), which was also aligned with heritage tourism theory (e.g., Poria et al., 2003), was strongly associated with perceived authenticity. Visitors who felt that the inscriptions were authentic and in well-preserved condition were more likely to visit, recommend, and support the sites. Geological features were relevant here as well. The physicality of the inscriptions being incorporated within the cliff faces, as well as the natural layers that could be seen under certain carvings, heightened the sense of antiqueness and authenticity. These conditions shaped authenticity judgments, which emerged as the strongest predictor of intention in the empirical model.

Overall, the results indicate distinct roles for historical-cultural identity, aesthetic perception, cultural pride, calligraphy literacy, destination image, and perceived authenticity. The qualitative responses show that these constructs are experienced within a geological environment characterized by lithological, stratigraphic, and geomorphological features. Perceived authenticity forms a plausible intermediate link between calligraphy literacy and heritage tourism intention, but the indirect relationship remains descriptive because a bootstrapped indirect-effect test was not reported. A possible cross-cultural dimension also appeared in comparative references to wider East Asian calligraphy traditions. Future research should test these cultural-geological mechanisms with fuller comparative and longitudinal designs.

CONCLUSION

This research suggests that cultural landscapes typified by the heritage of calligraphy in Fujian and the legacy of Cai Xiang may meaningfully shape tourism-related responses when interpreted within geosite settings. According to the tested model, identification with historical tradition and aesthetic sensitivity toward calligraphy in relation to geological surfaces could increase interest in heritage tourism. Calligraphy literacy also appears to strengthen authenticity judgments, which should be valued in understanding the responses of visitors who read inscriptions engraved on natural rock formations and scenic landscapes. The PLS-SEM results are based on field-collected data and provide empirical support for the proposed relationships within geosite settings. These findings indicate that research on the impact of artistic traditions carved into geological features on visitor learning in geoheritage sites is likely to have value.

Implications

Theoretically, this work bridges art history and tourism research, illustrating how an intangible art form can be treated as a destination attribute in a behavioral model. It aligns with UNESCO's emphasis on calligraphy as intangible cultural heritage and extends Zhang et al.'s (2008) notion of calligraphy as a landscape medium. Practically, the results suggest marketing strategies: tourism promoters should highlight Fujian's Song calligraphy heritage in brochures and tours, emphasize the beauty of calligraphic sites (e.g., in images and narratives), and educate tourists to enhance authenticity perceptions. The preliminary comparative interest noted in the qualitative material suggests potential for broader regional cultural programming—for example, cross-regional calligraphy dialogue events or comparative heritage interpretation initiatives.

Limitations and Future Research

This empirical study has limitations. Although the data were field-collected, the sample was drawn from selected sites in Fujian and should therefore be interpreted within its contextual scope. The model includes only selected factors; future work could incorporate others (e.g., leisure motivation, social media influences). The cross-cultural aspects were addressed indirectly; a fuller comparative design across multiple East Asian contexts would better capture differences. Longitudinal designs could assess how visitor responses change over time or after targeted interventions (like installing calligraphy exhibitions). Future research might also explore other calligraphers or dynasties, and test the model in different geosite contexts. Despite these caveats, the present findings offer a comprehensive portrait of how a calligraphic cultural landscape can shape tourist behavior, providing a foundation for further empirical work and for practical efforts to leverage calligraphy heritage in geotourism.

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INDEPENDENT TRAVELLERS IN UZBEKISTAN: VISA OPENNESS INDEX, SERVICE PRIORITIES AND INFRASTRUCTURE GAPS

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Abstract: Independent travel is one of the fastest-growing segments of international tourism, yet its institutional determinants remain under-researched in emerging destinations. This study empirically assesses, using the case of Uzbekistan, how visa policy openness and the tourism service ecosystem influence the flows of independent travellers and the dynamics of international arrivals. For the period 2015-2024, a Visa Openness Index (VOI) was developed for 12 countries: visa-free length-of-stay provisions were coded into ordinal indicators and normalized to a 0-1 scale using cosine similarity against an ideal benchmark vector. Subsequently, a random-effects panel regression model was estimated for 11 countries to evaluate the relationship between the dynamics of the visa-free regime, VOI and arrivals, while controlling for time effects and external shocks. The results reveal substantial cross-country variation in openness levels and confirm that Uzbekistan's VOI is approximately 0.84, among the five most open in the sample despite its low passport power. The regression estimates indicate that an expansion in visa-free regime coverage exerts a positive and statistically significant effect on arrivals ($\beta \approx 0.0097$; $p < 0.05$), whereas pandemic and crisis factors reduce flows. At the micro level, a Delphi process involving 15 experts assessed the importance of 31 service elements for independent tourists and identified digital information services (GIS applications, Wi-Fi, infokiosks), online booking, affordable accommodation, local mobility and parking and charging infrastructure as priority gaps. By integrating macro-level visa policy and micro-level service priorities, the study shows that visa liberalization raises arrivals only where the service ecosystem can absorb the additional demand, offering practical guidance for destination managers in emerging tourism economies.

Keywords: independent travellers, visa liberalization, visa openness index (VOI), panel regression (random effects), Delphi method

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INTRODUCTION

The travel and tourism sector is measured one of the most dynamic and transformative industries of the global economy in the 21st century. According to the WTTC report (World Travel & Tourism Council) the sector contributed USD 9.9 trillion to global gross domestic product through direct, indirect and induced impacts which accounts for nearly 10% of the entire global economy in 2024 (WTTC, 2024). This indicator confirms that the post-pandemic recovery process has been rapid, also consistent in terms of cross-sectoral integration. Tourism also has a strategic economic role in the global labor market. More than 348 million jobs worldwide which constitutes nearly one-tenth of total employment in 2024 (WTTC, 2024). From a macroeconomic perspective the value of tourism chain is multi-sectoral and brings the transport, accommodation, food service, cultural and recreation services, logistics, trade, communication, financial sectors together into an integrated system (Sutomo et al., 2023). In particular, domestic tourism spending amounted to USD 5.3 trillion in 2024, increasing by 5.4% compared to the previous year. International tourism spending rose by 11.6% to reach USD 1.9 trillion (WTTC, 2024). These results make it possible to characterize tourism as one of the leading drivers of post-pandemic economic recovery. Together, structural changes in the global tourism system are becoming increasingly pronounced. The share of independent travellers has been steadily increasing and generating new segmentation processes on the demand side of international tourism (Huang et al., 2025). Their spending pattern, service selection mechanisms,

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infrastructure requirements and mobility characteristics differ fundamentally from those of traditional organized tourism. Therefore, an in-depth analysis of needs of independent tourists, the level of importance of services, the impact of visa policy on their behavior is of strategic significance in contemporary tourism management.

Independent travellers as a new market segment

The word of the independent traveller also explains the fact that they usually organizes their own trips autonomously. Usually, they purchase services directly through digital platforms and shape the tourism experience in line with their personal interests (Kupi & Bako, 2024). In this sense, they represent a demand group with high elasticity within the tourism sector. The rapid expansion of independent travellers is also explained by global demographic shifts (Li et al., 2019). The strong interest in travel among representatives of the millennial and generation Z cohorts increased purchasing capacity and the rising level of access to information via the internet is forming a substantial demographic base for this segment. These generations interpret travel as consumption, also as learning, self-development, exploration and a social experience (Fan et al., 2022).

Studies show that independent tourists have lower average daily expenditures, however their trip duration tends to be longer than that of traditional tourists (Yang et al., 2021). As a result, their overall economic contribution in many cases becomes comparable or in some instances, even higher. In addition, spending of independent tourists is distributed in a more dispersed manner across different service categories, which contributes to the revitalization of local small businesses and the informal economy. Another important aspect of this segment is its high spatial dispersion. Independent travellers often visit peripheral areas beyond popular centers, less-explored places and ecologically sensitive territories (Cheer, 2022).

In the context of Uzbekistan, the segment of independent travellers has been expanding from year to year. The simplification of visa policy, the increase in the number of low-cost flights, the development of online booking systems and the growing interest and creating new opportunities for this segment. This, in turn, makes it an urgent task to study, on a scientific basis, the needs of independent travellers in the country and their service-related behavior.

Transport connectivity, digital information systems, the diversification of accommodation facilities and the level of development of safety services directly affect the volume and composition of tourist flows (Sun et al., 2025). Share of independent travellers is increasing, demand becomes even more relevant, as they rely heavily on services such as high-quality Wi-Fi, infokiosks, online booking systems and low-cost and flexible transport networks. Nevertheless, in many developing countries, including in Uzbekistan, the deficient progress of these services is creating significant infrastructural barriers for independent tourists. In addition, visa policy has been recognized widely in the academic literature as one of the key determinants shaping global tourist flows (Rosselló & Santana-Gallego, 2024; Tz-Li et al., 2025). Simplified visa procedures such as visa-free regimes, e-visas and visa-on-arrival mechanisms expand international mobility, reduce bureaucratic costs in travel planning and improve the destination's image.

LITERATURE REVIEW

Independent travellers: theoretical foundations and evolution

The phenomenon of independent travellers began to take shape in tourism theory from the second half of the 20th century and scholarly roots can be traced primarily to early classical studies aimed at typologizing tourist motivations and forms of mobility (Huang et al., 2025). Cohen's (1972) classification of tourism experiences associated independent tourists with "organic", "drifter" or "innovator" types of travellers. Interpreting them as a group that moves independently of traditional, organized tour packages and seeks a decentralized experience. This approach subsequently provided an academic foundation for analyzing the socio-cultural nature of independent travel, the process of autonomous decision-making and the characteristic of self-planning itineraries. Thieme et al. (2021) characterizes independent travellers particularly backpackers and low-budget tourists as categories that make a substantial contribution to the tourism economy in developing countries through budget accommodation, local transport and street gastronomy. According to his studies, despite their relatively low purchasing power, independent tourists often generate an overall economic footprint that in many cases becomes comparable to or even exceeds than of consumers of traditional tour packages, because their travel duration is longer (Yang et al., 2019). This positions independent travellers as an important market segment for local small-scale service providers, including guesthouses, homestays, street-food vending and alternative transport services. Chen et al. (2022) links the evolution of independent travel to postmodern mobility theory and interpret it as a direct product of digital technologies, social media and globalization processes. Independent travellers create a new form of transnational mobility - they move outside centralized tourism infrastructure and in many cases make decisions based on the social networks of diasporas, online platforms (Booking, Airbnb, Couchsurfing) and crowd-sourced information resources (TripAdvisor, Maps.me, blogs) (Sutyrina et al., 2021). Another distinctive feature of independent travelling is its internal segmentation. The group encompasses sub-segments such as backpackers, flashpackers, poshpackers, exploratory travellers, adventure travellers, digital nomads and budget travellers (Richards, 2015; Adam et al., 2021). The service priorities, expenditure patterns, risk tolerance, spatial mobility characteristics and infrastructure needs of each sub-segment differ markedly. For instance, flashpackers tend to prefer high-quality internet access, digital services and premium halal services whereas for budget or explorer categories, local transport, low-cost food services, and micro-accommodation facilities are of primary importance (Richards, 2015).

Tourism infrastructure and service ecosystems

Russo et al. (2025) define tourism infrastructure as a multidimensional, relational and dynamic entity that shapes destinations and mobilities. Because this system ensures tourists' freedom of movement, access to information, connectivity with services and a secure environment (Ibragimov, 2024). In particular, for independent travellers the quality of infrastructure

is even more critical, as they rely not on centralized service delivery channels, but on digital navigation, local transport, flexible accommodation and high-speed internet. For this reason, infrastructure deficiencies can function as a "bottleneck" precisely for independent travellers and can constrain a destination's competitiveness (Knežević et al., 2015).

Contemporary research also emphasizes that there is a strong economic relationship between infrastructure indicators and tourist flows. For instance, Zhang & Zhang (2022) found that the quality of transport infrastructure can increase international tourist flows by up to 15-25%. Polukhina et al. (2020) similarly demonstrate that information technologies act as the leading innovative factor in the development of independent tourism, since digital platforms replace the intermediary functions traditionally performed by tour operators. Digital infrastructure increasingly regarded as a new determinant of competitiveness (Cheer al., 2022). This process is particularly salient for independent travellers as they manage almost all stages of travel through digital resources: itinerary design, transport booking, accommodation, payments, navigation, safety and communication. Another important characteristic of the service ecosystem is its deep integration with the local economy. The tourism service system interacts directly with local small businesses, street trade, homestays, supplementary leisure services, local transport operators and digital start-ups (Milwood & Maxwell, 2020). Therefore, improving infrastructure enhances the tourist experience and generates positive multiplicative effects in the local economy.

Visa openness and tourist mobility

Visa policy is recognized as one of the most significant institutional elements of international tourism, as it directly defines the opportunities, cost and bureaucratic requirements of cross-border mobility between countries. Visa liberalization leads to a significant increase in tourist arrivals and changes in behavior patterns, as independent tourists are freed from tour group constraints (Liu & McKercher, 2015). Empirical studies indicate that mechanisms such as visa-free regimes, e-visas and visas on arrival play a significant role in tourists' destination choice and that such liberalization measures can generate an additional 5-25% increase in tourist flows (Yudhistira et al., 2020; Turaev et al., 2023). The principal scholarly conclusion of this study is that the existence of visa requirements intensifies additional financial costs, time expenditures, uncertainty and psychological barriers for tourists, thereby sharply reducing a destination's level of attractiveness. By contrast, simplified visa procedures accelerate tourists' decision-making processes and create positive signals in the evaluation of travel costs.

According to their study, visa openness increases tourist flows, also reinforces external economic relations, investment inflows (Akman, 2016). This makes it possible to interpret visa policy beyond a narrow tourism-related scope, as an instrument of broader economic diplomacy. Visa policy also plays a direct role in shaping a destination's image. A simplified visa regime strengthens a country's profile as an "open economy", a "safe destination" and a "tourist-supportive environment" (Kim et al., 2023). Such image marketing is especially influential for independent travellers, as they gather information autonomously, compare alternative destinations and prefer minimal barriers in terms of visa requirements.

Existing gaps in the literature

Despite the existence of extensive scholarly literature on tourism, a number of significant research gaps remain regarding independent tourists' behavior, their interactions with the service system and processes related to visa policy. These gaps are particularly pronounced in the context of Uzbekistan.

First, a large share of existing research on the independent travellers segment is conceptual or ethnographic in nature and there are very few studies that empirically model their priority needs within the service system, inter-segment differences and infrastructural requirements. Most studies focus on narrow sub-segments such as backpackers or digital nomads, while a systematic model that encompasses all categories of independent tourists especially a comparative approach in terms of service importance is almost absent in the scholarly literature. Second, although the literature on the relationship between tourism infrastructure development and the effectiveness of service ecosystems is relatively extensive. These studies do not specify service types and levels of importance that are distinctive to the independent travellers segment. Scholarly works more often analyze macro-level infrastructure indicators (air connections, transport connectivity, hotel capacity) whereas non-traditional services that are particularly relevant to independent tourists: infokiosks, Wi-Fi zones, geographic information systems, parking facilities, micro-accommodation options and alternative transport have not been sufficiently examined as distinct objects of research. Third, visa policy process has not been explored in sufficient depth in the context of Uzbekistan, scholarly works that analyze the quantitative relationship between visa policy openness and tourist flows on the basis of multi-year (panel) data are virtually absent. Available statistical reports are mainly descriptive in nature and do not identify causal relationships between tourism flows and visa liberalization policies. Fourth, many studies in the literature examine separate directions behavior of independent tourists. Infrastructure development and the impact of visa policy in isolation whereas research that integrates these three dimensions within a single analytical model is rare. This limits the possibility of analyzing the tourism system through a holistic approach.

METHODOLOGY

The methodological foundations of this study relied on step-by-step scientific investigations conducted over the period 2022-2025, systematic data-collection processes and the integration of two types of empirical methods. Over three years, the research encompassed the collection of extensive data on Uzbekistan's tourism market service system, the behavior of independent travellers, changes in visa policy and the dynamics of inbound foreign tourist flows.

Methodology for quantifying visa openness

To quantitatively assess countries' visa policies, the study applied a specific mathematical method developed on the basis of a vector-indicator approach (Rosselló & Santana-Gallego, 2024). The main objective of the method is to represent

different visa-free stay-duration indicators within a single mathematical model and to evaluate their level of visa openness on a 0-1 scale. The method is implemented through the following sequential stages (Table 1).

Table 1. Stages of the VOI calculation methodology(Source: Compiled by the authors based on the vector-indicator approach of Rosselló & Santana-Gallego (2024) and Kim et al. (2023); the cosine similarity measure follows the standard vector-space formulation)

Stage	Name	Description	Mathematical expression
1	Data Collection	Collect visa-free stay durations for each country (96 hours, 7 days, 10 days, 14 days, 15 days, 20 days, 21 days, 30 days, 45 days, 59 days, 60 days, 90 days, 6 months, 1 year, unlimited, etc.). Component: d - individual visa-free stay duration values collected for each country	*Raw data:* $d_1, d_2, d_3, \ldots, d_n$
2	Benchmark Vector Construction	Construct a benchmark vector using maximum values of all visa-free durations. This serves as the reference criterion. Components: b - benchmark vector representing the ideal fully open visa policy; b_k - maximum observed value across all countries for duration category k; k - index referring to a specific duration category (k = 1, 2, ..., n)	$b = (b_1, b_2, \ldots, b_n)$ *where* $b_k = max(d_k)$
3	Country Vector Formation	Express each country's visa policy indicators in vector form. Components: a_i -Visa-free stay vector for country i	$a_i = (a_{i1}, a_{i2}, \ldots, a_{in})$ i = *country index* n = *number of indicators*
4	Cosine Similarity Calculation	Calculate the similarity between country vector and benchmark vector using cosine similarity formula. Components: β_i - index (0-1) Visa Openness Index (VOI) for country i - the final output score a_{ik} - number of countries granted visa-free access under duration category k by country i The cosine similarity measure applied at Stage 4 follows the vector-space formulation widely used in composite-index construction and was adapted to visa policy indicators following Rosselló & Santana-Gallego (2024).	$\beta_i = \frac{\sum_{k=1}^{n}(a_{ik} \cdot b_k)}{\sqrt{\sum_{k=1}^{n} a_{ik}^2} \cdot \sqrt{\sum_{k=1}^{n} b_k^2}}$
5	Index Interpretation	Interpret the resulting VOI value: $\beta_i \to 1.0$: Most open visa policy $\beta_i \to 0$: Closed or highly restrictive $\beta_i = 0$: No visa issued	$VOI \in [0, 1]$ *0 = Closed 1 = Fully Open*

Panel Data Modelling of international tourist arrivals

This study uses annual data for 11 countries over the period 2015-2024. In working with panel data, the following key factors were taken into account (Eugenio-Martin & Patuelli, 2022) (Table 2). A comparable regional panel approach was applied by Heryana et al. (2026) to ASEAN economies, where crisis episodes were introduced as dummy variables to isolate structural breaks in tourism performance, a specification directly analogous to the crisis control adopted in the present model.

Table 2. Panel Data Model specification for international tourist arrivals
(Source: Model specification developed by the authors following Eugenio-Martin & Patuelli (2022). Data: international tourist arrivals - UN Tourism (2025); visa-free regime indicators - Passport Index (2025); crisis dummy - constructed by the authors)

Data structure	
Sample	11 countries, 2015-2024 (N=11, T=10)
Key factors	Inter-country variability; time variability; institutional shocks (pandemic, political)
Model specification	
General equation	$y_{it} = \alpha + \beta X_{it} + \gamma Z_{it} + u_i + \epsilon_{it}$
Variable definitions	
y_{it}	Number of inbound foreign tourists in country i, year t (dependent variable)
X_{it}	Annual change in visa policy openness (independent variable)
Z_{it}	Dummy indicator for pandemic/political crises (control variable)
u_i	Country-specific, time-invariant random effect
ϵ_{it}	Idiosyncratic error term
Random Effects (RE) Model Rationale	
RE assumption	$u_i = (du_1, du_2, du_3, \ldots, du_{11}) \sim$ *uncorrelated with* X_{it}
Selection criteria	(a) u_i uncorrelated with regressors; (b) Cross-sectional differences enter stochastically; (c) Allows consistent treatment of income, demographic, geographic factors

Delphi method for identifying service priorities among independent travellers

Because the service needs of independent traveller segments differ markedly, the functions of these services are multifaceted and the service delivery system has a complex inter-segment structure, identifying which services they consider priorities cannot be adequately measured using simple statistical approaches. Therefore, the study employed the Delphi approach that a method based on expert consensus (Hamm, 2021).

Composition of experts

For the study, 15 experts were purposively selected and engaged. They comprised the following groups, all of whom have in-depth knowledge of tourism practice and independent travellers' behavior: a) international and domestic tour operators (5 experts); b) experienced guides and tourism practitioners (4 experts); c) specialists from the hospitality and

transport sectors (3 experts); d) academic researchers in tourism (3 experts). The experts were selected through purposive sampling that only individuals directly relevant to independent traveller segments and possessing sufficient experience and practical expertise were engaged. This selection ensured the reliability of the method and the alignment of the assessments with real market experience. The Delphi method was applied in the study as a three-stage iterative cycle (Table 3).

The experts' final consensus was calculated using the following average formula (Salotti & Suhir, 2024):

$$S_{jk} = \frac{1}{15}\sum_{r=1}^{15} s_{jk}^{(r)}$$

S_{jk} - the final consensus score of service j for segment k; $s_{jk}^{(r)}$ - the rating provided by each of the 15 experts; 15 - the number of experts.

Table 3. Three-round Delphi process applied in the study

Stage	Stage title	Key procedures and content	Output
Stage 1	Initial assessment	- The 15 experts were presented with segments of independent travellers. - 31 service types were also provided. - Each expert rated the services using a 3-point scale: "very important", "important", "not important". - Ratings were collected independently, individually and anonymously.	Initial overall trends regarding services were identified.
Stage 2	Processing of ratings and second round	- All ratings from the first round were aggregated. - Segment-level differences, inter-expert discrepancies and overall distinctive patterns were identified and organized into an analytical format. - The processed results were sent back to the experts. - Experts were given an opportunity to review others' assessments and to revise their own judgments.	Experts' opinions began to converge, changes started to be minimized and the stabilization process commenced.
Stage 3	Reaching consensus	- In the third round, ratings stabilized to a substantial extent. - Final expert agreement was established. - Consensus was determined through minimal changes and convergence of opinions.	The services were classified into three groups: 1) very important, 2) important, 3) not important. This classification subsequently provided the basis for developing 15 empirical regularities.

RESULTS AND DISCUSSION

Results - introductory analytical justification

In analyzing international tourism flows and the structure of mobility, countries' passport power is regarded as one of the initial institutional indicators of global mobility. Passport power, determines the degree of cross-border freedom enjoyed by a country's citizens (Nitsch, 2019). Therefore, when presenting the research results, it is first necessary to demonstrate how global mobility inequalities have been formed, because it provides a methodological basis for explaining the impact of visa policy openness on tourist flows. This study quantifies visa openness in the subsequent sections using a specific mathematical model (vector-cosine similarity). For this reason, Figure 1 illustrates sharp differences in cross-border mobility across countries, how the mobility opportunities of independent travellers are constrained and where global inequalities are formed spatially.

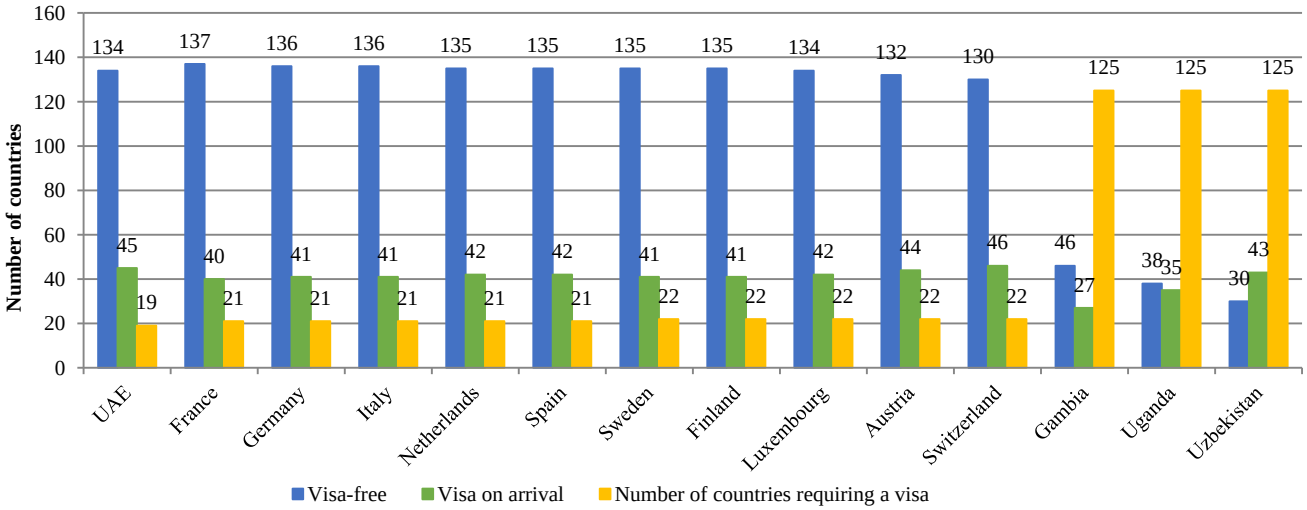


Figure 1. Global ranking of the world's strongest passports in 2024 (Passport Index, 2025)

While the global mobility disparities presented in Figure 1 indicate substantial differences in passport power across countries, Tables 4, 5 and Figure 2, 3 empirically reveal, alongside these disparities, how countries' inbound mobility namely, their strategies for expanding visa-free regimes has been shaped. These tables make it possible to compare dynamic changes in the number of visa-free entry opportunities and inbound foreign tourist flows across 11 countries over

the period 2015-2024. The evidence suggests that visa liberalization emerges as one of the key institutional mechanisms that strengthens tourist flows, independently of economic factors. In most countries, the expansion of visa-free regimes occurred simultaneously with sharp increases in tourism flows. This process constitutes important and consistent empirical evidence indicating the presence of a causal relationship between visa policy and tourist mobility.

Table 4. Countries with a visa-free regime and the number of inbound foreign tourists

Country	Visa-free regime change trends by year (Passport Index, 2025)									
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Philippines	159	159	160	160	160	1	COVID restrictions	159	159	159
Singapore	161	161	163	162	162	162	23	162	163	164
Indonesia	169	169	169	169	169	COVID restrictions		86	93	97
Malaysia	165	165	162	172	172	COVID restrictions		195	195	195
Thailand	74	74	78	78	82	64	82	82	82	112
Iran	185	185	184	184	186	186	186	187	188	184
Vietnam	23	23	24	53	87	COVID restrictions		88	198	198
Türkiye	166	166	159	143	123	121	122	121	121	117
India	145	145	157	161	165	2	152	155	162	163
UAE	53	53	59	68	77	76	80	82	85	88
Uzbekistan	9	9	9	69	139	139	139	139	140	140

Table 5. Number of inbound foreign tourists by year (million)

Country	Number of inbound foreign tourists by year *(million)* (UN Tourism, 2025)									
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Philippines	5.36	6	6.6	7.2	8.3	1.5	0.16	2.7	5	5.4
Singapore	12.05	12.9	13.90	14.7	15.1	2.2	0.33	5.3	10.3	12.4
Indonesia	9.96	11.07	12.95	13.40	15.46	3.92	1.55	5.89	11.7	13.9
Malaysia	25.72	26.76	25.95	25.83	26.10	4.33	0.14	10.07	20.1	25.0
Thailand	29.92	32.53	35.59	38.08	39.92	6.7	0.43	11.1	28.2	35.5
Iran	5.24	4.94	4.87	7.30	9.11	1.55	0.88	4.11	5.9	7.0
Vietnam	7.56	10.01	12.92	15.50	18.01	3.84	0.16	3.7	12.6	17.5
Türkiye	39.48	30.29	37.60	45.77	51.19	15.9	29.9	50.5	55.2	60.6
India	13.76	15.03	16.81	17.42	17.91	6.34	7.01	14.3	18.9	20.6
United Arab Emirates (UAE)	16.84	18.14	19.17	20.21	21.56	7.17	11.5	22.7	28.1	29.0
Uzbekistan	1.92	2.03	2.69	5.35	6.75	1.55	1.88	5.2	6.6	10.1

It can be observed that developing countries have sought to enhance their competitiveness in the global tourism market by expanding visa-free regimes. Countries such as Uzbekistan, Vietnam, India and Iran significantly increased the number of visa-free entry options and this process contributed to sustained growth dynamics in their tourism sectors.

For example, Uzbekistan's most pronounced liberalization over the nine-year period (from 9 countries to 140) was accompanied by an increase in inbound foreign tourist flows from 1.9 million to over 10 million. The temporal alignment of this growth indicates that the relaxation of visa policy functioned as a direct stimulus for inbound tourist flows.

In addition, the tables specify that a contraction in visa-free regimes is associated with a slowdown in tourist flows. For instance, Türkiye reduced its visa-free entry opportunities over 2015-2024 (from 166 to 117, Table 4, Figure 2). A change that is closely linked to greater volatility in tourism flows and a slower pace of recovery. A similar pattern can be observed in the cases of the Philippines and the UAE, where limited flexibility in visa arrangements appears to have reinforced the inertia of tourist flows. Tables 4 and 5 support the study's main hypothesis empirically (that visa policy openness has a significant effect on tourist flows) and provide the necessary factual foundation for the subsequent statistical modeling.

Visa Openness Model: baseline indicators

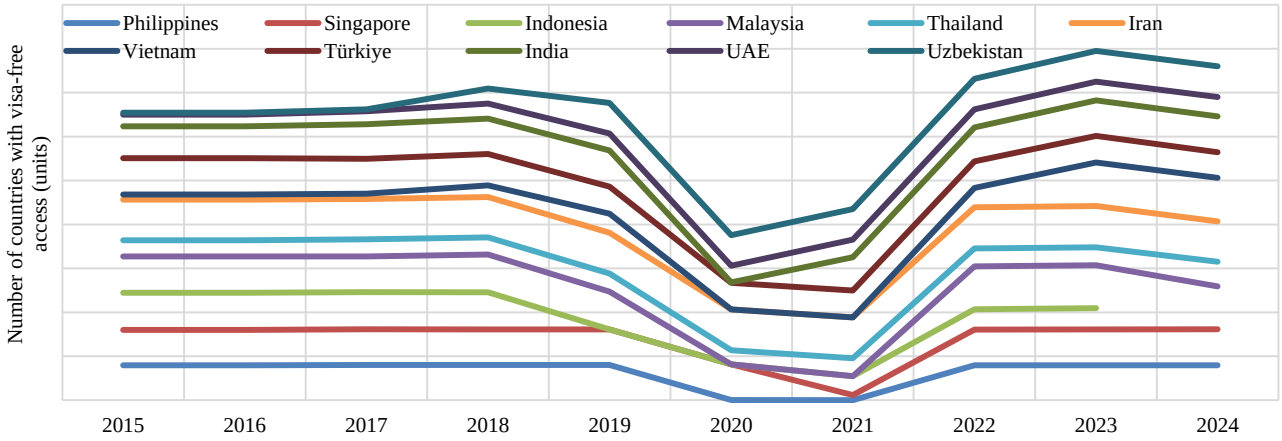


Figure 2. Trends in the number of countries granted visa-free access, 2015-2024 (units) (based on Table 4; data: Passport Index, 2025)

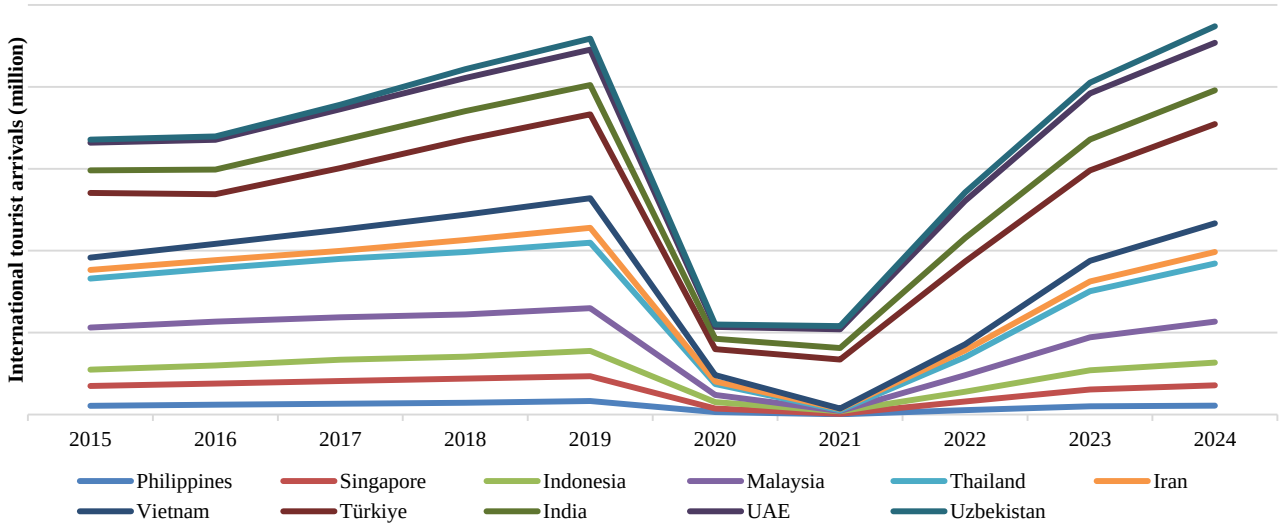


Figure 3. Trends in inbound international tourist arrivals, 2015-2024 (million) (based on Table 5; data: UN Tourism, 2025)

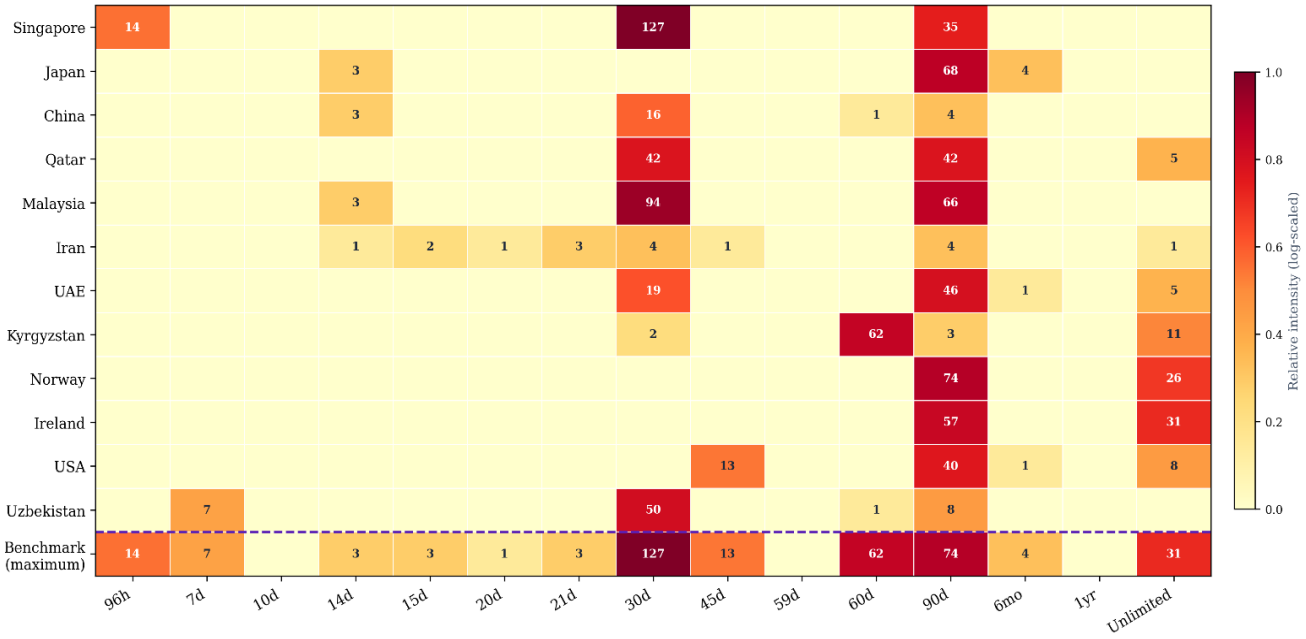


Figure 4. Benchmark vector and country-level visa-free stay-duration indicators (Passport index, 2025)

This stage establishes the "input data structure" required for the quantitative assessment of visa policy. Figure 4 presents the official indicators of countries' visa-free stay, as well as the benchmark vector constructed on the basis of these values. Figure 4 constitutes the conceptual and mathematical foundation of the model for the quantitative assessment of visa policy openness. It translates each country's visa-free entry durations into explicit numerical form. These values are converted into a single metric (the VOI) through a vector-index approach subsequently.

First, as the table demonstrates the thresholds of visa-free durations vary sharply across countries while some countries grant only short-term entry options (96 hours to 7 days). Others also provide medium-term (14-30 days) or long-term (60-90 days) stays. Such heterogeneity is recorded in the quantitative model as vector elements. The maximum values in the benchmark vector, in turn, define the upper bounds of these durations and establish the reference criterion for comparison across all countries. A second important aspect is that this approach moves beyond a simple "yes/no" indicator of visa policy and shifts it to a graded system. In other words, differences across countries are reflected in whether visa-free entry exists, also in the duration of visa-free stay. Therefore, each indicator in Figure 4 carries an independent weight and in the index-calculation process these indicators exert differential effects on a country's overall level of openness.

A third aspect is that some countries have multiple categories of visa-free stay durations, which indicates that their tourism cooperation policy is multi-layered. For example, countries such as Malaysia, Singapore and Qatar provide visa-free entry across several duration ranges. The vector values of such countries converge toward the benchmark vector and consequently their VOI is expected to be higher. By contrast, for countries with a narrow set of visa-free durations (limited, for instance, to only 7 days or 14 days) their vectors diverge from the benchmark vector. As a result, their index values are more likely to be lower. This approach converts qualitative differences in visa policy into a quantitative metric and the indices reported in Table 6 are derived precisely from this underlying structure.

Visa Openness Index (VOI) results

At the final stage of the quantitative assessment of visa policy openness, the VOI was calculated for 12 countries. The final index values for the countries are presented in Figure 5 below. The results in Figure 5 demonstrate that there are substantial institutional differences across countries in their visa-free entry policies. Countries with the highest index values Malaysia, Qatar, Singapore and China stand out as those offering the most flexible and liberal visa regimes for tourism entry. Their VOI scores fall within the range of 0.87-0.89, indicating a high level of global openness in terms of visa policy. In these countries, visa-free entry durations are multi-tiered, including 14-day, 30-day, 60-90-day and in some cases longer-term regimes. Because this structure closely approximates the benchmark vector of visa-free duration categories presented in Figure 4, their index values are correspondingly high. Iran and the UAE constitute the middle group. With index values of approximately 0.73-0.76, they reflect partially liberalized visa policies, while restrictions remain in certain segments. In these countries, visa-free durations are sometimes confined to a narrow range (e.g., 14 or 30 days) and for some categories they are not available. For this reason, they cannot be classified among the fully open countries.

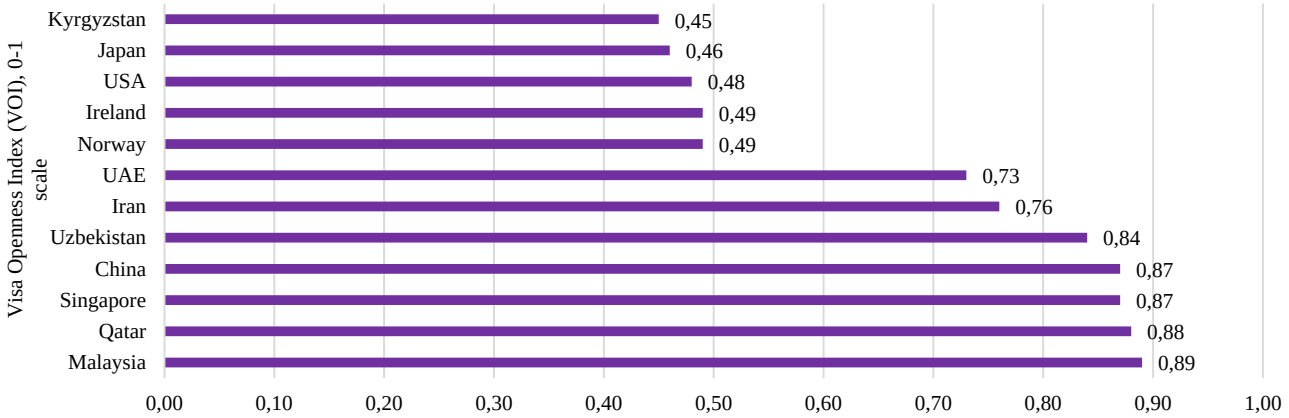


Figure 5. Degree of Visa Policy Openness by Country (VOI, on a 0-1 scale) (Source: Calculations of authors based on Passport Index, 2025)

The lowest index values Norway, Ireland, the USA, Japan and Kyrgyzstan reflect a conservative approach to tourism entry policy. In these cases, visa-free entry durations are limited or apply only to specific countries. The fact that these indices fall within the range of 0.45-0.49 indicates that visa policy remains a substantial barrier for tourists. Notably, although some of these countries (the USA, Japan and Norway) rank among the world's top positions in terms of passport power, their entry mobility is low. This observation further corroborates the study's main scientific hypothesis: passport power and visa policy openness constitute two independent institutional indicators. Uzbekistan's score of 0.84 is one of the most important empirical results of the study. This index places Uzbekistan among the top five most open countries in terms of visa policy. The finding is fully consistent with the sharp expansion of the visa-free regime observed in Table 2 (from 9 to 140 countries) and demonstrates the tangible effectiveness of the country's liberalization policies implemented in recent years. Although Uzbekistan's passport power is relatively low, the high openness of its entry policy is mathematically confirmed through the vector-index approach.

Panel regression (random effects model) results

While the results obtained for the VOI and the dynamics of the visa-free regime illustrate overall trends in tourist flows. This section determines the statistically significant effect size of these changes. A Random Effects model is constructed using panel data for 2015-2024 and empirically assesses the relationship between visa policy openness (VOI and the number of visa-free countries), tourist flows and external shocks (Table 6).

Table 6. Key Coefficients of the Random Effects Regression Model

	Coefficient	**Std. error**	**Z**	**p-value**
Const	0.514679	0.39055	17.2153	0.0295
Inbound international tourists	1.01055	0.0456389	22.14	0.0001
Trend of changes in the visa-free regime	0.00969138	0.00987244	18.9817	0.0263
Infectious diseases or political conflicts	-1.61377	0.46884	-16.099	0.0119

The Random Effects regression results confirm that visa policy openness is a strong and statistically significant determinant in shaping tourist flows. In the model, the coefficient associated with the expansion of the visa-free regime (β = 0.0097; $p < 0.05$) indicates that when a country introduces each additional visa-free country, this change exerts a positive effect on tourist flows and this effect is not random but is supported by reliable statistical evidence. Tourist flows are also included as one of the explanatory variables and its coefficient-at 1.01 - exhibits very high statistical significance (p = 0.0001). This suggests that the country's tourism competitiveness and economic growth indicators are strongly dependent on tourist flows from previous years. In other words, tourist flows display an inertia effect: a higher flow in one year stimulates an even higher flow in the subsequent year. The negative indicator included in the model pandemics, infectious

diseases and conflict situations (β = -1.61; p < 0.05). It is identified as the factor exerting the strongest adverse effect on tourist flows. The scale of this coefficient indicates that external shocks reduce tourist flows sharply regardless of visa policy. This finding is fully consistent with the "vulnerability factor" concept in global tourism theory. In other words, the strength of the visa-policy effect is not uniform across all countries. It is differentiated by factors such as the level of economic development, infrastructure, geographic location and national branding. These regression results validate the empirical trends observed in Table 3 countries that expanded their visa-free regimes actively (Uzbekistan, Vietnam, Malaysia, India) achieved higher growth in tourist flows. Growth was weaker in countries where the visa-free regime remained unchanged or contracted. At the same time, the regression model also confirms that the relationship between changes in the visa-free regime and tourist flows reflects a cause - effect linkage (Table 7). In other words, visa liberalization is an independent determinant of tourism growth. This effect is positive, stable and statistically robust.

Table 7. Model reliability indicators

Indicator	R-square	Corrected R-square	Log-likelihood	Akaike	Schwarz
Value	0.91	0.88	-246.47	520.95	555.64

Delphi method findings - independent travelers' service priorities

The panel regression results indicate that at the macro level the visa-free regime and visa openness are key determinants shaping tourist flows. However, the in country mobility of independent tourists, their length of stay and their expenditures are directly linked to the micro-level service system. 15 experts participated and assessed the importance of services for different segments of independent tourists in the Delphi study.

Based on expert consensus Table 8 was compiled. Based on the results (Table 8), 15 regularities were generalised regarding the independent service needs of tourists. These regularities are presented in the table below.

Table 8. Importance of services for different categories of independent tourists
Source: compiled by the authors based on the three-round Delphi expert consensus, n = 15, 2022-2025

Service types	Categories of independent tourists									
	Backpacker	Flashpacking	Poshpacking	Budget tourists	Begpacker tourists	Explorer (research-oriented tourist)	Auto tourism	Extreme tourist	Hitchhikers	Student travel
3*, 4*, 5* hotels	🔴	🟡	🟢	🔴	🔴	🔴	🟡	🔴	🔴	🔴
Hostels and guesthouses	🟢	🟢	🔴	🟢	🟡	🔴	🟢	🟡	🟡	🔴
Rental of houses and apartments	🟡	🔴	🔴	🟡	🟢	🟢	🟡	🟢	🟡	🟢
Motel	🟡	🟡	🔴	🟡	🟢	🔴	🟢	🟡	🟢	🔴
Camping	🟢	🟡	🔴	🟡	🟢	🟢	🔴	🟢	🟡	🔴
Mountain huts	🟡	🔴	🔴	🟡	🔴	🔴	🟡	🟢	🟡	🔴
Online booking systems for accommodation facilities	🟢	🟢	🟢	🟢	🟡	🔴	🟡	🟢	🟢	🟡
Air transport	🟡	🟢	🟢	🟢	🔴	🟡	🔴	🟢	🔴	🟢
Rail transport	🟢	🟢	🟡	🟢	🟡	🟡	🔴	🟡	🔴	🟡
Car rental services	🟡	🔴	🔴	🟡	🔴	🟡	🟢	🟡	🔴	🔴
Use of local transport	🟢	🟡	🔴	🟡	🟢	🟢	🔴	🟡	🟢	🟢
Bicycles and similar modes of transport	🟢	🔴	🔴	🟡	🟡	🟢	🟡	🟡	🔴	🔴
Parking facilities	🔴	🔴	🔴	🔴	🔴	🟡	🟢	🔴	🔴	🔴
Roadside fuel stations and charging stations for electric vehicles	🔴	🔴	🔴	🔴	🔴	🟡	🟢	🔴	🔴	🔴
Restaurant	🟡	🟢	🟢	🟡	🔴	🔴	🟡	🔴	🟡	🔴
Fast food	🟢	🟡	🔴	🟢	🟡	🟡	🟢	🟢	🟢	🟡
Canteen	🟢	🔴	🔴	🟢	🟢	🟡	🟡	🟢	🟢	🟢
Traditional guiding services	🔴	🟡	🟢	🟡	🔴	🔴	🟡	🔴	🔴	🔴
Innovative guiding services	🟢	🟢	🟡	🟢	🟡	🔴	🟢	🟡	🟢	🔴
Guide-instructor	🔴	🔴	🔴	🔴	🔴	🟢	🔴	🟢	🟡	🔴
Shower facilities	🟢	🟡	🔴	🟡	🟢	🟢	🟢	🟢	🟢	🟡
Electronic ticket booking systems	🟢	🟢	🟢	🟢	🟡	🟢	🟡	🟢	🟢	🟢
Online systems for purchasing tickets to events	🟢	🟢	🟢	🟢	🟡	🔴	🟢	🟡	🟢	🟢
Tour operator services	🔴	🔴	🟡	🟡	🔴	🔴	🔴	🔴	🔴	🔴
Information services at border crossings	🟢	🟡	🔴	🟡	🟢	🟢	🟢	🟢	🟢	🟡
Geographic information systems (GIS) services	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Wi-Fi services	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Info kiosk services	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
International card ATMs	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Tourism police services	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Local travel agency services	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
🟢 - very important 🟡 - important 🔴 - not important										

Table 9. Categorized regularities for independent tourist service system (Based on Delphi expert consensus, n=15)

Digital and connectivity	
1	Digital navigation (maps, GPS, wayfinding signage) fundamental need for all segments
2	Stable, free internet core infrastructure for routing, information, and payments
3	Online booking services high importance for all segments, enhances trip planning
4	Centralized tourist information portal reduces uncertainty, optimizes routes
Financial services	
5	International payment systems and card-accepting ATMs enables economic activities
Safety and trust	
6	Safety services (tourism police, info centres) builds tourists' sense of trust
7	Gaps in service system increases risk perception, reduces repeat visits
Transport and mobility	
8	Auto-tourist services (parking, fuel, EV charging) essential for road travel
9	Multilingual public transport info determines freedom of movement
10	Infrastructure interchange points reduces route length and costs
Accommodation	
11	Segment-specific: backpackers-budget; poshpackers-quality; families-comfort
12	Affordable options (hostels, camping) extends trip duration for budget travelers
Amenities and facilities	
13	Food-service diversity and accessibility directly affects length of stay
14	Roadside sanitation (WC, rest areas) critical for long-distance travelers
Interpretation and experience	
15	Audio guides, multimedia, QR-codes makes sites “readable”, enhances experience

On the basis of the expert assessments summarised in Table 8, fifteen empirical regularities were derived and grouped into thematic blocks. These regularities are presented in Table 9, which organises them into digital and connectivity, accommodation, mobility, catering and information-service categories.

While the regularities derived through the Delphi method identify independent tourists’ service needs, the next stage consists of determining the extent to which Uzbekistan’s existing infrastructure meets these needs. Therefore, the regularities identified for the service system are now linked to an assessment across Uzbekistan’s regions of: (a) which services have been implemented; (b) which are lacking; (c) which are only partially functioning; (d) which require accelerated development.

To address this need, Table 10 has been developed, it provides a comparative analysis of the real implementation status across Uzbekistan’s regions of services that are of high importance for independent tourists. Table 10 provides a comparative picture of the extent to which services identified as important for independent tourists are available across Uzbekistan’s regions, thereby enabling the identification of the gap between the Delphi results and practice. As the table indicates, although Uzbekistan’s tourism infrastructure has undergone noticeable modernization in recent years, a fully integrated service system has not yet been established, given the complexity of services and their uneven territorial distribution.

Table 10. Degree of implementation across the country’s regions of services with high preference among independent tourists

Regularities and related services	Service implementation status	National level	International level	Solution
Geographic information systems (GIS)	Not implemented sufficiently		Yandex navigator, maps.me, google map, google earth	Introduce a mobile application that consolidates tourist sites, recreation areas and mountainous zones in one platform
Wi-fi zones	Not implemented sufficiently		-	Establish free or paid Wi-fi zones in the areas of airports, railway stations, catering facilities and shopping complexes
Infokiosk (booking centers)	Not implemented sufficiently			Establish infokiosks staffed by individual travel agents at airports, railway stations and within tourist-site areas
International card exchange ATMs	Not implemented sufficiently	National card exchange ATMs are available in front of all tourist sites	Available at some tourist sites and hotels	Install terminals that accept international cards and ATMs for cash withdrawal at airports and railway stations, at entrances to tourist sites and in restaurants and shopping complexes
Tourism police	Implemented	-	-	-
Parking bases	Not implemented	Established on the premises of some hotels	-	Establish parking zones near eco-zones and tourist sites that provide opportunities for stopping, washing, and dining for visitors arriving by private transport
Roadside fuel stations	Not implemented sufficiently	Only 8 fuel stations exist on the Tashkent-Khiva route	-	Establish fuel stations every 50-100 km along the Tashkent-Samarkand-Bukhara-Khiva route
Charging stations for electric transport vehicles	Not implemented sufficiently	Available in city centers and on intercity routes	-	Establish charging stations for electric vehicles every 200-300 km along the Tashkent-Samarkand-Bukhara-Khiva route
3*,4*,5* Hotel services	Implemented	-	-	-

Accommodation facilities in mountainous zones	Not implemented sufficiently	Only overnight-stay services in local residents' homes are available	-	Establish camping zones in the upper parts of the mountains and the adjacent infrastructure
Car rental services	Not implemented sufficiently	Organized only in the centers of tourist cities	-	Organize car rental services in the vicinity of airports and railway stations
Restaurant services	Implemented	-	-	-
Fast&food services	Implemented	-	-	-
Traditional guiding services	Implemented	-	-	-
Innovative guiding services	Not implemented sufficiently	-	-	Organize services such as short video clips about tourist sites, audio guides and opportunities for tourists to view sites remotely through 3D-format visuals
Guide-instructor services in remote areas and mountainous zones	Not implemented	-	-	Establish the activity of guides in remote areas and mountainous zones who can accompany independent tourists and speak English and Russian
Online booking systems air tickets	Implemented	uzairways.com	aviasales.com wizzair.com/en-gb	-
Railway tickets	Implemented	eticket.railway.uz	eticket.railway.uz	-
Booking of accommodation facilities	Implemented	mybooking.uz/ru	booking.com expedia.com airbnb.com/ru	-
Roadside shower facilities	Not implemented sufficiently	-	-	Construct motels with shower facilities every 200-300 km along routes to tourist cities for tourists traveling by buses and passenger cars
Online booking of events	Not implemented sufficiently	https://www.afisha.uz/	https://www.afisha.uz	Only the list of events in Tashkent is included on Afisha.uz; it is advisable to add events in other tourist cities as well
Tour operator and travel agency activities	Implemented	Tour operators and travel agencies engaged in domestic tourism and organizing packaged	Tour operators and travel agencies engaged in outbound tourism and organizing packaged tours	Organize tour operator and travel agency activities that specifically serve independent tourists
GIS services at national borders	Not implemented	-	-	Establish infokiosks in the areas of each border entry point to provide information about the country
Regional travel agency activities	Not implemented	-	-	Establish regional travel agents around airports, railways and tourist sites that organize short-term local tour packages

CONCLUSION

According to analytical observations, the trend of visa liberalization has been more strongly manifested in Uzbekistan, as tourism has been viewed in these states as a relatively rapid instrument for economic growth and employment generation. As a result of the step-by-step liberalization of the visa regime, the number of countries whose citizens could enter Uzbekistan visa-free was increased to 140 (i.e., by nearly 15 times), while inbound foreign visitors were increased to 10 million by 2024. This dynamic correspondence has been treated as an important indicator through which it has been demonstrated that, as visa openness is increased, the volume of arrivals is also increased, thereby providing a basis for visa policy to be interpreted as one of the central instruments of tourism policy.

Independent tourists have been differentiated from traditional tourists (those travelling via tour agencies) by travel purpose, needs during travel, the types of services selected and the infrastructure relied upon. Through a comparative analysis in which the services used by independent tourists during travel were classified into three categories by importance, it was determined that a higher propensity has been shown toward atypical and less commonly used services, rather than toward the services typically used by organized (group) tourists. In addition, it was determined from the above analysis that, although independent tourists may be classified into different categories, a similar tendency toward the same needs for certain services has been observed; on this basis, 15 distinct regularities were formulated. On the basis of the importance levels of service types used by different categories of independent tourists and the identified regularities, a comparative analysis of the degree to which these services have been implemented in the country's tourism regions was conducted and primary proposals were developed as solutions for services that have been insufficiently implemented or have not been implemented at all.

1. In Uzbekistan's tourism industry, the citywide availability of tourism services that are often regarded as secondary-namely geographic information systems, infokiosks and Wi-Fi zones-is expected to be ensured, whereby inbound international tourism, also the development of domestic tourism and the enhancement of local residents' cultural engagement are expected to be promoted.

2. In eco-zones, parking facilities are expected to be established, through which increases are expected to be observed in the number of independent tourists traveling by private and rented cars as well as campers, in cross-border freight transport movements and in one-day trip visitors.

3. Through the further development of online booking systems widely used by independent tourists, the dependence of accommodation providers in Uzbekistan on tour operators is expected to be reduced and direct communication between tourists and hotels is expected to be established. In addition, the operation of small accommodation providers (home-stay hotels, hostels, private home rentals, motels) is expected to be stimulated.

4. Given that a stronger preference among independent tourists tends to be shown for fast food, street food and low-cost meals, the development of small restaurant businesses is expected to be stimulated, while service quality and foreign-language proficiency are expected to be improved. Furthermore, the organization of street-food services around tourist attractions is increasingly expected to be required.

5. By independent tourists, innovative guiding services are expected to be preferred rather than conventional guiding. By them, the acquisition of a remote, advance visual understanding of tourist sites is expected to be sought and entrance tickets are expected to be purchased online. As a result, the need is expected to be created for a national and international system in which all tourist attractions are integrated. Moreover, in mountainous zones and remote areas, the popularization of services such as guide-instructors is expected to be expanded and the foreign-language proficiency of local residents is expected to be improved.

6. A need is also expected to be generated for national and international systems through which tickets for air travel, rail transport and national events can be purchased online.

7. The activities of individual tour operators and travel agents are required to be organized in Uzbekistan. By them, short-term tours for independent tourists visiting the country are expected to be provided. Unlike tour operators serving organized group tourists, their activities are expected to be arranged in offices also around tourist attractions, where the full range of tourism services is expected to be facilitated and coordinated.

The implementation of the above-mentioned services, as well as the improvement of certain existing services, is expected in the future to increase Uzbekistan's tourism attractiveness, service quality and service diversity for independent tourists also for organized tourists. Most importantly, healthy competition is expected to be fostered between small and large business actors operating in the tourism sector.

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Abbreviations: APC: Article Processing Charge; ATM - Automated Teller Machine; GIS – Geographic Information System; GPS - Global Positioning System; ICT - Information and Communication Technologies; RE - Random Effects; UAE - United Arab Emirates; VOI - Visa Openness Index; WTTC - World Travel & Tourism Council.

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SPATIAL ANALYSIS OF SERVICE INNOVATION AND QUALITY IN UPPER UPSCALE HOTELS: THE HUMAN-ENVIRONMENT RELATIONSHIP IN HANOI

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Abstract: Contemporary upscale hotels have evolved into "micro-geographies" where spatial design, technology, ecology, and human interaction co-produce the guest experience. However, substantial managerial investments in service innovation often fail to enhance guest perception. This creates a structural "Perceptual Gap" between conceived and lived spaces that traditional functionalist frameworks cannot explain. This study aims to examine the divergence between managerial innovation strategies and guests' perceptions, identifying the spatial and psychological mechanisms driving this gap. A multiple-case study triangulates supply side data (interviews with senior managers at two contrasting upper upscale hotels in Hanoi, Vietnam) with demand-side data (2,377 scraped TripAdvisor reviews). Managerial data underwent deductive thematic coding using an extended 8-dimension Service Quality model to generate Strategic Input scores (Lefebvre's conceived space). Guest data were analyzed via sentiment analysis and Semantic Network Analysis (VOSviewer), employing Digital Geography to map the cognitive topology of the guest experience. The results validate three theoretical propositions. First, the Visibility Paradox (P1) shows that perceived smart service quality is inversely correlated with technological obtrusiveness; visible interfaces cause spatial friction (divergence: −3), whereas invisible backend systems enable seamless flow (convergence: +1). Second, Sociability Primacy (P2) identifies community building as the paramount driver of place attachment, manifested as a centripetal network topology in boutique properties versus a centrifugal, fragmented topology in international chains. Third, the Environmental Prerequisite (P3) reveals that green practices act as hygiene factors; their presence yields negligible positive sentiment (<0.5%), but their absence triggers severe negative disconfirmation. Ultimately, this study advances a spatial reframing of service innovation, demonstrating that value is co-createdand potentially distorted through embodied encounters among guests, technology, and urban morphology.

Keywords: urban tourism planning, spatial analysis, human-environment relationship, smart tourism territory, Hanoi

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INTRODUCTION

In the contemporary urban landscape, upper upscale hotels have evolved into "micro-geographies"-territorial nodes where spatial design, technology, ecology, and human interaction converge to co-produce the tourism experience. Driven by digital transformation and sustainability imperatives, innovation in this sector has traditionally been viewed as measurable operational output (Hjalager, 2010). Recent literature continues to reflect this supply side logic, focusing heavily on digital orientation as a driver of service innovation (Zhou et al., 2025) or the implementation of Sustainability-Oriented Service Innovation (Bordian et al., 2026) as firm-centric capabilities. However, a critical paradox disrupts this managerial logic: substantial technical investments do not invariably yield superior customer satisfaction (CS). Recent studies indicate that treating technological innovation-such as AI-enabled experiences (Alhomaid et al., 2025)-as a monolithic construct obscures how customers decode these signals within the service space. According to Signaling Theory (Spence, 1973), innovations act as territorial signals of competence. However, when the actual lived experience fails to confirm the expectations set by these signals (e.g., star ratings), "Negative Disconfirmation" occurs (Tiwari & Omar, 2025). This creates a structural Perceptual Gap between the manager's "conceived space" and the guest's "lived space" (Lefebvre, 1991)-a supply demand divergence that constitutes the central problem of this study. Despite its criticality, the extant literature exhibits three notable gaps. Conceptually (Spatial Gap): Prevailing research either adopts a purely functionalist, supply side perspective (Ruiz-Fernández et al., 2026; Zhou et al., 2025) or a macro-level destination focus (Alshiha et al., 2025), largely ignoring the micro-geographical tension between visible interfaces and invisible infrastructure. The spatial dynamics of how technology and human elements entangle (Kandampully et al., 2023) within specific urban morphologies remain unexplored.Measurement-wise (Dimensional gap): Traditional scales such as LODGSERV (Knutson et al., 1990) systematically overlook the perceptual triad of Industry 4.0. They fail to capture how

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technological complexity triggers anxiety rather than delight (Yang & Leung, 2025) or how green practices function merely as environmental prerequisites (hygiene factors) rather than competitive differentiators (Khuong et al., 2025). Methodologically (The Cognitive Gap): Prior studies rely heavily on self-reported surveys susceptible to social desirability bias (Perez-Aranda et al., 2025) or analyze macro-social media discourse (Yang & Leung, 2025). There is a pronounced paucity of research utilizing property-level User-Generated Content (UGC) to map the unmediated cognitive topology of the guest's lived spatial experience. To bridge these gaps, this study proposes an integrated framework grounded in service-dominant logic (Vargo & Lusch, 2008), Signaling Theory, and Humanistic Geography (Lefebvre, 1991; Tuan, 1977). The study posits that innovation value is co-createdand potentially distortedduring embodied service encounters. This study aims to examine the structural divergence between managerial innovation strategies and guests' perceptual reception in upper upscale hotels. To achieve this, this study pursues four objectives: (O1) to operationalize an extended 8-dimension Service Quality model integrating LODGSERV with Smart Services, Green Practices, and Sociability; (O2) to map supply demand divergence through a comparative case study of two contrasting hotels in Hanoi, Vietnam; (O3) to apply Semantic Network Analysis (VOSviewer) as a tool of Digital Geography, constructing a cognitive topology of the guest experience as a virtual cartographic representation of territorial identity; and (O4) to generate mid-range theoretical propositions (Visibility Paradox, Sociability Primacy, Environmental Prerequisite) advancing the understanding of innovation-perception dynamics. Finally, Hanoi's contrasting urban morphologies (the French and Old Quarters) serve not merely as a geographic backdrop but as a theoretically constitutive element for examining how urban spatial grammar shapes the translation of innovation signals into territorial quality outcomes.

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

The evolution of service innovation: from operational output to spatial reconfiguration

The functionalist perspective: innovation as operational output

Traditionally, service innovation has been conceptualized as a measurable, operational output (Hjalager, 2010; Schumpeter, 1934). Recent studies in the hospitality context, including those focused on emerging markets such as Vietnam (Nguyen, 2020, 2023), adhere to this supply side logic by focusing on absorptive capacity and process restructuring. Similarly, Ruiz-Fernández et al. (2026) empirically found that chain-affiliated hotels suffer from structural lags between their strategic intent and operational adaptation. Zhou et al. (2025) demonstrated that digital orientation positively impacts service innovation, mediated by digital capabilities with government support.

Furthermore, Bordian et al. (2026) found that Sustainability-Oriented Service Innovation (SOSI) significantly enhances customer satisfaction through value co-creation. Although these findings provide robust supply side metrics, their critical limitation lies in treating customers as passive recipients rather than active co-creators (Truong et al., 2020). Zhou et al. (2025) and Ruiz-Fernández et al. (2026) rely exclusively on managerial self-reporting, completely omitting customers' perceptual reception. Consequently, sophisticated backend systems (e.g., Mövenpick's ACDC CRM) may represent high digital capability but fail to generate customer recognition. Furthermore, Bordian et al. (2026) utilized a cross-sectional design that treated SOSI as a unidimensional construct, failing to capture the structural "Perceptual Gap" between the managerial conceived space and the guest's lived spatial experience.

The Dichotomous Perspective: Technology vs. Human Touch

Industry 4.0 has popularized a binary view of technological and non-technological innovation. Cheng & Liu (2026) found that smart technologies significantly enhance service efficiency, personalization, and novelty. Conversely, Yang & Leung (2025) utilized Social Network Analysis to reveal that technological complexity triggers anxiety, acting as a primary barrier to adoption that spreads virally through structural holes. Alhomaid et al. (2025) found that AI-enabled experiences drive sustainable consumption via psychological ownership, while Li & Huang (2022) proved that sociability needs cannot be substituted by contactless efficiency, as the absence of human interaction creates an emotional void. The primary limitation of this dichotomous stream is its reductionist and macro-level framing of the issue. Yang & Leung (2025) rely on macro-social media discourse (Twitter), which obscures the micro-spatial reality of how guests interact with specific interfaces inside a hotel room. Moreover, Alhomaid et al. (2025) treat AI as a monolithic construct, ignoring the vital spatial distinction between visible interfaces (which cause friction) and invisible infrastructure (which accelerates services). This study addresses this limitation by advancing Kandampully et al. (2023) argument that technology and human elements are deeply entangled, mapping how the successful invisibilization of technology allows human geography to dominate the experiential foreground.

The Integrative Perceptual Perspective: Value Co-Creation

Grounded in Service-Dominant (S-D) logic (Vargo & Lusch, 2008), the contemporary stream views innovation as a co-created phenomenon (Dai et al., 2025; Zhang & Ha, 2025). Alhomaid et al. (2025) found that both hedonic and utilitarian features drive tourist value co-creation in smart destinations. Concurrently, Khuong et al. (2025) found that green practices mediate return intentions, although specific water- and energy-saving measures fail to directly boost positive mood or satisfaction. While conceptually advanced, Alhomaid et al. (2025) are limited by their macro-destination focus, which lacks the micro-geographical context of organically evolved urban morphologies. Khuong et al. (2025) relied on survey data that were highly susceptible to social desirability bias regarding environmental issues. This necessitates the use of unprompted User-Generated Content (UGC) to capture authentic spatial perceptions and distinguish between utilitarian innovation strategies (operational standardization) and hedonic pathways (personalized human interactions).

Reconceptualizing service quality: from process to territorial quality

The durability and limitations of LODGSERV

While LODGSERV (Knutson et al., 1990) remains foundational, modern classifications act as pre-encounter signals.

Tiwari & Omar (2025) found that failing to meet star-rating expectations triggers severe "Negative Disconfirmation." Similarly, Perez-Aranda et al. (2025) noted consumer ambivalence toward sustainability practices, and Wong & Loo (2026) highlighted the operational efficiency of smart buildings through longitudinal data. However, a critical limitation of these traditional and operational frameworks is their systematic oversight of the perceptual triad of the Industry 4.0 servicescape. They measure functional delivery but fail to capture the spatial and psychological nuances of modern luxury.

Extended 8-component model

To capture contemporary territorial quality, we extend LODGSERV with three non-substitutable dimensions:

Smart Service (The Digital Environment): Transcending static "Tangibles," this differentiates between obtrusive (visible) and seamless (invisible) interfaces. As Yang and Leung (2025) note, complexity breeds anxiety; thus, truly smart services minimize cognitive load. Green Practices (The Ecological Environment): Functioning not as a delighter, but as an "Environmental Prerequisite"-a baseline legitimacy factor where absence punishes the brand (negative disconfirmation), but presence is merely expected compliance (Khuong et al., 2025). Sociability (Social Geography): The architectural principle determining whether a space becomes a meaningful "place" (Tuan, 1977) or a standardized "non-place" (Augé, 1995). As Li & Huang (2022) demonstrated, technological efficiency cannot replace the emotional resonance of human sociability.

Spatial dimensions and digital geography

Drawing on Lefebvre's (1991) spatial trialectic, this study operationalizes the gap between conceived space (managerial intent) and lived space (guest experiences). Recent spatial studies have provided partial insights: Suess et al. (2024) found that biophilic design reduces guest anxiety, whereas Lai et al. (2025) identified social interaction spaces as primary satisfaction drivers. However, their critical limitation is the neglect of the full human-environment-technology triad, while macro-level destination studies (Alshiha et al., 2025) obscure property-level dynamics. Methodologically, we conceptualized Semantic Network Analysis (VOSviewer) as a tool of Digital Geography. Moving beyond the frequency-based sentiment limitations of Pacheco et al. (2026), we mapped the cognitive topology of the guest experience. Just as Yang & Leung (2025) identified structural holes in social networks, we analyzed structural absences in UGC (e.g., missing tech keywords) as empirical proof of successful backend invisibilization, directly addressing technology anxiety (Haque et al., 2026). To explicitly contextualize this research within the current state-of-the-art and address the structural limitations of the extant literature, Table 1 critically analyzes seven highly similar articles published within the last three years (2024-2026). This matrix highlights their core findings, methodological limitations, and specific gaps that the present study resolves.

Table 1. Critical analysis of similar recent studies (2024-2026)

Study (Year)	Core Findings	Critical Limitations	Gap Addressed by Present Study
Cheng & Liu (2026)	Smart technology enhances efficiency and novelty in hotels.	Lacks spatial/morphological context and ignores emerging markets.	Introduces urban morphology analysis and UGC semantic topology.
Alhomaid et al. (2025)	AI experiences drive sustainable consumption through psychological ownership.	Treats AI as a monolithic construct and ignores interface obtrusiveness.	Disaggregates AI into visible (friction) and invisible (flow) technologies.
Zhou et al. (2025)	Digital orientation drives service innovation (supply side).	It relies entirely on managerial self-reports and ignores demand-side perception.	Measures the "Perceptual Gap" between managerial input and guest-generated content (UGC).
Yang & Leung (2025)	Technological complexity triggers anxiety, spreading via structural holes.	Macro social media focus (Twitter): Lacks micro-spatial property reality.	Structural analysis was applied to the micro-spatial property UGC (VOSviewer).
Bordian et al. (2026)	SOSI positively influences satis-faction through value co-creation.	Cross-sectional design that treats inno-vation as a unidimensional construct.	Disaggregates spatial dimensions (ecological versus social innovation).
Tiwari & Omar (2025)	Star ratings act as signals; failure causes Negative Disconfirmation.	COVID-specific health framing and ignores social geography.	It extends disconfirmation theory to spatial and sociability dimensions.
Suess et al. (2024)	Biophilic design creates restorative experiences that reduce stress.	Design-only focus; ignores the digital and social spatial dimensions.	Integrates physical design with the human-environment-technology triad.

Theoretical synthesis and research propositions

Our framework integrates the S-O-R paradigm (Mehrabian & Russell, 1974), Signaling Theory (Spence, 1973; Mahmoud et al., 2018), and Humanistic Geography (Lefebvre, 1991; Tuan, 1977). Within the S-O-R paradigm, service innovation functions as an Environmental Stimulus (S) that shapes the internal evaluative state (O) and behavioral response (R). We posit that innovation is a territorial signal. When technological signals are too visible, they are decoded by guests as operational complexity, creating "noise" and Negative Disconfirmation (Tiwari & Omar, 2025).

The transformation of a hotel from a mere "space" of accommodation into a meaningful "place" of belonging is mediated by three spatial forces: digital, ecological and social. This synthesis generated three validated propositions.

P1 (Visibility Paradox): Perceived Smart Service quality is inversely related to technological obtrusiveness (visible technology generates spatial friction; invisible technology enables seamless flow).

P2 (Sociability Primacy): Sociability is the paramount driver of place attachment, overriding functional dimensions and generating a centripetal cognitive topology anchored by human interaction.

P3 (Environmental Prerequisite): Green Practices function strictly as a hygiene factor (a baseline for institutional legitimacy) rather than a competitive differentiator, where absence punishes but presence is merely expected.

RESEARCH METHOD

Research design

This study employs a qualitative multiple-case study design (Yin, 2018) to examine the structural divergence between firms' innovation efforts - operationalized as "conceived space" in Lefebvre's (1991) spatial trialectic - and customers' perceptual reception of those efforts, operationalized as "lived space." A case study design is epistemologically appropriate here because service quality is not a decontextualized attribute but an emergent property of specific socio-spatial encounters; it cannot be adequately captured through the variance-based logic of survey research alone (Flyvbjerg, 2006). The multiple-case structure, following Yin's (2018) replication logic, enables cross-case pattern matching that strengthens the transferability of theoretical propositions beyond the idiosyncrasies of any single property.

This study adopts an abductive reasoning strategy (Dubois & Gadde, 2002), iterating between theoretical frameworks - S-O-R, Signaling Theory, Lefebvre's spatial trialectic, and Humanistic Geography - and empirical observations to generate mid-range theoretical propositions. This approach is particularly suited to the study's objective of theory refinement: rather than testing pre-specified hypotheses, the study seeks to identify the mechanisms through which innovation inputs are translated - or fail to be translated - into territorial quality outcomes. The three research propositions (P1: Visibility Paradox; P2: Sociability Primacy; P3: Environmental Prerequisite) emerged through this iterative process and are presented as theoretically grounded, empirically illustrated propositions rather than as statistically tested hypotheses.

Case selection: A comparative spatial approach

Purposive sampling was employed to select two hospitality entities in Hanoi that contrast not only along the market tier dimension (5-star international chain versus 4-star independent boutique) but also along the urban morphology dimension - a selection criterion that distinguishes this study from conventional comparative hotel research and directly operationalizes the study's spatial theoretical framework. As illustrated in Figure 1, the two cases are embedded in structurally distinct urban fabrics that function as physical antecedents to the observed service dynamics. The Mövenpick Hotel Hanoi Center (5-star international archetype) occupies the French Quarter, defined by a colonial grid pattern, wide boulevards, and spatial separation from the city's organic commercial fabric. This morphology reinforces spatial detachment and exclusivity, creating a "sanctuary effect" (Suess et al., 2024) that aligns with the hotel's global standardization strategy. The physical buffer from street-level activity favors high-tech integration and formalized service protocols but simultaneously constrains the spontaneous social interactions that generate place attachment. Thus, the spatial grammar of the French Quarter functions as a structural enabler of the centrifugal topology observed in the VOSviewer analysis.

The May De Ville Crown Hotel (4-star boutique counterpoint) is embedded in the Old Quarter, characterized by high-density "tube house" architecture and porous boundaries between private and public spaces. This morphology facilitates "Social Convergence" by positioning the hotel within a vibrant, human-scaled urban fabric that naturally amplifies social interaction. The Old Quarter's spatial grammar functions as a structural enabler of the Centripetal topology observed in the VOSviewer analysis, where human nodes dominate the cognitive landscape, and the hotel achieves brand-place fusion. These distinct spatial fabrics are not merely contextual backgrounds but are theoretically constitutive of the "Visibility Paradox" and "Morphological Convergence/Inertia" phenomena analyzed in this study.

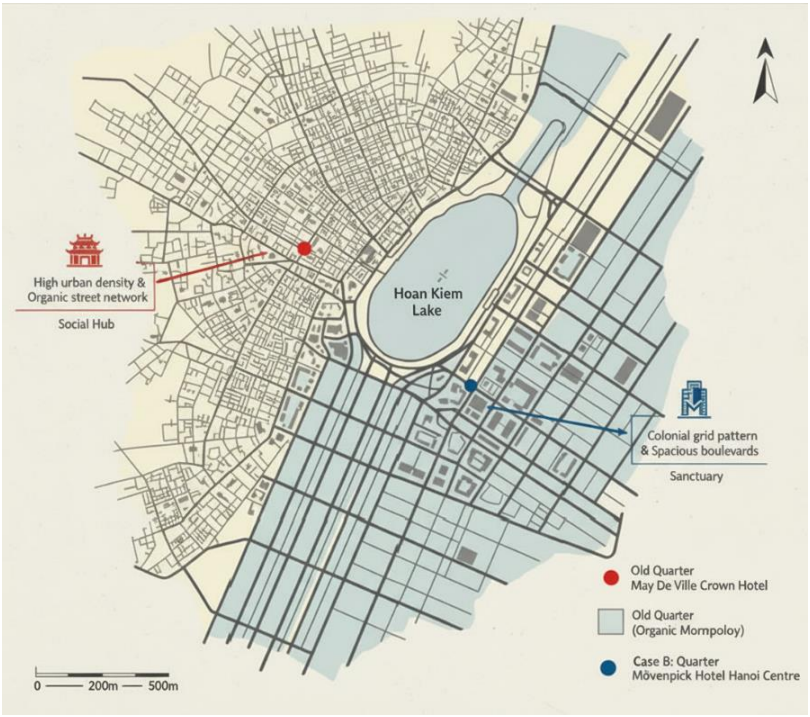


Figure 1. Comparative Spatial Analysis of Study Areas in Hanoi (Source: Authors, 2026)
(Note: The map illustrates the distinct urban morphologies influencing the "micro-geographies" of the two cases.)

Data collection

To ensure methodological rigor and adhere to the principle of triangulation (Denzin, 1978), data were collected from two independent sources reflecting the dual perspectives of the service encounter - the managerial "conceived space" and the guest's "lived space" - in direct correspondence with the study's Lefebvrian theoretical framework.

Supply side data were gathered through semi-structured in-depth interviews with senior managers responsible for strategy and operations: Mr. Ngo Van Lung (HR Manager, Mövenpick Hotel Hanoi Center) and Ms. Le Thi Ngoc (Manager, May De Ville Crown Hotel). The interview protocol was structured around the proposed 8-dimensional service quality model, probing strategic innovation orientation, resource allocation priorities, technological infrastructure decisions, and managerial expectations regarding guest behavior. The interviews were audio-recorded, transcribed verbatim, and subjected to member checking to ensure interpretive accuracy. These data provide insight into the "input" side of the innovation process - both tangible capital investments (CRM systems, physical renovations) and intangible efforts (personnel training, green SOPs) - constituting the "Strategic Input (Conceived Space)" scores in the radar model.

While the supply side sample comprises two primary managerial interviews, this purposive selection is epistemologically justified within the case study design through the "key informant" and "elite interviewing" techniques (Marshall, 1996). In operationalizing Lefebvre's (1991) "conceived space," the objective is not the statistical representativeness of the general workforce, but the accurate capture of top-down strategic intent, capital allocation, and spatial planning. As senior decision-makers, these informants possess concentrated and authoritative knowledge of their respective properties' strategic trajectories. Furthermore, to prevent single-source bias and ensure data saturation, these elite interviews were systematically triangulated with institutional documentary evidence, including corporate Standard Operating Procedures (SOPs), rebranding press releases, digital infrastructure blueprints, and direct spatial observations of the physical environment. This rigorous triangulation ensures that the "Strategic Input" scores reflect objective institutional realities rather than individual managerial idiosyncrasies, providing a robust, structurally valid counterweight to the extensive demand-side UGC dataset (N=2,377). Demand-side data were obtained through the automated extraction of User-Generated Content (UGC) from TripAdvisor using the Apify web-scraping tool.

The final dataset comprised 1,813 reviews for the Mövenpick Hotel Hanoi Centre and 564 reviews for the May De Ville Crown Hotel, including full textual comments, sub-ratings (cleanliness, service, value, and location), and timestamps. The deliberate asymmetry in the corpus size reflects the differential review volume associated with the two properties' market positions and is addressed analytically through proportional rather than absolute frequency measures. UGC was selected as the demand-side data source because it provides organic, unprompted, post-experience narratives that are free from the social desirability bias inherent in researcher-administered surveys (Perez-Aranda et al., 2025), capturing the authentic "lived space" of the guest experience rather than a socially constructed response to a structured instrument.

Data analysis and visualization

Data analysis employed a multi-tiered analytical framework combining qualitative content analysis for managerial inputs and computational text mining for customer outputs, operationalizing the dyadic supply-demand structure of the research design. To ensure methodological transparency and replicability, the translation of qualitative data into quantitative spatial metrics (1-5 scale) was governed by a rigorous, theoretically grounded scoring rubric (Table 2). For managerial data, deductive thematic coding was applied to the proposed 8-dimensional service quality model. Each coded segment was assigned a "Strategic Input" score (1-5), reflecting the intensity of managerial investment, resource allocation, and strategic intentionality. These scores constitute the "Conceived Space" axis. For UGC data, sentiment intensity was quantified using a hybrid approach: automated sentiment analysis via the VADER (Valence Aware Dictionary and sEntiment Reasoner) lexicon, chosen for its robust handling of social media and UGC microblogs, coupled with manual contextual validation for industry-specific nuances. The resulting sentiment distribution, triangulated with the node centrality metrics from VOSviewer, was translated into "User Experience" scores (1-5). This dual-verification ensures that a score of '5' requires not just positive sentiment but also structural centrality in the guest's cognitive topology. The gap between the Strategic Input and User Experience scores-the "Divergence/Convergence Value"-operationalizes Lefebvre's (1991) spatial contradiction between conceived and lived space and is visualized through Radar Charts.

Table 2. The Dyadic patial scoring rubric (1-5 scale)

Score	Strategic Input (Conceived Space) Based on Interviews & Resource Allocation	User Experience (Lived Space) Based on UGC Sentiment & Network Topology
5	Core Territorial Pillar: Maximum strategic priority; heavy capital/training investment; defines the brand's spatial identity.	Territorial Anchor (Delighter): Overwhelmingly positive sentiment (>80%); forms a central and high-density node in the cognitive network.
4	Proactive Investment: High strategic focus; deliberate integration into daily operational protocols and spatial design.	Positive Alignment: Consistent positive mentions function as a reliable spatial enabler without dominating the network core.
3	Baseline Compliance: Moderate investment; treated as an industry standard or operational necessity rather than a differentiator.	Zone of Indifference: Neutral sentiment or structural absence (invisible infrastructure); expected but not actively praised.
2	Reactive/Minimal Focus: Low strategic priority; addressed only when necessary; minimal resource allocation.	Spatial Friction: Frequent negative mentions create noticeable operational or emotional drag on the guest experience.
1	Strategic Void: No intentional investment or managerial focus on this spatial dimension.	Severe Disconfirmation: Dominant negative sentiment forms a peripheral cluster of complaints indicating systemic territorial failure.

Crucially, in constructing the UGC dataset, platform-specific traces-including hyperlink artifacts ("http") and reviewer metadata-were intentionally preserved rather than removed as noise. Consistent with the study's Digital Geography framework, these traces are treated as markers of "infrastructural visibility": their prominence in the semantic network maps the degree to which the digital layer becomes salient in the guest's discourse, functioning as empirical evidence of the "Virtual Encroachment" phenomenon theorized in Section 2.

RESEARCH RESULTS

The production of tourism space: strategic intent vs. territorial reality

The managerial perspective: divergent spatial strategies

In-depth interviews with senior management, Mr. Ngo Van Lung (HR Manager, Mövenpick) and Ms. Le Thi Ngoc (Manager, May De Ville)-reveal that while competitive pressures are shared, spatial development trajectories diverge significantly based on urban morphology. The 5-star segment prioritizes global spatial synchronization. Mövenpick utilizes its CRM system (ACDC) to dissolve geographical boundaries through continuous data flow. Mr. Lung noted, "ACDC is a massive technological innovation... if a guest enjoys milk coffee in Vietnam, staff in Cambodia will know to serve it," creating a unified global service territory. Conversely, the 4-star segment leverages technology for operational optimization within a constrained footprint. Ms. Ngoc emphasized that "service time is faster with automated booking software," noting that eliminating manual entry compresses the time and space required for service delivery.

Regarding resource allocation, Mövenpick adopts a demographic adaptation strategy by modifying F&B products (e.g., dim sum and kimchi) for specific international flows. In contrast, May De Ville pursues functional expansion, transforming from a lodging unit into an integrated "experience territory" via Sky Bars and Spas. Notably, a convergence exists at the human-environment interface: both entities have transitioned to eco-friendly materials, with Ms. Ngoc citing the shift to branded paper boxes as a tangible commitment to the restaurant's ecological contract. Finally, spatial restructuring differs: Mövenpick is undergoing a metamorphosis to "modern luxury" for rebranding, while May De Ville utilizes micro-spatial adjustments to optimize utility within the high-density Old Quarter.

The customer perspective: spatial perception and digital geomarketing

Geomarketing analysis via Apify provides an empirical counter-narrative to the managerial production. At Mövenpick (5-star), Word Cloud analysis highlights experiential keywords ("Chocolate Hour," "Lounge") rather than technological attributes. While positive sentiment clusters around service rituals, significant negative clusters emerge regarding material degradation ("Old," "Dated," "Dark") and friction in the Human-Environment relationship ("Light switches," "AC"). This indicates spatial dissonance, where high-tech backend efforts fail to compensate for the built environment’s physical deterioration. Conversely, May De Ville (4-star) data reflect a highly personalized social geography. The prevalence of specific staff names ("Rosie," "Bella," "Anna") in 5-star reviews indicates that customers are captivated by human-place interactions rather than systemic perfection. Keywords like "Rooftop Bar" and "Pool" confirm the success of the hotel as a "Social Hub." The contrast is stark: large-scale hotels rely on technocratic systems, whereas boutique hotels succeed through social convergence and effective utilization of relational space.

Impact on functional quality: The interplay of digital and social geographies

Regarding Responsiveness, a clear spatial-temporal optimization is observed in the 4-star segment. Managerial claims regarding automated software are corroborated by customer keywords such as "swift" and "efficient," demonstrating that technology successfully acts as a spatial accelerator. However, regarding reliability, structural dissonance exists in the 5-star segments. While the backend CRM creates a seamless digital territory, the physical interface (key cards, room controls) exhibits failure. This represents tangible friction, where the stability of the built environment lags behind the sophistication of the virtual infrastructure. Finally, in terms of assurance, human geography remains the ultimate stabilizer. Even when technological infrastructure falters (e.g., app glitches at Mövenpick), professional staff recovery preserves trust, suggesting that while technology facilitates efficiency, the social component ensures structural integrity.

Impact on emotional quality: Social geography and environmental integrity

Regarding Empathy, the study uncovers a dichotomy between "Algorithmic Empathy" and "Authentic Connection." Mövenpick’s data-driven standardization creates a perception of "professional correctness" but lacks the emotional resonance for genuine place attachment. In contrast, May De Ville’s "High-touch" approach generates superior emotional scores through unscripted interactions. Regarding Tangibles, a "Perceptual Gap" characterizes the 5-star case. A "Rebranding Lag"-where modernized public zones contrast with dated private interiors-creates spatial fragmentation and "Negative Disconfirmation." Meanwhile, the 4-star hotel achieves higher satisfaction by maintaining territorial consistency and environmental hygiene ("Sleeping on a cloud"), proving that rigorous preservation often trumps superficial modernization.

Empirical analysis of new spatial dimensions

Smart service: The digital-physical interface paradox

The results indicate that digital proliferation does not equate to high quality. At Mövenpick, complex physical interfaces (e.g., light switches) create "spatial friction" in the private sphere. Conversely, May De Ville’s "Invisible Technology" (backend support) empowers human agents, resulting in higher perceived "smartness." Thus, smart services should be conceptualized by spatial fluidity and seamless man-machine interaction, not device density.

Green practices: environmental baseline

Text mining revealed a "zone of indifference" in relation to ecological footprints. Positive mentions are negligible

(<0.5%); however, negative sentiment spikes when practices disrupt experiences (e.g., paper straw failure). This confirms that Green Practices have transitioned from a "Delighter" to a "Fundamental Environmental Prerequisite"-a baseline for institutional legitimacy where absence punishes the brand, but presence is viewed merely as compliance.

Sociability: The production of relational space

Sociability is the most potent driver of place attachment. Whether through structured rituals ("Chocolate Hour") or organic zones ("Rooftop Bar"), the function of the hotel as a "Social Hub" consistently garners the highest sentiment. This validates sociability as a critical dimension, filling the emotional void that functional attributes cannot address.

Comparative spatial analysis and synthesis

Table 3 contrasts the governing spatial dynamics by applying Yin's (2018) pattern matching.

The cross-case synthesis crystallizes into three dynamics. First, a "Spatial Interface Paradox" exists, i.e., technological efficacy is inversely related to hardware obtrusiveness and technology creates maximal value as an "invisible enabler." Second, large-scale organizations suffer from "Territorial Inertia," where strategic rebranding outpaces physical adaptation, causing temporal and spatial dissonance. Ultimately, "Social Convergence" remains the universal denominator: regardless of scale, the capacity to foster sociability drives the successful production of tourism space.

Table 3. Comparative matrix of territorial strategy vs. perceived spatial quality (Source: Synthesized from case study data)

Analysis Criteria	Mövenpick Hotel Hanoi Centre (5-Star International)	May De Ville Crown Hotel (4-Star Boutique)	Geo-Spatial Implication
Territorial Management Strategy	System-based: Global standardization, Big Data (ACDC), and rebranding.	Human-centric: Micro-spatial agility, Empowerment, On-site amenities.	Scale dictates morphology: Large scale favors Structure; Small scale favors Behavioral Geography.
Technological Interface	Visible Tech: Obtrusive in-room devices and apps. *Results:* Spatial Friction (Negative Gap).	Invisible Tech: Backend logistics. *Results:* Seamless Flow (Positive Gap).	Technology maximizes value when it acts as an "Invisible Spatial Enabler."
Social Geography	Programmed: Standardized rituals (Chocolate Hour). *Perception:* Professional Correctness.	Naturalized: Spontaneous interaction. *Perception:* Intimacy/Place	Global chains must "soften" rigid protocols; Boutiques must maintain "familial culture."
Spatial Coherence	High Divergence: Gap between investment and physical reality.	High Convergence: Alignment between effort and spatial satisfaction.	Complexity increases the risk of "Territorial Dissonance."

Table 4. Spatial divergence scoring for Mövenpick Hotel Hanoi Centre (Source: Authors, 2026)

Spatial Dimension	Strategic Input (Conceived Space)	User Experience (Lived Space)	Divergence Value	Geo-Spatial Interpretation
Smart Interface	5	2	-3 (Negative)	Technological imposition creates interface friction within the private zone.
Physical Infrastructure	5	2	-3 (Negative)	Strategic rebranding conflicts with the inertia of the built environment.
Ecological Integration	4	3	-1 (Neutral)	Environmental commitment is perceived as a baseline standard.
Social Geography	4	3	-1 (Neutral)	Data-driven personalization fails to generate place attachment.
Social Spatiality	3	5	+2 (Positive)	The peripheral social ritual (Chocolate Hour) becomes the primary spatial attractor.

Modeling spatial dissonance: A semi-quantitative geomarketing assessment

The spatial divergence scoring for the Mövenpick case is detailed in Table 4 and visualized through a multidimensional radar model (Figure 2).

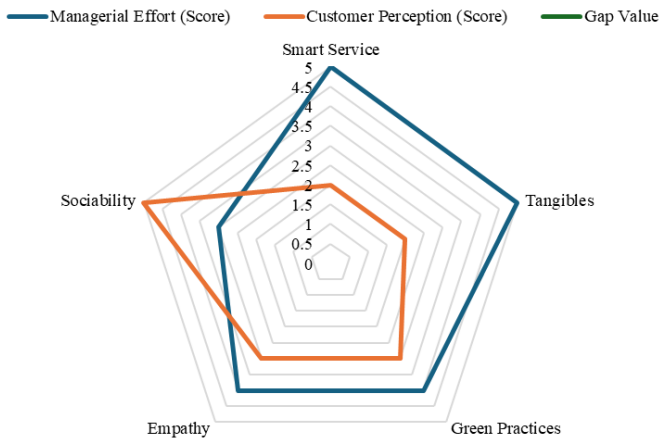


Figure 2. The radar chart of territorial alignment (Mövenpick Case) (Source: Authors, 2026)

Table 5. Spatial convergence scoring for May De Ville Crown Hotel
(Source: Self-constructed based on Interview and Geomarketing Data Analysis)

Spatial Dimension	Strategic Input (Conceived Space)	User Experience (Lived Space)	Convergence Value	Geo-Spatial Interpretation
Social Geography (Empathy)	5 (High-touch core)	5 (Excellent)	0 (Perfect Alignment)	The "Human Agency" strategy is fully realized. Specific staff (Rosie, Nina, and Nikki) act as key territorial agents who define the place.
Social Spatiality (Sociability)	4 (Strategic focus)	5 (Delighter)	+1 (Positive)	The Rooftop Bar & Pool functions as a "Territorial Node," generating place attachment that exceeds the boutique scale.
Smart Interface (Smart Service)	3 (Backend efficiency)	4 (High Efficiency)	+1 (Positive)	The Invisible Logistics" (booking software) optimizes the spatial flow, creating speed without interface friction.
Built Environment (Tangibles)	4 (Maintenance)	4 (Good)	0 (Alignment)	The quality of the micro-geography (e.g., "comfy beds") aligns perfectly with the boutique morphology.
Ecological Integration (Green Practices)	3 (SOP compliance)	3 (Neutral)	0 (Neutral)	Validated as an Environmental Prerequisite: present as a baseline norm but not a primary spatial attractor.

The radar configuration elucidates three types of territorial divergence. First, pronounced "Negative Spatial Friction" characterizes Smart Interface and Physical Infrastructure, signaling a malfunction where aggressive inputs fail to translate into habitable quality due to execution lags. In contrast, a "Positive Spatial Surplus" emerges in Social Spatiality, where auxiliary social zones unexpectedly outperform the core-built environment, highlighting the organic vitality of the territory. Intermediate is the "Environmental Baseline" (Ecological Integration), functioning as a prerequisite for legitimacy, rather than a spatial attractor. Conversely, the May De Ville Crown exhibits morphological convergence, detailed in Table 5 and visualized in Figure 3 as a convergence bar chart in which all spatial dimensions register a gap value approaching zero - a stark visual contrast to the multi-directional divergence observed in the Mövenpick radar. This "flat alignment" is not a sign of managerial underinvestment but rather of strategic parsimony: by concentrating resources on the dimensions most valued by guests (Social Geography and Sociability) and deploying technology invisibly (Smart Interface), the hotel achieves a state of territorial coherence where conceived space and lived space are effectively co-extensive. The hotel achieves perfect alignment in Social Geography (Convergence Value = 0), with staff names (Rosie, Nina, and Nikki) permeating >80% of the data, confirming human capital as the primary territorial agent. A "Positive Spatial Surplus" in Smart Interface (+1) is driven by "Invisible Infrastructure," where backend logistics create spatial fluidity without interface friction. Concurrently, Social Spatiality exhibits a "Spatial Halo Effect" (+1), where the rooftop bar acts as a "Territorial Node," mitigating dissatisfaction with physical constraints through strong atmospheric vibes.

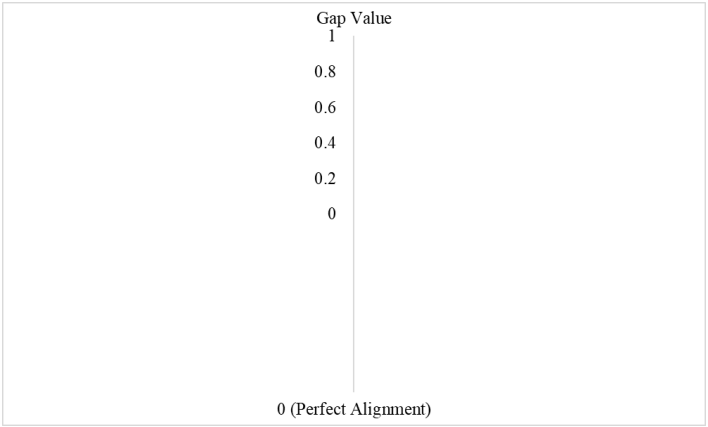


Figure 3. The Radar Chart of Territorial Coherence (May De Ville Case) (Source: Authors, 2026)

Mapping the cognitive landscape: A semantic topology of place attachment

Using VOSviewer, this study maps the "Cognitive Topology" of the guest experience, revealing hidden associations beyond linear frequency counts.

The "Anthropogenic" Territorial Cohesion (May De Ville Crown): Network topology (Figure 4) reveals a dense, cohesive structure (125 items, 28,951 link strength) organized around a gravitational center. Structurally, the brand node ("de ville crown hotel") occupies the largest and most central position in the network, functioning as the primary territorial anchor. This finding confirms brand-place fusion, wherein the hotel's identity and the guest's sense of place have become inseparable in the cognitive landscape. Radiating outward from this anchor, three interconnected clusters define the network architecture:

The Anthropogenic Core: The nodes "team," "guest," and "experience" form a tightly linked blue cluster at the network's operational center, underscoring that human interaction dominates the physical space in the guest's mental map. The node "opportunity" occupies a bridging position between the anthropogenic core and the brand anchor, suggesting that guests perceive the hotel not merely as a place of consumption but as a space of possibility - a finding consistent with

hedonic value co-creation theory (Alhomaid et al., 2025). The Loyalty-Intimacy Cluster: The nodes "patronage," "whole team," and "trip" form a peripheral western cluster, strongly linked to the brand node through high-strength co-occurrence. The presence of "patronage" - denoting repeated, loyal visitation - alongside "family" and "highly" in the brand's immediate semantic neighborhood empirically validates the transformation from abstract space to meaningful "place" (Tuan, 1977), where the hotel becomes a "Domestic Sphere." The eastern periphery is anchored by "praise" and "next trip" (orange cluster), representing the behavioral outcome of place attachment: the intention to return and recommend.

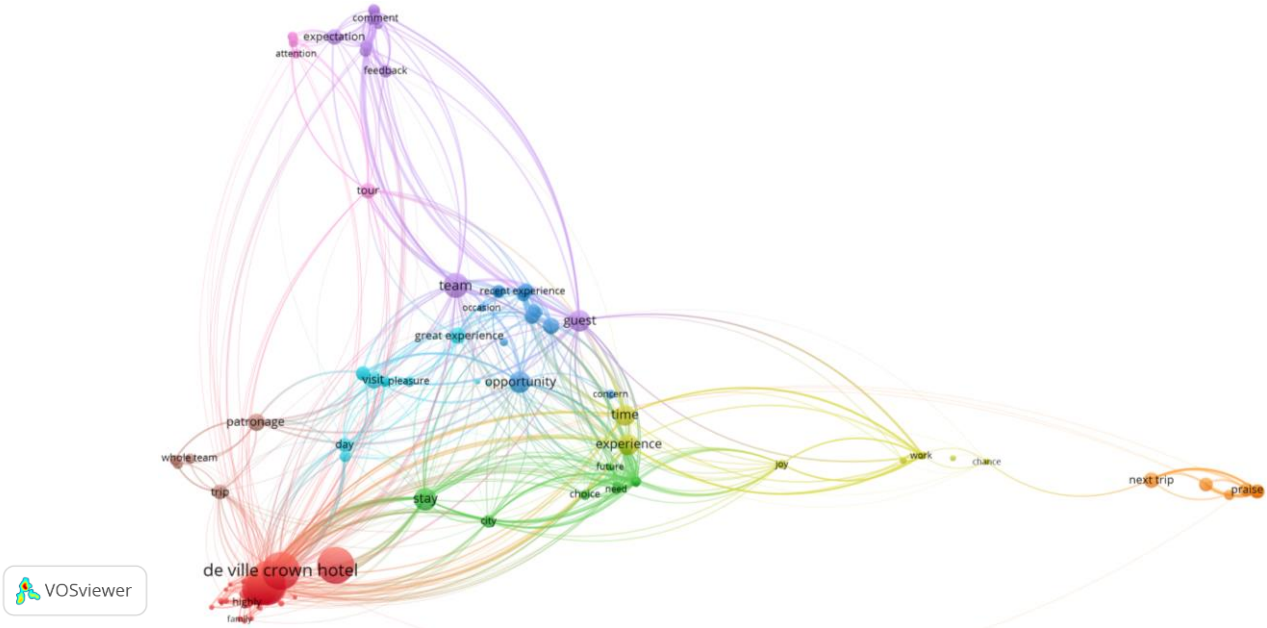


Figure 4. Comparative Spatial Topology of Guest Experience - (a) May De Ville Crown Hotel - The "Anthropogenic" Territorial Cohesion (Source: Author's elaboration using VOSviewer geomarketing analysis based on TripAdvisor data mining, 2026)
(Based on VOSviewer analysis: Binary counting, Threshold = 10 occurrences)

The Voice of Customer Cluster: A distinct purple cluster in the upper network - comprising "expectation," "feedback," "comment," and "attention" - reveals a meta-communicative dimension absent from the Mövenpick network. May De Ville guests do not merely experience the hotel; they actively reflect on and articulate their experiences, suggesting a higher level of cognitive engagement and emotional investment. This cluster functions as a "Reflexive Geography" - a space where the guest becomes a co-author of the hotel's territorial narrative.

Invisible Infrastructure: Critically, a "structural hole" exists in the technological keywords. The complete absence of backend system terms from the cognitive map supports the "Spatial Interface Paradox": technology functions successfully as an invisible infrastructure, creating spatial fluidity without demanding conscious engagement, thereby allowing the human team to occupy the entire foreground of the guest's mental territory.

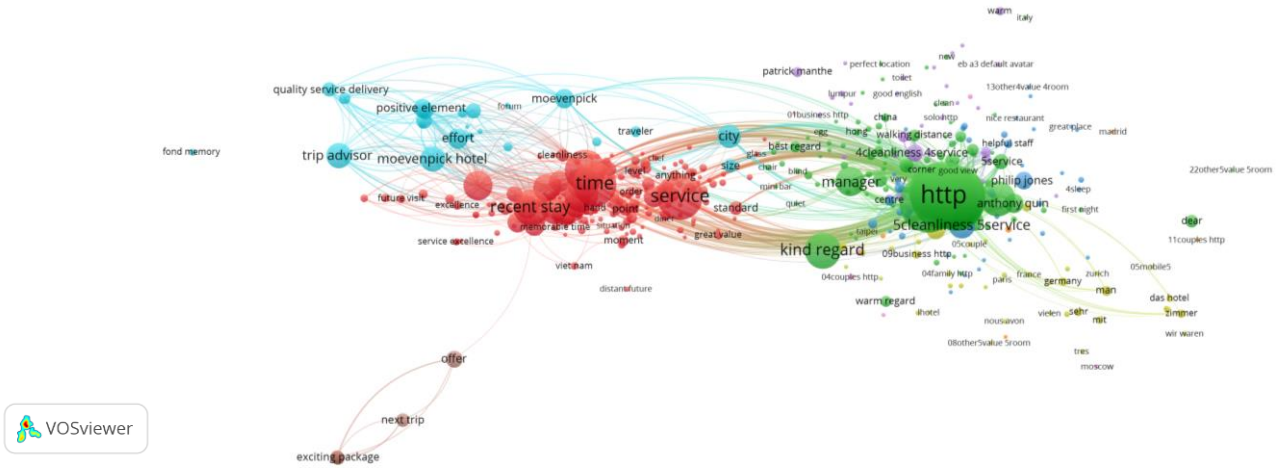


Figure 5. Comparative Spatial Topology of Guest Experience - (b) Mövenpick Hotel Hanoi Centre - The "Systemic" Territorial Fragmentation (Source: Author's elaboration using VOSviewer geomarketing analysis based on TripAdvisor data mining, 2026)
(Based on VOSviewer analysis: Binary counting, Threshold = 10 occurrences)

The "Systemic" Territorial Fragmentation (Mövenpick): In contrast, the Mövenpick network (Figure 5) reveals a sprawling, fragmented topology (484 items) that is structurally "Centrifugal" - pushing guest perception outward into

systemic noise rather than inward toward a social core. Four structural features characterize this fragmentation. Temporal-Operational Dominance: The largest nodes in the network are "recent stay" and "time" (Red Cluster), not experiential or emotional descriptors. This temporal fixation reveals that guests evaluate Mövenpick primarily through the lens of transactional efficiency - how long things take and how recently they occurred - rather than through the lens of place attachment. The co-dominance of "service" within this cluster confirms that the hotel is perceived as a service delivery system rather than a meaningful place, a finding consistent with Augé's (1995) conceptualization of the "Non-Place" as a space defined by transit and transaction. Digital Territorial Encroachment: The network is dominated by the oversized "http" node (Green Cluster), which in digital geography represents "Virtual Encroachment" - the invasion of administrative space into lived space. The structural proximity of "http" to "manager" and "kind regard" is particularly revealing: "kind regard" is a formulaic email closing, indicating that a significant proportion of the UGC corpus consists of management response templates rather than authentic guest narratives. This "Algorithmic Governance" - where managerial voice colonizes the review space - creates a "Technological Wall" that further distances the hotel from genuine human connection, rendering the territory a "Non-Place" (Augé, 1995). Spatial Fragmentation and Material Degradation: The network lacks a unified emotional core and is divided into functional silos. Peripheral nodes - "toilet," "blind," "glass" - indicate that guest attention is fixed on material degradation, amplifying "Negative Disconfirmation." The presence of "moevenpick hotel" and "trip advisor" as co-occurring nodes within the Cyan Cluster reveals a meta-cognitive awareness: guests are conscious of the review platform as a mediating layer between their experience and its public representation, suggesting a more transactional, less immersive relationship with the hotel environment.

The Geography of "Placelessness": Multilingual nodes ("vielen," "sehr," "wir waren," "das hotel," "nousavon") reflect the hotel's global standardization strategy but topologically create a diffuse network lacking community identity (Relph 1976). Notably, the node "fond memory" appears in the far western periphery - isolated from the network's core - suggesting that while positive emotional experiences do occur at Mövenpick, they fail to achieve the semantic density and centrality necessary to define the hotel's territorial identity. This peripheral positioning of positive affect, in contrast to the central positioning of transactional and technological nodes, encapsulates the hotel's fundamental spatial challenge: emotional value is produced at the margins, while operational complexity dominates the center.

The boutique network is thus "Centripetal," pulling guests into a social core anchored by human agency, whereas the international chain is "Centrifugal," pushing perception outward into systemic noise. This confirms that without "Sociability" as the architectural principle of the service territory, service volume alone fails to construct a coherent territorial narrative, and that the consequences of this failure are legible in the very topology of the guest's cognitive map.

DISCUSSION AND IMPLICATIONS

Decoding the territorial fractures: spatial and digital dissonance

Cross-verification of dyadic data - managerial interviews and VOSviewer semantic topologies - reveals a critical asymmetry: strategic inputs do not translate linearly into territorial recognition but are mediated by three distinct "Spatial Fractures," each corresponding to a specific failure mode in the human-environment relationship.

The "Virtual Encroachment" on lived space

The study identifies a "Visibility Paradox": perceived technological efficacy is inversely proportional to technological visibility. This finding directly advances and complicates the theoretical position of Zhou et al. (2025), who demonstrated that digital orientation and capabilities are necessary and sufficient conditions for service innovation from a supply side perspective. The demand-side evidence in the present study reveals the critical boundary condition that Zhou et al.'s framework cannot detect: *the same level of digital capability generates diametrically opposite spatial outcomes depending on whether the technology is visible or invisible to the guest.* Mövenpick's ACDC system - representing precisely the "high digital orientation + high digital capability" configuration that Zhou et al. (2025) theorize as optimal - fails to generate corresponding customer recognition in the UGC data, while May De Ville's comparatively modest automated booking software generates a "Positive Spatial Surplus" (+1) precisely because it operates as a silent infrastructure.

The geomarketing analysis (Figure 5) exposes a "Systemic Intrusion" in the 5-star segment of the market. The oversized "http" node acts as a trace marker of infrastructural visibility, creating a "Technological Wall" that fragments the guest's lived space. Critically, the structural proximity of "http" to "manager" and "kind regard" in the Mövenpick network reveals a dimension not previously theorized in the literature: "Algorithmic Governance." The node "kind regard" - a formulaic email closing - indicates that a significant proportion of the UGC corpus consists of management response templates rather than authentic guest narratives. This managerial voice colonizes the review space, creating a meta-layer of administrative language that further distances hotels from genuine human connections. This finding extends Augé's (1995) concept of the "Non-Place" beyond its original architectural application into the digital domain: the Mövenpick review space is itself a "Non-Place," a transactional corridor of standardized responses rather than a community of authentic voices. A nuanced counterpoint, however, must be acknowledged: the node "fond memory" appears on the far western periphery of the Mövenpick network - isolated from the core but present. This peripheral positioning of positive affect is not analytically trivial or unimportant. This suggests that genuine emotional experiences do occur at Mövenpick, but they fail to achieve the semantic density and centrality necessary to define the hotel's territorial identity. This finding resonates with Kandampully et al. (2023) argument that technology and human elements are "deeply entangled" in the luxury servicescape; the entanglement at Mövenpick is not absent but asymmetric, with operational complexity dominating the center while emotional value is produced at the margins. The strategic implication is significant: Mövenpick does not need to abandon its technological infrastructure but rather to rebalance

the entanglement, pushing technology toward the periphery and elevating emotional experiences toward the center. Conversely, the "Anthropogenic Topology" of the 4-star segment (Figure 4) is characterized by a "structural hole" in technology. The absence of technical nodes, juxtaposed with the centrality of human agents, confirms that technology generates maximal value only when it functions as an "Invisible Infrastructure." This finding validates Yang & Leung's (2025) complexity-resistance thesis at the micro-spatial level: by eliminating interface complexity, May De Ville eliminates the primary trigger of technology anxiety, liberating human agency to cultivate the "Social Territory." The digital interface must recede to allow human geography to dominate - a principle that the present study terms the "Background-Foreground Inversion" of the optimal human-environment-technology triad.

Morphological inertia and spatial dissonance

This research illuminates "Morphological Inertia" - a concept that operationalizes Lefebvre's (1991) spatial contradiction between conceived space (the planned, strategic space of managers) and lived space (the experiential, symbolic space of guests) at the property level. While Mövenpick's management envisioned "Modern Luxury" as the hotel's conceived space, semantic clusters of "Old," "Dated," and "Dark" in the UGC data confirm that the physical landscape acts as a drag on the brand's narrative, producing a lived space that contradicts the managerial representation. This exemplifies "Territorial Malfunction": corporate narratives inflate expectations that the material territory cannot fulfill, generating the "Negative Disconfirmation" that Tiwari & Omar (2025) theorize as the primary mechanism of loyalty erosion. The temporal dimension of this inertia is significant in this study. Ruiz-Fernández et al. (2026) demonstrate that chain-affiliated properties suffer from structural lag between strategic intent and operational adaptation; the present study provides granular spatial evidence of where this lag manifests: not in public zones (which have been modernized) but in the private sphere of the guest room, where dated interfaces (light switches, AC controls) create "spatial friction" at the most intimate level of the hotel experience.

This spatial specificity - the divergence between the public face and the private reality of the hotel - is a finding that neither Ruiz-Fernández et al. (2026) nor Suess et al. (2024) could detect through their respective methodologies, and it constitutes a distinctive empirical contribution of the present study's UGC-based spatial analysis. In contrast, the boutique model achieves "Morphological Convergence" because its spatial adjustments - rooftop expansion, pool installation, micro-spatial optimization within the Old Quarter's constrained footprint - are agile, immediately perceptible, and morphologically consistent with the boutique promise. The convergence bar chart (Figure 3) visualizes this alignment: all spatial dimensions register a Gap Value approaching zero, a stark visual contrast to the multi-directional divergence of the Mövenpick radar. This "flat alignment" is not a sign of managerial underinvestment but of strategic parsimony - the disciplined concentration of resources on dimensions most valued by guests, a principle that resonates with Alhomaid and Bel Hadj's (2025) finding that hedonic value pathways generate stronger place attachment than utilitarian ones.

Ecological integration: The human-environment contract

The valuation of green practices has undergone a fundamental ontological shift: from a "value-add" differentiator to a "Territorial Prerequisite." Despite managerial pride in sustainable SOPs - both Mövenpick and May De Ville have adopted eco-friendly materials as convergent baseline practices - the "zone of indifference" in sentiment analysis (positive mentions < 0.5%) confirms that Green Practices have evolved into an Environmental Norm. This finding corroborates and extends Khuong et al. (2025) discovery that specific green practices (water- and energy-saving) do not directly influence satisfaction or positive mood, and Perez-Aranda et al.'s (2025) observation that sustainability practices elicit more ambivalent consumer responses than health-safety practices. The present study advances this literature by providing a mechanism for this ambivalence: green practices are noticed only when they fail (negative disconfirmation from paper straw failure) but are invisible when they succeed (baseline compliance). This asymmetric visibility pattern - what the present study terms the "Ecological Invisibility Principle" - has direct implications for resource allocation: investment in green practices beyond the baseline threshold generates diminishing perceptual returns, while failure to meet the baseline generates disproportionate reputational damage. In the contemporary tourism landscape, ecological responsibility is a baseline for institutional legitimacy; its presence secures "Assurance," but its functional failure disrupts the guest's comfort within the service ecosystem - a pattern structurally identical to the health-safety baseline that Tiwari & Omar (2025) identify in the post-COVID hotel context.

Validation of the geo-spatial service framework

Based on empirical pattern matching and network topology, this study affirms the validity of the proposed 8-component Service Quality model. The three newly integrated dimensions - Smart Service, Green Practices, and Sociability - demonstrate not only theoretical distinctiveness but also empirical non-substitutability: no combination of the original five LODGSERV dimensions can capture the spatial dynamics that these three dimensions reveal.

Smart Interface: The Digital Geography Dimension

The data definitively separate "Machine Efficacy" from "Human Willingness," confirming Smart Service as an independent spatial construct for measuring the quality of the digital environment, distinct from and non-reducible to the Tangibles dimension of LODGSERV. Semantic separation in the 5-star network (the "http" cluster operating as a distinct functional silo, disconnected from the social and emotional clusters) provides topological evidence that guests cognitively segregate technological experiences from human experiences, processing them through different evaluative frameworks.

This finding has important implications for the development of the scale. Ahmad et al.'s (Alhomaid et al., 2025) treatment of "AI-enabled experience" as a monolithic construct would conflate the ACDC system (which generates spatial friction) and the automated booking software (which generates spatial fluidity) into a single undifferentiated score, masking the divergence that drives competitive differentiation. The present study's operationalization of Smart Service through the visibility dimension - rather than the quantity or sophistication of technology deployed - provides a more discriminating

and managerially actionable construct. Furthermore, the "Centripetal vs. Centrifugal" topology contrast provides a novel network-level indicator of Smart Service quality: a centripetal network, in which human nodes dominate the center and technological nodes are absent from the cognitive landscape, signals successful Smart Service delivery; a centrifugal network, in which technological nodes fragment the center, signals Smart Service failure. This topological indicator complements and extends the node-level analysis of Yang & Leung (2025), offering a structural measure of smart service quality that individual keyword frequency counts cannot provide.

Ecological Integration: Ethical Landscape

Refuting the notion of sustainability as peripheral CSR, the findings validate Green Practices as a core quality constituent representing the ethical dimension of the service territory. The convergent adoption of eco-friendly materials by both hotels - despite their divergent strategies in every other dimension - confirms that ecological responsibility has achieved the status of a non-negotiable institutional norm, consistent with Bordian et al.'s (2026) finding that Sustainability-Oriented Service Innovation positively influences satisfaction through value co-creation.

However, the empirical evidence of the present study introduces a critical qualification to Bordian et al.'s (2026) optimistic assessment: the positive effect of the SOSI on satisfaction is contingent on execution consistency. The paper straw failure at Mövenpick, where an eco-friendly substitution disrupts the guest's sensory experience, demonstrates that poorly executed green practices can generate negative disconfirmation that outweighs the positive legitimacy signal of ecological commitment. This "Execution Consistency Condition" is a boundary condition that Bordian et al.'s (2026) cross-sectional PLS-SEM design cannot detect, and it constitutes a theoretical refinement of the SOSI construct.

As tourists become more environmentally conscious, the ability to harmonize luxury with ecological responsibility directly impacts "Territorial Assurance" - the guest's confidence that the hotel's values align with their own. This alignment between personal and institutional values is the mechanism through which Green Practices contribute to place attachment, operating not through direct sensory pleasure (hedonic value) but through moral congruence (ethical value) - a distinction that the present study's 8-component model captures and the original LODGSERV framework cannot.

Sociability: The Apex of Place Attachment

Perhaps the most significant theoretical contribution of this study is the validation of Sociability as the architectural principle of the luxury hotel experience - not merely one dimension among many, but the organizing force that determines whether a hotel's service territory coheres into a meaningful "place" or dissolves into a standardized "non-place."

The May De Ville VOSviewer network (Figure 4) provides multilayered empirical evidence for this claim. At the network's center, the brand node ("de ville crown hotel") achieves the highest semantic density, confirming brand-place fusion: the hotel's identity and the guest's sense of place have become inseparable in the cognitive landscape. Radiating outward, the "Loyalty-Intimacy" cluster - where the hotel name is strongly linked to "family," "patronage," and "highly" - empirically validates Tuan's (1977) space-to-place transformation, where the hotel becomes a "Domestic Sphere" rather than a commercial transaction space. The eastern periphery, anchored by "praise" and "next trip," represents the behavioral outcome of this place attachment: the intention to return and to recommend - the ultimate measure of loyalty in the Social Exchange Theory framework (Tiwari & Omar, 2025). A finding not previously theorized in the literature is the "Voice of Customer" cluster - the purple nodes "expectation," "feedback," "comment," and "attention" in the upper network.

This cluster reveals a meta-communicative dimension of sociability: May De Ville guests do not merely experience the hotel; they actively reflect on and articulate their experiences, functioning as co-authors of the hotel's territorial narrative. This "Reflexive Geography" - absent from the Mövenpick network - suggests that high-sociability environments generate not only emotional attachment but also cognitive engagement, transforming passive consumers into active territorial agents.

This finding resonates with S-D Logic's (Vargo & Lusch, 2008) conceptualization of value co-creation, extending it from the service encounter to the post-encounter review space. Whether through structured rituals (e.g., "Chocolate Hour" at Mövenpick) or organic atmospheres ("Rooftop Bar" at May De Ville), sociability functions as a Spatial-Social Outcome that transcends the functional quality dimensions of LODGSERV. The boutique network's centripetal topology - pulling guests into a social core - versus the international chain's centrifugal topology - pushing perception outward into systemic noise - confirms that successful hotels in dense urban landscapes such as Hanoi must function as "Territorial Nodes" facilitating human connections, rather than as mere shelter providers or technology showcases.

Implications for Territorial Planning and Management

The findings advocate a paradigm shift from product-centric operations to a holistic "Placemaking Strategy" - one that conceptualizes the hotel not as a bundle of service attributes but as a produced territory whose quality is determined by the alignment between conceived and lived space (Lefebvre, 1991). Resolve the Visibility Paradox through "Strategic Concealment." Rather than indiscriminate digitization - which risks creating sterile "non-places" (Augé, 1995) by imposing technological complexity on the guest's private sphere - capital allocation should prioritize backend logistical systems as "Invisible Enablers." This strategic concealment liberates anthropogenic agency, allowing human actors to reclaim their roles as the primary architects of guest experiences. For international chain hotels, the implication is counterintuitive: the path to higher perceived Smart Service quality may require reducing the visibility of technological investment rather than increasing it. The value of the ACDC system should be communicated to guests through its effects (personalized service delivery, anticipatory hospitality) rather than through its interfaces (complex in-room control panels, app-dependent functions). Cultivating Social Geographies as Primary Competitive Assets.

The re-conceptualization of the physical environment as a dynamic "Social Geography" is critical. The "Voice of Customer" cluster in the May De Ville network confirms that high-sociability environments generate not only emotional

attachment but also organic advocacy - guests become co-producers of the hotel's territorial narrative through their reviews, amplifying the sociability signal through the digital public sphere.

For boutique hotels, this implies institutionalizing the "familial culture" that drives staff-name mentions in >80% of reviews, through targeted recruitment, empowerment-based HR practices, and the deliberate cultivation of "Territorial Agents" - staff members who function as the human anchors of the hotel's place identity.

For international chains, the implication is to "soften" rigid service protocols by creating unscripted interaction zones - spaces and moments where staff are empowered to deviate from standardized scripts and engage guests as individuals rather than as data points in a CRM system. Standardizing Environmental Contracts through Execution Consistency.

Ecological practices must be elevated to non-negotiable "Hygiene Factors" with zero tolerance for execution failure. The "Ecological Invisibility Principle" - whereby successful green practices are invisible but failed ones generate disproportionate negative sentiment - implies that the primary risk management challenge is not adoption (both hotels have adopted eco-friendly materials) but consistency. A single paper straw failure can negate months of ecological investment by triggering the collapse of the “zone of indifference” into active negative sentiment.

Therefore, hotels should implement ecological quality control protocols that treat green practice execution with the same rigor as food safety standards - not as a marketing initiative but as an operational non-negotiable.

Limitations and Directions for Future Research

As with all empirical work, the findings of the present study must be interpreted within the context of its methodological boundaries. This study has three limitations warrant explicit acknowledgment.

First, the dual-case design, while methodologically appropriate for exploratory theory building (Yin, 2018), limits the statistical generalizability of the findings. The "Visibility Paradox," "Morphological Inertia," and "Sociability Primacy" propositions are theoretically grounded and empirically illustrated, but their prevalence and magnitude across the broader Vietnamese hospitality landscape and across different cultural contexts remain to be established through large-scale quantitative research. Future studies should test these propositions through multi-property surveys incorporating the extended 8-component model as a validated measurement scale. Second, the UGC-based methodology, while providing organic, unprompted demand-side evidence that corrects for the social desirability bias of survey research, introduces its own selection bias: TripAdvisor reviewers are not representative of all hotel guests, and the platform's review incentive structure may systematically over-represent extreme experiences (very positive or very negative) at the expense of moderate ones. The "zone of indifference" toward green practices, for instance, may partly reflect the platform's emotional amplification effect rather than the true distribution of guest sentiments.

Future research should triangulate UGC data with in-stay experience sampling methods to capture the full spectrum of guest sentiments. Third, the temporal scope of the data collection - a single cross-sectional snapshot of TripAdvisor reviews - cannot capture the dynamic evolution of territorial quality over time.

The "Morphological Inertia" observed at Mövenpick, for instance, may be a transitional phenomenon associated with an ongoing rebranding process rather than a structural characteristic of international hotel chains. Longitudinal UGC analysis - tracking the evolution of semantic network topology across multiple time periods - would provide a more nuanced understanding of how territorial quality responds to strategic interventions and would constitute a significant methodological contribution to the emerging field of Digital Geography in hospitality research.

CONCLUSION

This study aimed to examine the structural divergence between hotel managers' innovation strategies and guests' perceptual reception of those strategies in upper upscale hotels and to identify the spatial and psychological mechanisms through which this divergence is produced, sustained, or resolved. Grounded in the theoretical integration of service-dominant logic, Signaling Theory, and Humanistic Geography, the findings yield three contributions that advance the intersection of tourism geography and hospitality management. First, this study confirms the measurement obsolescence of traditional functionalist frameworks in the Industry 4.0 hospitality context. The empirical validation of smart services, green practices, and sociability as psychometrically distinct and non-substitutable dimensions demonstrates that the contemporary guest experience constitutes a complex spatial construct - shaped by the triadic dynamics among the guest, technology, and physical environment - rather than a linear function of material asset deployment.

Second, the Visibility Paradox (P1) establishes that digital technology functions optimally as an "invisible infrastructure." When technological interfaces intrude upon physical touchpoints, they amplify the Perceptual Gap between conceived and lived spaces, generating spatial friction rather than the convenience signal intended by management.

Third, Sociability Primacy (P2) and Environmental Prerequisite (P3) together establish that the capacity to transform physical spaces into territorial nodes fostering organic social communities constitutes the paramount differentiator of place attachment, overriding both technological investment and operational scale. Green Practices operate as a hygiene factor whose absence penalizes but whose presence alone does not elevate perceived territorial quality.

This study had some limitations. The dual-case design constrains statistical generalizability beyond Hanoi’s specific urban morphologies. Although the UGC-based methodology corrects for social desirability bias, it introduces platform-specific selection effects. Finally, the cross-sectional temporal scope cannot capture the dynamic evolution of territorial qualities over time. Future research should operationalize the proposed 8-dimension model through large-scale Structural Equation Modeling to test causal relationships between spatial quality dimensions and loyalty metrics and extend the framework to morphologically diverse destinations to assess the cross-contextual transferability of the three propositions advanced here.

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Institutional Review Board Statement: Ethical review and approval were waived for this study due to the minimal risk nature of the research. The primary data collection involved in-depth interviews with industry professionals discussing non-sensitive, managerial topics, and informed consent was obtained prior to participation. The secondary data consisted of publicly available User-Generated Content (UGC) from TripAdvisor, which was collected and analyzed in aggregate, ensuring no individual privacy rights were compromised.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. The interviewees explicitly agreed to participate and consented to the publication of their names, titles, and affiliated institutions in this research.

Data Availability Statement: The data presented in this study may be obtained on request from the corresponding author.

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Conflicts of Interest: The authors declare no conflict of interest.

Use of Generative AI: During the preparation of this manuscript, the authors utilized generative artificial intelligence tools, specifically Gemini, ChatGPT, and Claude. These tools were employed for three primary purposes: (1) to translate the original manuscript from Vietnamese to English; (2) to perform comprehensive language editing and stylistic refinement to enhance the academic quality of the text; and (3) to generate the map visualizations presented in the study. Following the use of these tools, the authors thoroughly reviewed, edited, and validated all outputs. The authors remain fully responsible for the accuracy, integrity, and originality of all content, data interpretation, and conclusions presented in this manuscript.

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THE IMPACT OF ECO-TOURISM BUSINESS TRANSFORMATION ON THE EFFECTIVENESS OF THAILAND'S FUTURE GREEN ECONOMY POLICY FORMULATION

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Abstract: This research aims to analyze the influence of changes in eco-tourism on the transformation of green economic policy. The analysis adopts a holistic and systematic approach. A mixed-methods research design was employed to ensure the completeness and appropriateness of the findings, with the objective of applying the results to formulate effective strategies for managing Thailand's tourism industry to achieve maximum efficiency in the future. The research findings indicate that the PAr-ARIMAX(1,1,1) model is the most appropriate model, demonstrating strong validity, the absence of spurious relationships, and comprehensive goodness-of-fit measures. This confirms its suitability for use in policy formulation and planning for Thailand, particularly in setting strategic directions for sustainable and continuous growth in the tourism industry. The results further reveal that eco-tourism entrepreneurship has the strongest direct effect on the environmental sector, accounting for 65% at a 1% significance level. This implies that a 1% change in eco-tourism entrepreneurship leads to a 65% change in the environmental sector in the same direction. At the same time, eco-tourism entrepreneurship exerts the greatest influence on changes in the green economy when compared with all other sectors. Moreover, changes in the social sector, especially community participation and cultural transformation, have a substantial impact on eco-tourism entrepreneurship, with an influence of up to 60%. Therefore, the government should consider the combined effects of changes in eco-tourism entrepreneurship and social dynamics, as their integration can maximize positive transformations in the green economy and contribute meaningfully to Thailand's sustainable national development in the future.

Keywords: eco-tourism, eco-entrepreneurship, green economy policy, social sector, community participation, social culture

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INTRODUCTION

Thailand has established a national strategic framework for long-term national development following its membership in the United Nations, particularly in relation to environmental governance (The World Bank: Energy Use (Kg of Oil Equivalent Per Capita) Home Page, 2025). Evidence indicates that from 1992 to the present (2025), Thailand has achieved continuous national development, especially in terms of economic and social growth (National Statistical Office Ministry of Information and Communication Technology, 2025). Urban expansion has increased significantly across regions, with urbanized areas expanding by approximately 65 percent (ONEP, 2025). This trend reflects Thailand's ongoing transition toward becoming a developed country (Office of Natural Resources and Environmental Policy and Planning (DEDE), 2025).

If Thailand is able to fully attain developed-country status, it would generate substantial positive impacts and enable accelerated development across all dimensions in the future (Thailand Greenhouse Gas Management Organization (Public Organization), 2025). For this reason, the government has played a crucial role in economic development by formulating long-term policies, such as modern industrial development plans, promoting both domestic and foreign investment, expanding and upgrading infrastructure to ensure nationwide coverage, and significantly advancing tourism development in all dimensions, particularly eco-tourism (Office of the National Economic and Social Development Council (NESDB), 2025). The government has also actively encouraged continuous growth among entrepreneurs across sectors (Hasanein & Ayad, 2025).

Tourism is a key industry within Thailand's economic system and represents a major source of revenue generated from both domestic and international tourists (Ahmed et al., 2025; Salama et al., 2025). It plays a vital role in economic stimulation, job creation, and local development (NESDB, 2025; Muna et al., 2025). Beyond its economic benefits, tourism also has strong potential to support environmental conservation and promote sustainable understanding of local cultures (OECD, 2025). The growth of Thailand's tourism industry in recent years has largely been driven by government policies aimed at promoting sustainable tourism to enhance national competitiveness (Junsiri et al., 2025).

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In recent years, eco-tourism has gained increasing popularity among tourists who prioritize nature-based experiences and adventure travel (Sutthichaimethee et al., 2025). These tourists typically seek close interaction with natural environments and wish to learn about the lifestyles of host communities rather than engaging in conventional forms of tourism (Energy Policy and Planning Office, 2025; Sutthichaimethee et al., 2025).

This trend has encouraged greater participation by local communities in the management and stewardship of tourist destinations, ensuring sustainability and minimizing negative impacts on natural resources. Regarding the role of tourism in Thailand's economy in 2025, the Tourism Authority of Thailand reported that during the first quarter of the year, the country welcomed approximately 9.98 million international tourists, representing a significant increase compared to the previous year (United Nations Framework Convention on Climate Change, UNFCCC, 2014). These visitors generated total revenue of 559,015 million baht, highlighting the critical importance of tourism to economic growth.

In addition to direct tourism revenue, the sector has produced positive spillover effects on local businesses, including restaurants, hotels, and related service industries, as well as supporting local and indigenous industries with unique cultural identities (United Nations Framework Convention on Climate Change, 2016; Sisriany & Furuya, 2024). Tourism, therefore, plays a crucial role in income distribution to remote and rural communities, improving quality of life and supporting local development. It also benefits communities seeking supplementary income through the production of distinctive local goods and services, such as handicrafts and souvenirs. This creates employment opportunities and enhances the well-being of communities actively involved in sustainable tourism development (Ministry of Natural Resources and Environment, 2025; Sutthichaimethee et al., 2024; Winyuchakrit et al., 2021; Sun et al., 2023).

At present, eco-tourism in Thailand has gained widespread popularity due to its emphasis on learning about nature while simultaneously conserving the environment and preserving local culture (NESDB, 2025). Eco-tourism activities in Thailand are diverse and include nature trekking, wildlife observation, coral reef diving, and immersive experiences within local communities (Waiyasusri et al., 2024). These activities not only bring tourists closer to nature but also foster long-term environmental awareness (Piedra-de-la-Cuadra & Ortega, 2024; Rahmawati et al., 2021).

Eco-tourism further creates economic opportunities for local communities by promoting sustainable use of natural resources and strengthening pride in traditional cultural heritage (Rasool et al., 2021). The connection between tourists and communities through environmentally friendly activities encourages sustainable relationships and serves as an important mechanism for conserving natural resources alongside local economic development (DEDE, 2025; Razzaq et al., 203; Salemi et al., 2019). As a tool for sustainable development, eco-tourism provides not only economic value but also serves as a critical mechanism for environmental education and awareness-building among tourists (ONEP, 2025; Sharif et al., 2020; Sharpley, 2020). This development model enables local communities to participate directly in managing tourism resources closely linked to their natural environments. Such participation not only increases income but also reduces resource-use conflicts and promotes environmentally and socially responsible development.

Moreover, eco-tourism enhances national tourism competitiveness and stimulates local economic growth efficiently. Community-based management contributes to equitable income distribution, reduces inequality, and strengthens economic security at the community level, supported by organizations such as the Thailand Ecotourism and Adventure Travel Association. Nevertheless, despite Thailand's demonstrated capacity to expand tourism and achieve effective economic and social growth over the long term, a critical challenge remains: environmental development has not progressed in parallel with economic and social advancement.

National-level data indicate that Thailand's environmental conditions have not significantly improved from the past to the present, despite the existence of major policies promoting eco-tourism.

This suggests that genuine sustainability has not yet been fully achieved. Between 1992 and 2025, overall tourism growth increased by 64.05 percent, while greenhouse gas emissions generated by the tourism sector rose by 59.72 percent. This increase in emissions has occurred at an accelerating rate, directly correlated with tourism growth. Although the government has introduced multiple tourism models across various dimensions, it has yet to conduct in-depth, integrated analyses of how changes in the eco-tourism industry affect the broader national sectoral system. Previous studies have largely examined individual sectors in isolation, lacking a comprehensive, holistic perspective. This research recognizes the necessity and value of such an integrated analysis. Its findings aim to provide concrete guidance for national governance and contribute meaningfully to Thailand's future development, enabling sustainable and genuine growth in the long term.

MATERIALS AND METHODS

A review of both domestic and international literature reveals that no previous study has constructed an analytical model of this nature or conducted a comprehensive, system-wide analysis comparable to the approach adopted in this research. Existing studies have primarily focused on individual dimensions or sectors in isolation, without integrating them into a holistic framework. As a result, such fragmented analyses have been insufficient for accurately formulating future strategic directions, as they fail to capture the true dynamics and interrelationships of transformational influences. This limitation may contribute to policy misalignment or errors, as evidenced by certain policies implemented in the past.

Accordingly, this research develops an integrated analytical model designed to support strategic decision-making and guide Thailand toward sustainable development. The study places particular emphasis on the eco-tourism industry, as it represents a major revenue-generating sector for Thailand and is among the leading contributors to rapidly increasing greenhouse gas emissions. For the quantitative component of the study, secondary data spanning the period from 1992 to 2025 were employed. The researcher developed a novel analytical framework referred to as Path Analysis with Correlation Based on the Autoregressive Moving Average (p) Model ($PAr - ARIMAX(p)$), the details of which are

presented as follows (Bentler & Chou, 1987; Kline, 2015). For the model used in this research, the researcher applied an integrated modeling approach by selecting a high-performance model while ensuring that the analytical results were appropriate. The model was developed based on its key strengths for application and is referred to as Path Analysis with Correlation based on the Autocorrelation Moving Average (p) model ($PAr - ARIMAX(p)$).

Path Analysis (PA) is a method for studying causal relationships among variables and is grounded in regression analysis. It relies on diagrams and structural equations derived primarily from hypotheses, conceptual frameworks, theories, and prior research to analyze and explain the relationships between independent variables and dependent variables, both in terms of magnitude and direction (Holbert & Stephenson, 2002).

These relationships can be explained as both direct and indirect effects. Correlation coefficients among variables are then analyzed using path analysis techniques. The results of path analysis serve as a test of the validity of the structure or model specified by the hypotheses, indicating whether the collected empirical data adequately support the existing theory or hypotheses. The researcher constructed diagrams or models illustrating influences based on theory and hypotheses.

The relationships among variables in the model (T) can be decomposed into the sum of parameters according to path coefficient theory. Specifically, the correlation coefficient between two variables in the model is equal to the sum of the Direct Effect (DE), Indirect Effect (IE), Spurious Relationship (SR), and Joint Effect (JE), as follows (Hayes, 2013):

$$r = DE + IE + SR + JE \quad (1)$$

Equation (1) illustrates the true structure of relationships in the causal factor influence analysis model, which consists of four key components: Direct Effect (DE), Indirect Effect (IE), Spurious Relationship (SR), and Joint Effect (JE). It eliminates the misconception or belief that conducting an analysis using path analysis necessarily results in **S**R and JE being equal to zero. Therefore, the equation used for the analysis can be written as follows (Holbert & Stephenson, 2002).

$$r = DE + IE \quad (2)$$

Equation (2) demonstrates that the previous conceptual understanding is incorrect, because in real analytical situations the analysis must follow the form specified in Equation (1) only. If, after implementation, **S**R and JE are found to be non-zero, this will adversely affect the validity of the model and may lead to substantial forecasting errors. Consequently, this study incorporates causal factors comprehensively, while carefully controlling critical issues arising from the analytical results, namely autocorrelation**,** multicollinearity**,** and heteroscedasticity**.** If any of these problems occur in a model, they can severely distort directional interpretation or lead to significant errors when applying the results for national policy formulation (Baltagi, 2021). Regarding the research procedure using the $PAr - ARIMAX(p)$ model**,** it is essential to consider the properties of the data used in constructing a complete and robust model, ensuring that spurious relationships do not occur. The data must exhibit **s**tationarity. Let Y_t be a stochastic time series variable. For the series to be stationary, it must satisfy the following three properties (Harvey, 1980).

$$\text{Mean :} \quad E(Y_t) = E(Y_{t-k}) = \mu \quad (3)$$

$$\text{Variance :} \quad \text{Var}(Y_t) = E(Y_t - \mu)^2 = E(Y_{t-k} - \mu)^2 = \sigma^2 \quad (4)$$

$$\text{Covariance :} \quad \text{E}[(Y_t - \mu)^2(Y_{t-k} - \mu)^2 = \gamma_k] \quad (5)$$

From Equations (3)–(5), it can be observed that the magnitude or spacing of the covariance remains constant; that is, the distance between two values of Y_t does not depend on time. When all three properties are satisfied, the data are considered stationary. This indicates that the time series has a constant mean or expected value, constant variance, and constant covariance over time. These properties do not depend on time itself but rather on the distance or lag between time periods (Baltagi, 2021). Transforming non-stationary data into stationary or weakly stationary data involves adjusting only the first and second moments. However, in the case of strict stationarity, consideration is not limited to the first and second moments; higher-order moments must also be examined. The consideration of moments involves two key principles. First, a stationary variable fluctuates within a narrow range around its mean, whereas a non-stationary variable exhibits increasing variability as the number of observations grows. Second, when an external shock occurs in the economic system, stationary data deviate from the mean only temporarily and return to equilibrium relatively quickly. In contrast, non-stationary data produce the opposite effect, influencing the model itself or affecting other variables within the model across different time periods. This indicates that non-stationary variables do not possess a long-run mean level, which can be represented by three populations as follows (Harvey, 1980).

$$Y_t = \delta Y_{t-1} + \varepsilon_t \quad (6)$$

$$\Delta Y_t = \alpha_1 + \delta Y_{t-1} + \varepsilon_t \quad (7)$$

$$\Delta Y_t = \alpha_1 + \alpha_2 T + \delta Y_{t-1} + \varepsilon_t \quad (8)$$

Equations (6)-(8) define Y_{t-1} as the variable under study in the lag period (t-1), while T represents the time variable. These equations indicate the formulation of the hypotheses: $H_0 : \delta = 0$, non–stationary, and $H_a : \delta < 1$, stationary. The differenced series ΔY_t exhibits non-stationary properties when H_0 is accepted, indicating that $\delta = 0$. In this case, the variance increases in an exponential or explosive manner as time increases. However, applying first differencing to a time series, or higher-order differencing, can transform the series into a stationary process. The procedure for difference-stationary transformation is shown as follows (Hoyle, 1995).

$$\Delta Y_t = \alpha_1 + \alpha_2 T - \delta Y_{t-1} + \varepsilon_t \quad (9)$$

From Equation (9), the relationship among the variables is specified in differential form as time increases at the level form. Rejecting H_a or accepting H_0 implies that the data are non-stationary, with the coefficient $\delta = 0$ being statistically significant. This result indicates that the absolute value of the tau statistic for the estimated coefficient is smaller than the critical value in absolute terms. Under this condition, the error term ε_t does not satisfy the white noise property, implying that the analyzed data exhibit autocorrelation. Therefore, the Augmented Dickey–Fuller (ADF) test must be employed. The ADF test modifies the original equation by including higher-order lagged values of the dependent variable in order to eliminate the autocorrelation problem. In this study, the selected specification is the Autoregressive Model of Order p: AR(p), denoted as AR(p)**,** which can be expressed as follows (Byrne, 2001).

$$Y_t = \alpha + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \ldots + \beta_p Y_{t-p} + \varepsilon_t \quad (10)$$

From Equation (10), Y_{t-p} is defined as the variable under study in the lag period (t-p). Imposing the conditions $\beta_1 + \beta_2 < 1$, $\beta_2 - \beta_1 < 1$, and $|\beta_1| < 1$ indicates that the time series possesses stationarity. The Moving Average Model of Order q, denoted as **MA(q),** can be expressed as follows (MacKinnon, 1991).

$$Y_t = \delta + \varepsilon_t - \gamma_1 \varepsilon_{t-1} - \gamma_2 \varepsilon_{t-2}, \ldots, \gamma_q \varepsilon_{t-1} \quad (11)$$

From Equation (11), the condition $|\gamma_1| < 1$ indicates that the time series is invertible or stationary. Consequently, the Mixed Autoregressive and Moving – Average Model of Order p and q, denoted as ARMA(p, q)**,** can be expressed as follows (Dickey & Fuller, 1981; MacKinnon, 1991).

$$Y_t = \alpha + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \ldots + \beta_p Y_{t-p} + \varepsilon_t - \gamma_1 \varepsilon_{t-1} - \gamma_2 \varepsilon_{t-2} - \ldots - \gamma_q \varepsilon_{t-q} \quad (12)$$

Equation (12) shows the relationship between Y_{t-p}, which is referred to as ARIMA, and ε_{t-q}, which is referred to as the Moving Average.

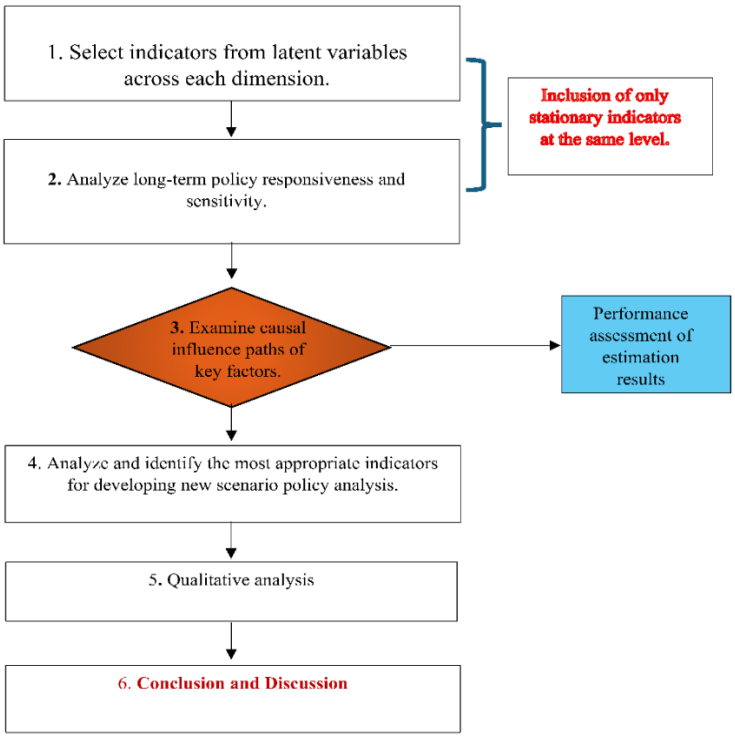


Figure 1. The research procedure based on the materials and methods used in this study

Based on the materials and methods described above, the researcher summarizes the research procedure as shown in Figure 1 into several main steps. First, indicators that possess stationarity properties at the same level are selected. Second, the ability of the variables to adjust toward equilibrium in both the short run and the long run is examined. Third, the appropriateness of the relationships among the latent variables is determined, along with testing the validity of the $PAr - ARIMAX(p)$ model.

RESULTS

In this study, the researcher developed the $PAr - ARIMAX(p)$ model and conducted rigorous validity testing. In addition, potential estimation problems associated with the $PAr - ARIMAX(p)$ model were systematically examined, including heteroskedasticity, multicollinearity, and autocorrelation. The model was also evaluated for its goodness-of-fit properties. Only models that satisfied these diagnostic criteria and demonstrated appropriate statistical performance were deemed suitable for subsequent analysis and interpretation of results. This research adopted a mixed-methods research design. The quantitative component involved constructing and estimating the $PAr - ARIMAX(p)$ model. Upon completion

of the quantitative analysis, the findings were complemented and enriched through qualitative research, incorporating insights from experts and key informants who possess direct responsibility and specialized expertise in Thailand's sustainable national development. Particular emphasis was placed on experts involved in the eco-tourism industry, given its critical role in Thailand's sustainable development framework. The detailed procedures and analytical steps are presented as follows.

Selection of Appropriate Indicators for Constructing the $PAr - ARIMAX(p)$ Model

The analysis involved the systematic selection of indicators to be incorporated into the $PAr - ARIMAX(p)$ model in order to examine the causal influences of eco-tourism–related factors on entrepreneurial performance and the transition of the tourism industry toward the green economy in the future. The model specifies several latent variables, namely the social sector, green economic sector, environmental sector, and eco-tourism entrepreneurship sector. These latent constructs are measured through a total of 15 observed variables, including green urbanization rate (E_1), green industrial structure rate (E_2), green total exports (E_3), expenditure government rate (E_4), green household rate E_5, employment rate (F_1), health and illness (F_2), social security (F_3), education rate (F_4), income distributions rate (F_5), Community Participation (F_6), Eco-tourism (G_1), total energy consumption (H_1), energy intensity (H_2), and Carbon dioxide emission (H_3).

The selected indicators were chosen to comprehensively capture the multidimensional interactions among sectors and to ensure the robustness and interpretability of the $PAr - ARIMAX(p)$ model in analyzing long-term structural changes and policy-relevant dynamics, as per the underlying results in Table 1. As shown in Table 1, all indicators satisfy the required statistical properties and are deemed appropriate for inclusion in the $PAr - ARIMAX(p)$ model.

The analysis indicates that each indicator is stationary at first difference at a statistical significance level of $\alpha = 0.01$. Consequently, all selected indicators are suitable for model construction and can be effectively utilized to analyze the impacts of structural and dynamic changes within the proposed analytical framework. Therefore, the researcher proceeds to incorporate all indicators into the estimation of the $PAr - ARIMAX(p)$ model in subsequent analyses.

Table 1. The results of the diagnostic analysis of the indicators used for constructing the $PAr - ARIMAX(p)$

Tau Test				MacKinnon Critical Value		
Variables	Level I(0) Value	Variables	First Difference I(1) Value	1%	5%	10%
$ln(E_1)$	−3.11	$\Delta\, ln(E_1)$	−4.39***	−4.10	−3.05	−2.50
$ln(E_2)$	−2.50	$\Delta ln(E_2)$	−4.57***	−4.10	−3.05	−2.50
$ln(E_3)$	−2.75	$\Delta ln(E_3)$	−4.68***	−4.10	−3.05	−2.50
$ln(E_4)$	−2.05	$\Delta ln(E_4)$	−5.10***	−4.10	−3.05	−2.50
$ln(E_5)$	−3.25	$\Delta ln(E_5)$	−5.01***	−4.10	−3.05	−2.50
$ln(F_1)$	−2.44	$\Delta ln(F_1)$	−4.95***	−4.10	−3.05	−2.50
$ln(F_2)$	−2.70	$\Delta ln(F_2)$	−5.58***	−4.10	−3.05	−2.50
$ln(F_3)$	−2.89	$\Delta ln(F_3)$	−5.03***	−4.10	−3.05	−2.50
$ln(F_4)$	−2.99	$\Delta ln(F_4)$	−5.11***	−4.10	−3.05	−2.50
$ln(F_5)$	−2.78	$\Delta ln(F_5)$	−5.58***	−4.10	−3.05	−2.50
$ln(F_6)$	−2.05	$\Delta ln(F_6)$	−4.89***	−4.10	−3.05	−2.50
$ln(G_1)$	−3.79	$\Delta ln(G_1)$	−6.02***	−4.10	−3.05	−2.50
$ln(H_1)$	−3.16	$\Delta ln(H_1)$	−4.76***	−4.10	−3.05	−2.50
$ln(H_2)$	−3.54	$\Delta ln(H_2)$	−4.79***	−4.10	−3.05	−2.50
$ln(H_3)$	−3.12	$\Delta ln(H_3)$	−4.25***	−4.10	−3.05	−2.50

Note: *** denotes significance α = 0.01

Table 2. The relational effects derived from the $PAr - ARIMAX(1,1,1)$ model

Dependent Variable	Type of effect	Independent Variable			
		Green economic sector	Environmental sector	Social sector	Ecotourism entrepreneurship sector
Green economic sector	DE	-	-	-	0.59***
	IE	-	-	0.11***	-
Environmental sector	DE	0.12***	-	0.58***	0.65***
	IE	0.10***	-	0.21***	0.19***
Social sector	DE	0.38***	0.35***	-	0.40***
	IE	0.11***	-	-	0.03***
Ecotourism entrepreneurship sector	DE	0.21***	-	0.60***	-
	IE	0.15***	-	-	-

Note: *** denotes significance α = 0.01, DE is direct effect and IE is indirect effect

Analysis of the Influence of Changes in Eco-Tourism Entrepreneurship

The analysis based on the $PAr - ARIMAX(p)$ model indicates that both latent variables and observed variables are interrelated through direct and indirect effects, as presented in Table 2.

The results shown in Table 2 indicate that the most appropriate specification of the $PAr - ARIMAX(p)$ model is $PAr - ARIMAX(1,1,1)$. This model represents the best-fitting and most robust specification, allowing for accurate estimation of the magnitude of relationships through both direct and indirect effects. The findings reveal that eco-tourism entrepreneurship exerts the strongest direct effect on the environmental sector, with an effect size of 65 percent, significant

at the 1 percent level. This result indicates that a 1 percent increase in eco-tourism entrepreneurship leads to a 65 percent change in the environmental sector in the same direction. Furthermore, eco-tourism entrepreneurship demonstrates the highest overall influence on changes in the green economy when compared to all other sectors included in the model.

These findings suggest that government policies and interventions aimed at stimulating change in eco-tourism entrepreneurship will generate corresponding positive transformations in the green economy, thereby promoting long-term sustainable growth. This strategy is more effective than interventions targeting other sectors in isolation. However, if policy actions are to be implemented across multiple sectors, it is essential to consider the intersectoral dynamics and relational influences identified in the model. The analysis further indicates that the social sector, particularly community participation and cultural transformation, has a substantial impact on eco-tourism entrepreneurship, with an influence level of up to 60 percent. This finding underscores the critical role of social factors in driving changes in eco-tourism entrepreneurship and, consequently, in shaping green economic outcomes. Therefore, when changes in eco-tourism entrepreneurship are combined with progressive transformations within the social sector, the resulting impact on the green economy is maximized compared with alternative policy approaches. Figure 2 illustrates the directional pathways and relational structure among the sectors within the $PAr - ARIMAX(1,1,1)$ model. The figure confirms that policy measures designed to stimulate eco-tourism entrepreneurship produce positive and aligned effects on green economic development and support sustainable long-term growth more effectively than interventions in other sectors alone.

Moreover, the figure highlights that change in the social sector, especially enhanced community participation and cultural adaptation, significantly influence eco-tourism entrepreneurship, with an impact magnitude of up to 60 percent. This reinforces the conclusion that social dynamics play a pivotal role in shaping entrepreneurial behavior within eco-tourism and are essential to achieving meaningful transformations in the green economy.

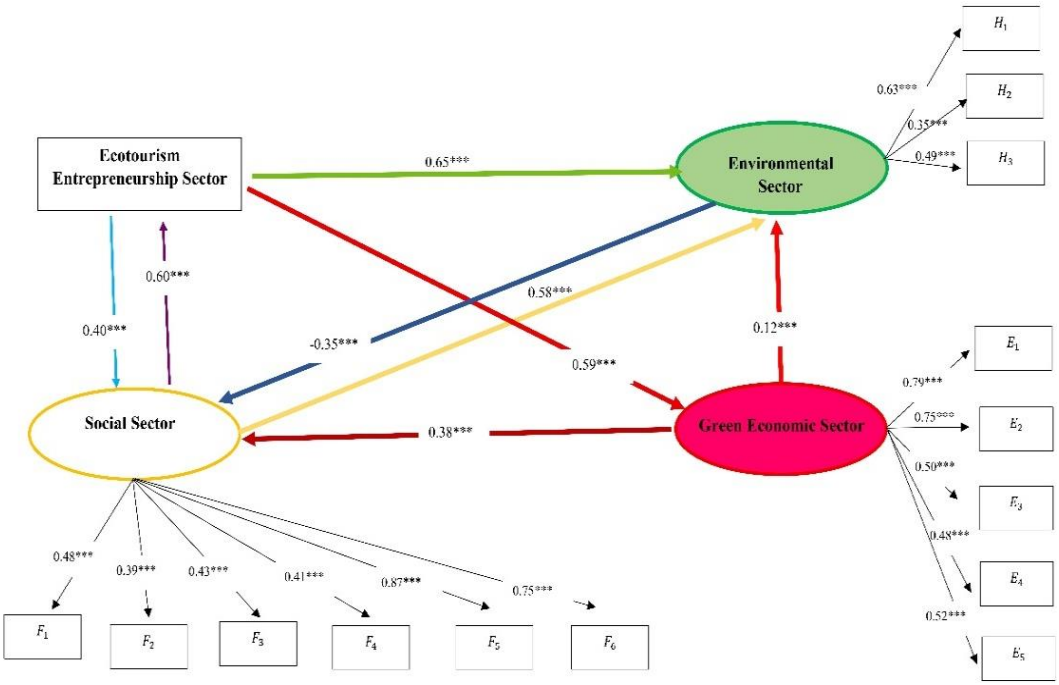


Figure 2. Direction of Intersectoral Relationships in the $PAr - ARIMAX(1,1,1)$ Model

Synthesis of Impacts on Various Sectors from Changes in Ecotourism Businesses and Operational Pathways toward the Green Economy

Based on qualitative research conducted through in-depth interviews with experts directly responsible for advancing Thailand toward the Green Economy goal, the impacts arising from changes in ecotourism were identified as follows.

1. Environmental Impacts: Ecotourism has strong potential to support environmental conservation by encouraging sustainable land use, protecting natural habitats, lowering carbon emissions, and preserving biodiversity. Studies show that it can generate funding for conservation and wildlife protection. However, its environmental outcomes depend heavily on management quality. Poorly managed activities, such as hiking or wildlife viewing, and unsustainable infrastructure development can degrade habitats and disturb ecosystems. In contrast, well-planned ecotourism generally produces lower environmental impacts than conventional tourism, particularly due to reduced carbon emissions from more sustainable transport and accommodation. Overall, the environmental effects of ecotourism are context-specific and influenced by activity types, infrastructure design, and ecosystem sensitivity; maximizing benefits requires careful planning, habitat protection, and low-carbon tourism practices.

2. Economic Impacts: Ecotourism can contribute to sustainable economic development by creating jobs, diversifying local economies, and supporting small and local enterprises. Evidence suggests it can make a meaningful contribution to GDP, particularly in developing countries, while generating income and employment at the community level. However, economic gains are not always evenly shared, as some communities benefit more than others, and economically

marginalized groups may receive limited returns. The scale of activities, community participation, and infrastructure quality strongly influence outcomes. Maximizing economic benefits therefore requires active local involvement in planning, fair benefit distribution, and investment in infrastructure that safeguards natural resources and cultural heritage.

3. Social Impact Mitigation: Protecting local communities and their cultural heritage is essential in ecotourism development to prevent social tension and conflict. Effective approaches include meaningful community participation, cultural sensitivity training for ecotourism operators, and the promotion of local cultural activities. Involving communities in planning, development, and management helps ensure that tourism respects local traditions and values, as demonstrated by community-led tourism initiatives offering cultural tours, craft workshops, and homestays. Training operators to understand and respect cultural norms further reduces conflict and improves the quality and appropriateness of tourism services. Promoting cultural events also supports heritage preservation while generating local economic benefits. Overall, these strategies help minimize negative social impacts and support ecotourism development that delivers long-term social benefits while safeguarding cultural heritage for future generations.

When it comes to monitoring and evaluation, they play a critical role in ensuring that ecotourism achieves sustainability goals and identifies areas for improvement. Ecotourism operators should systematically collect data on environmental, economic, and social impacts to assess the effectiveness of management practices and tourism policies. Environmental monitoring, such as waste generation, energy and water use, and greenhouse gas emissions, is essential for preventing ecological degradation and guiding operational improvements. Economic monitoring helps ensure that tourism activities generate local employment, support income distribution, and contribute to sustainable local development. Social monitoring focuses on cultural heritage protection, community participation, and the promotion of local products and services to ensure socially responsible tourism. Overall, integrated M&E supports long-term sustainability of ecotourism destinations, enhances community benefits, and safeguards natural and cultural resources for present and future generations. Achieving these outcomes requires coordinated collaboration among government agencies, destination managers, and local communities to promote responsible and sustainable ecotourism practices.

However, ecosystem conservation should remain the core focus of ecotourism, emphasizing biodiversity protection, reduced environmental impacts, and sustainable resource management. Active community participation in decision-making helps generate shared economic and social benefits, strengthens cultural understanding, and ensures fair benefit distribution. Capacity building through training and education for local communities, tourism operators, and guides enhances skills and informed participation in sustainable practices. Ecotourism infrastructure should prioritize sustainability by using eco-friendly materials, renewable energy, effective waste systems, and water-saving measures. Responsible visitor management, such as setting carrying capacities, promoting ethical travel behavior, and providing environmental education, helps minimize negative impacts on nature and communities.

Continuous monitoring and evaluation are essential to assess performance and refine management strategies. Strong partnerships among governments, local communities, NGOs, and businesses enable coordinated action and shared responsibility. Effective marketing can raise awareness of sustainable practices and attract environmentally conscious travelers by highlighting unique natural and cultural assets. Finally, certification and standards from recognized bodies help ensure compliance with sustainability principles and strengthen credibility.

DISCUSSION

This research developed a model with strong validity and conducted diagnostic tests on the $PAr - ARIMAX(p)$ estimation. The results indicate no problems of heteroskedasticity, multicollinearity, or autocorrelation, and the model also demonstrates satisfactory goodness of fit. These findings suggest that the model is appropriate for use in policy formulation and strategic planning in Thailand, particularly for guiding sustainable tourism management and supporting long-term growth, with a specific emphasis on the future development of ecotourism.

In selecting the indicators for the $PAr - ARIMAX(p)$ model, the analysis focused on examining the causal effects of ecotourism-related factors on entrepreneurial success and progress toward a green economy, while ensuring that carrying capacity can be maintained. The model incorporates latent variables representing the social sector, green economic sector, environmental sector, and ecotourism entrepreneurship sector. These latent constructs are measured through 15 observed variables, including green urbanization rate (E_1), green industrial structure rate (E_2), green total exports (E_3), expenditure government rate (E_4), green household rate E_5, employment rate (F_1), health and illness (F_2), social security (F_3), education rate (F_4), income distributions rate (F_5), Community Participation (F_6), Eco-tourism (G_1), total energy consumption (H_1), energy intensity (H_2), and Carbon dioxide emission (H_3). The results show that all indicators are appropriate for model construction and can be effectively used to analyze the impacts of change, as each variable is stationary at first difference at a statistical significance level of $\alpha = 0.01$.

Based on these findings, the researcher was able to develop the $PAr - ARIMAX(p)$ model as an optimal (best-fit) time-series model, enabling a reliable analysis of the magnitude of relationships in terms of both direct and indirect effects. The results indicate that ecotourism entrepreneurship has the strongest direct effect on the environmental sector, accounting for 65% at the 1% significance level. This implies that a 1% change in ecotourism entrepreneurship leads to a 65% change in the environmental sector in the same direction. At the same time, ecotourism entrepreneurship exerts the greatest influence on changes in the green economy compared with all other sectors included in the model.

Therefore, policy interventions or structural changes targeting ecotourism entrepreneurship are likely to generate corresponding positive changes in the green economy and deliver the highest benefits for long-term sustainability. In

addition, a key finding that warrants close attention is the role of the social sector, which influences changes in ecotourism entrepreneurship by as much as 60%. This highlights the critical importance of social dynamics in shaping ecotourism entrepreneurship and, consequently, in driving transformations toward a green economy.

When changes in ecotourism entrepreneurship are combined with social-sector transformation, the resulting impact on the green economy is maximized. This research approach and its findings have not been previously identified in the literature. The results further indicate that, in aligning with government policy objectives, the sector with the highest adaptive capacity is the social sector. Accordingly, government policy should urgently prioritize social-sector development, with particular emphasis on community participation and cultural transformation, and implement these measures in a concrete and systematic manner. Such coordinated change, aligned with the evolution of ecotourism entrepreneurship, is essential for achieving sustainable long-term development goals.

The development of ecotourism in Thailand can be strengthened through the following key approaches:

1. Promote public–private collaboration: Strong cooperation between government and the private sector is essential for effective ecotourism development. The public sector should support planning and infrastructure development, such as nature trails, sustainable resource management systems, and regulations encouraging the use of eco-friendly materials. The private sector can contribute by developing tourism services that prioritize sustainability, enhance visitor experiences, and promote conservation awareness.

2. Strengthen sustainable resource management: Sustainable resource management is central to the long-term success of ecotourism. Destinations should implement measures to prevent environmental degradation, including visitor limits, waste and pollution control, and the conservation of forests and key natural attractions. Clear management plans, supported by appropriate technologies, can improve efficiency and ensure sustainable destination development.

3. Enhance local community participation: Sustainable ecotourism should actively involve local communities as owners and stewards of tourism resources. Community-based activities can generate income while strengthening local economies and social cohesion. Government support is needed to build community capacity through guide training, resource management education, and assistance in developing distinctive local products for tourists.

4. Building integrated networks for systematic ecotourism development: Establishing networks among ecotourism destinations across different regions can promote coordinated and systematic tourism development. Such networks should involve public agencies, private sector actors, local communities, and other stakeholders, including researchers and conservation organizations. These networks facilitate knowledge sharing and the exchange of best practices for sustainable destination management, enhance the visibility of ecotourism sites, and support the creation of interconnected tourism routes that link multiple destinations.

As for the limitations of this study, it is subject to limitations arising from Thailand's relatively weak and outdated environmental legal framework. Environmental governance continues to rely primarily on the National Environmental Quality Promotion and Conservation Act B.E. 2535 (1992), with only limited amendments, alongside related legislation. As a result, legal mechanisms are often insufficient to effectively prevent or mitigate environmental impacts. Tourism development has significantly contributed to environmental degradation, particularly through the rapid growth of greenhouse gas emissions. Although tourism has been promoted as a national agenda, environmental protection has not progressed at a comparable pace. Consequently, this study could not fully incorporate legal and regulatory dimensions into the analysis or use them as a basis for defining comprehensive policy strategies.

CONCLUSIONS

This study investigates how transformations in ecotourism entrepreneurship shape Thailand's green economy policy, employing a holistic, systematic, and mixed-methods approach. Quantitative analysis was complemented by expert qualitative insights from sustainable development and ecotourism sectors.

The results identify the PAr-ARIMAX(1,1,1) model as the optimal analytical tool, demonstrating robust validity, no spurious associations, and excellent goodness-of-fit. This model thus provides a sound basis for policy formulation, strategic planning, and the sustainable management of Thailand's tourism sector. The result reveals that Ecotourism entrepreneurship exerts the strongest direct impact on the environmental sector, explaining 65% of the variance at a 1% significance level. A 1% increase in ecotourism entrepreneurship corresponds to a 65% rise in the environmental sector, underscoring its outsized influence relative to other modelled sectors. Accordingly, policies that promote ecotourism entrepreneurship can substantially advance environmental outcomes and accelerate the green economy transition.

At the same time, the social sector—especially community participation and cultural transformation—significantly affects ecotourism entrepreneurship, with an effect size of up to 60%. This suggests that green economy transformation requires more than shifts in entrepreneurship alone; government policy must address the interplay between ecotourism and social dynamics. Emphasizing community engagement, cultural adaptation, and active local stakeholder participation is therefore essential for effective ecotourism development.

In summary, integrating ecotourism entrepreneurship with progressive social sector change is the most effective strategy for advancing Thailand's green economy. Targeted government action to support entrepreneurs, build community capacity, and foster stakeholder collaboration is vital to ensure tourism aligns with both environmental and social sustainability, strengthening national development.

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MULTISTAKEHOLDER CO-MANAGEMENT FOR DEVELOPING SUSTAINABLE COASTAL TOURISM: AN INSIGHT FROM NGANTEB BEACH, MALANG, INDONESIA

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Abstract: This study aims to formulate a sustainable coastal tourism development strategy for Nganteb Beach, Malang Regency, Indonesia, by integrating geomorphological characteristics, ecological conditions, disaster risks, and stakeholder collaboration within a co-management framework. The study employed a mixed-method approach combining qualitative observations, literature review, and documentation with quantitative analysis using SWOT, Internal Factor Analysis Summary (IFAS), and External Factor Analysis Summary (EFAS) matrices. Weighted scoring was applied to internal and external factors to identify the strategic position and determine development priorities. The results indicate that Nganteb Beach possesses strong internal advantages, including unique coastal geomorphological characteristics, relatively stable shoreline conditions, high biodiversity, and considerable potential for nature-based tourism development. However, the destination continues to face several challenges, including limited accessibility, inadequate tourism infrastructure, disaster vulnerability, and declining interest in ecotourism activities. The SWOT quadrant analysis places Nganteb Beach in Quadrant II, indicating that a diversification strategy is required to utilize existing strengths while mitigating external threats. The findings demonstrate that Nganteb Beach has significant potential to be developed as a sustainable ecotourism destination through diversification strategies supported by collaborative governance among local communities, government institutions, and academic institutions. The integration of environmental conservation, disaster risk mitigation, sustainable tourism planning, and community-based management is essential to strengthen destination resilience and ensure the long-term sustainability of coastal tourism development.

Keywords: ecotourism, coastal geomorphology, SWOT analysis, sustainable tourism, co-management, Nganteb Beach

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INTRODUCTION

Collaboration between communities and governments is crucial for improving the sustainability of ecotourism in South Malang. The beaches of South Malang, Indonesia, are renowned for their stunning coastal landscapes, characterized by sandy beaches, cliffs, and rocky shorelines. These features enhance the area's aesthetic appeal and serve as important habitats for various marine and terrestrial ecosystems, making them ecologically significant (Hadmoko et al., 2021; Irawan et al., 2024). However, the development of beaches in South Malang, including Nganteb Beach, presents several challenges. Issues such as environmental degradation and inadequate infrastructure pose significant threats to their sustainability (Gunawan et al., 2020; Irawan et al., 2023). Furthermore, the lack of integrated planning and coordination among community groups exacerbates these challenges. Each community group operates independently, lacking a unified vision for disaster risk reduction and sustainable tourism initiatives. This fragmented approach is further compounded by the limited involvement of local governments, resulting in the absence of a well-documented, organized planning framework (Irawan et al., 2021; Sumarmi et al., 2024). Recent studies highlight that stakeholder co-creation plays a crucial role in promoting climate-resilient and sustainable coastal tourism by integrating environmental conservation and tourism management (Boqué-Ciurana, 2025). However, such collaborative governance mechanisms are still rarely implemented in many emerging coastal tourism destinations, including several areas in Indonesia.

A comprehensive approach is needed to unlock the full potential of Nganteb Beach. Conducting a systematic analysis of Nganteb Beach's tourism potential is essential to identify its strengths, weaknesses, opportunities, and threats. These four elements serve as the basis for developing a roadmap for sustainable tourism development. This

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analysis highlights the beach's unique geomorphological and ecological characteristics while addressing key challenges, including erosion control, disaster preparedness, and the implementation of conservation measures. Strategies such as integrated coastal zone management (ICZM) and community-based tourism models can be adopted to balance environmental conservation with economic development (Irawan et al., 2024).

Furthermore, involving local communities in the planning and management processes is crucial to ensuring sustainable outcomes. Empowering residents through training and promoting environmentally friendly practices can foster greater ownership and long-term commitment to sustainable tourism development (Sumarmi et al., 2024). Previous studies have explored various aspects of tourism development in coastal destinations. Research by Astina et al. (2021) indicates that SWOT analysis has been used to formulate policy strategies for ecotourism management at Goa China Beach, South Malang, Indonesia. However, most of these studies primarily emphasize tourism attractiveness, scenic beauty, available facilities, and visitor numbers. Similar findings have been reported in several recent studies, which indicate that tourism development assessments often focus on tourism attractiveness and visitor statistics while paying less attention to environmental dynamics and governance structures that influence long-term sustainability (Ali & Li, 2024; Smith et al., 2023). These approaches provide useful insights for understanding tourism potential, but they tend to offer limited guidance for integrated coastal tourism planning.

In addition, previous studies often overlook several important aspects related to the sustainability of coastal tourism. For instance, there has been limited analysis of coastline changes that may significantly influence the long-term sustainability of tourism destinations (Xu & Li, 2025). Environmental dynamics, particularly those related to coastal geomorphology and shoreline changes, play an important role in determining the resilience and sustainability of coastal tourism areas (Theocharidis et al., 2025). However, these aspects have rarely been incorporated into tourism development studies. Moreover, the external aspects of tourism development, particularly visitor interest in ecotourism and the role of stakeholders in tourism governance, are often not analyzed comprehensively. As a result, existing studies tend to provide only a partial understanding of the factors influencing sustainable tourism development. Furthermore, SWOT analysis in tourism studies is often limited to identifying factors that strengthen or weaken tourism development without clearly explaining the strategic actions that should be taken to support sustainable tourism management.

Therefore, a more comprehensive analytical framework that integrates environmental characteristics with multi-stakeholder collaboration is needed to support sustainable tourism development in coastal areas (Setiawan et al., 2025). In this context, this study aims to analyze the potential of Nganteb Beach for sustainable coastal tourism development by integrating several key variables, including geomorphological characteristics, tourism facilities, accessibility, coastline changes, and visitor interest in ecotourism. In addition, this study seeks to develop strategic recommendations through a SWOT-based approach to support collaborative tourism management between local communities and government institutions. The results are expected to provide policy recommendations that can be collaboratively implemented by the government and local communities and serve as a reference for other coastal areas facing similar challenges, thereby contributing to broader regional and national efforts toward sustainable coastal development (Irawan et al., 2023; Smith et al., 2023), which are based on collaboration between the government and local communities.

MATERIALS AND METHODS

Materials

The materials used in this study comprise both primary and secondary data to support the analysis of sustainable coastal tourism development at Nganteb Beach, Malang Regency, Indonesia. Primary data were obtained through direct field observations conducted at the study site. These observations focused on coastal geomorphological characteristics, including shoreline configuration, beach typology, cliff morphology, sediment composition, and coastal dynamics. In addition, observations covered ecological aspects such as mangrove distribution, coastal vegetation density, biodiversity conditions, and environmental quality, as well as existing tourism facilities, accessibility, safety infrastructure, and patterns of tourist activities.

Secondary data were collected to complement and strengthen the primary observations. These data include scientific articles and academic publications related to coastal geomorphology, ecotourism, and sustainable tourism management. Government documents and official reports were also used, particularly statistical data on tourism trends from the Indonesian Central Statistics Agency (BPS), coastal hazard maps from the National Disaster Mitigation Agency (BNPB) via the Inarisk platform, and regional planning documents on coastal and tourism development. In addition, satellite imagery and digital spatial data were used to analyze changes in the coastline, landform patterns, and spatial characteristics of the study area. Supporting information from online databases and institutional websites was incorporated to provide contextual data on wave characteristics, tidal conditions, and ecotourism trends relevant to Nganteb Beach.

Methods

The research object is Nganteb Beach, located in Sukorejo Hamlet, Tumpakrejo Village, Gedangan District, Malang Regency, Indonesia. The exact coordinates are 8° 40' 8.786 "South Latitude and 112° 34' 47.87" East Longitude.

This beach is located approximately 72 km south of the city center.

The research method combines qualitative and quantitative approaches. The quantitative approach is carried out using weights and scoring against predetermined parameters. A qualitative approach is employed to describe the condition of Nganteb Beach, drawing on observations and literature. The data collection techniques used are direct observation, literature review, and documentation studies. The research flow is illustrated in Figure 1.

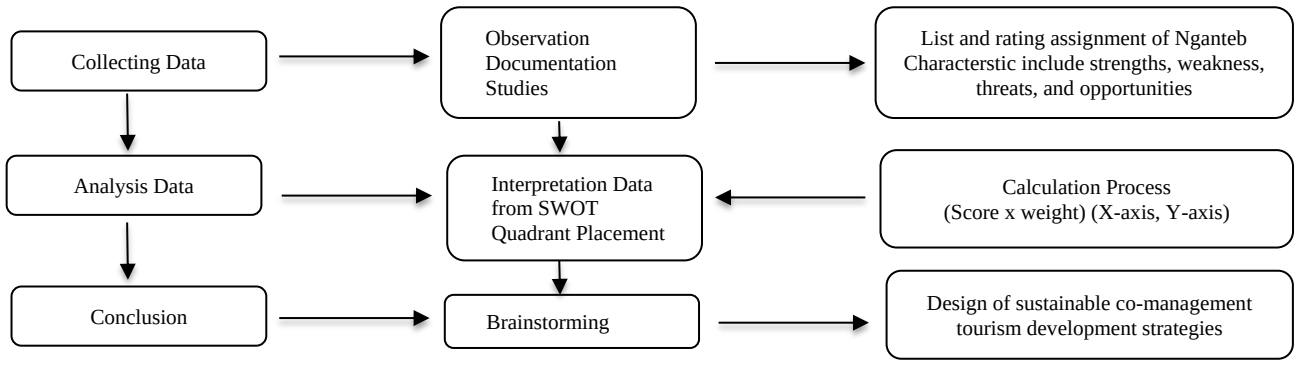


Figure 1. Research Flowchart

A qualitative descriptive approach was adopted to systematically describe the collected data, aligning with the factual conditions and theoretical framework. Data presentation involved interpreting the suitability of landforms for tourism activities and categorizing the findings into a structured narrative. Scores were assigned to factors based on their importance and impact, providing a quantitative basis for the SWOT analysis. The Internal Factor Analysis Summary (IFAS) evaluates the internal aspects of an organization or subject, focusing on Strengths and Weaknesses. Meanwhile, the External Factor Analysis Summary (EFAS) evaluates external factors that may impact Nganteb Beach, namely its opportunities and challenges. The calculation process for IFAS and EFAS is as follows:

1. Identify strengths, weaknesses, opportunities, and threats from a SWOT analysis.
2. Assign a weight between 0 and 1 to each factor, representing its level of importance. The total weight for all aspects in each analysis (IFAS and EFAS) must equal 1.
3. Calculation of the final score by multiplying the weight and score.
4. Add up all scores for IFAS and EFAS separately to get an overall score for internal and external factors.

The assessment instruments can be seen in Table 1 as follows:

Table 1. Criteria for Determining Scores and Weights

Criteria	**Score**			**Weight**
	1	**2**	**3**	
Internal Factor Analysis Summary				
Unique Coastal Geomorphology	There are 1-2 geomorphological forms	There are 3-4 geomorphological forms	There are more than 5 geomorphological forms	0.35
Stable Beach Profile	Coastline change >300 ha	Coastline changes of 100-300ha	Shoreline change <100	0.15
Biodiversity and cultural landscape	There are 1-5 biodiversities	There are 5-10 biodiversities	There are more than 10 biodiversities	0.21
Big beach waves with strong winds	Small beach waves with slight wind	Small beach waves with big wind	Big beach waves, big wind	0.11
The beach sand is soft and white	Black sand and coarse grains	Black sand with fine grains	The sand is white with fine sand	0.18
Basic facilities	Complete and good facilities	Complete but simple facilities	Incomplete facilities	0.15
Limited access to transportation	There are many transportation access options	There are 1-2 transportation accesses	There is only 1 transportation access	0.26
Long distance from the city center	Distance from city center <10km	Distance from city center 10-30 km	Distance from city center >30km	0.3
Lack of safety equipment	Standard safety equipment and warning signs are in place.	There are warning signs without any safety equipment.	There are no warning signs or safety equipment.	0.1
Lack of tourism promotion media	Have social media with lots of followers	Have social media with a few followers	Do not have promotional media	0.19
External Factor Analysis Summary				
Government and community support for tourism development	The government and society provide no support.	The government provides financial support for facility construction.	The government and community work together on financial support, promotion, and conservation.	0.6
Environmental Conservation Program	There is no environmental conservation	Environmental conservation is carried out, but not intensively	Ecological conservation is carried out intensively	0.4
Natural disasters	Does not have the potential for natural disasters	Has one potential natural disaster hazard with moderate risk	Having more than one natural disaster hazard with a high category	0.1
Fluctuations in Ecotourism Interest	Interest in ecotourism is high and continues to grow	Interest in ecotourism is high but declining	Low interest in ecotourism	0.25
Environmental Damage Due to Tourism	No environmental damage	Minor to moderate environmental damage	Major environmental damage	0.3
Competition with Other Destinations	Has no competition with other destinations	Have 1-5 competing destinations	Have more than five competing destinations	0.35

SWOT analysis includes the methodology used for weight allocation, weighted score calculation, and placement in the SWOT quadrants.

Weight Calculation

The weight of each factor is calculated by dividing the score of the factor by the total score within the same category (Strengths, Weaknesses, Opportunities, or Threats). The normalization ensures that the total weights for Strengths and Weaknesses equal 1, and the total weights for Opportunities and Threats also equal 1 (Chang & Huang, 2006). The formula for calculating the weights is:

$$\text{Weight for Factor} = \frac{(\text{Score of Factor})}{(\text{Total Scores of the Category})} \quad (1)$$

Where:

- Weight for Factor = relative importance of each SWOT factor (unitless);
- Score of Factor = rating assigned to a specific factor based on expert judgment (scale: 1–5);
- Total Scores of the Category = total score of all factors within the same SWOT category (unitless).

Weighted Score Calculation

The weighted score for each factor is obtained by multiplying the factor score by the calculated weight. This step reflects the proportional contribution of each factor to the overall SWOT evaluation (Helms & Nixon, 2010). The formula for calculating the weighted score is:

$$Weighted\ Score = \frac{(Score\ of\ Factor)}{(Total\ Scores\ of\ the\ Category)} \quad (2)$$

Where:

- Weighted Score = the contribution value of each factor in the SWOT analysis (unitless index);
- Weight of Factor = normalized importance value (unitless);
- Score of Factor = rating value assigned to each factor (scale: 1–5).

SWOT Quadrant Placement

The SWOT quadrant is used to assess the study area's strategic position. The X-axis represents the difference between the total weighted scores of strengths and weaknesses. In contrast, the Y-axis represents the difference between the total weighted scores of opportunities and threats (Helms & Nixon, 2010). The X-axis and Y-axis formulas for the SWOT Quadrant can be shown as follows:

$$\text{X} - \text{axis} = (\text{Total Weighted Score of Strenghts}) - (\text{Total Weighted Scores of Weakness})$$
$$\text{Y} - \text{axis} = (\text{Total Weighted Score of Opportunities}) - (\text{Total Weighted Scores of Threats})$$

Where:

- X-axis value = internal strategic position (unitless index);
- Y-axis value = external strategic position (unitless index);
- Total Weighted Score of Strengths (S) = sum of weighted scores for all strength factors;
- Total Weighted Score of Weaknesses (W) = sum of weighted scores for all weakness factors;
- Total Weighted Score of Opportunities (O) = sum of weighted scores for all opportunity factors;
- Total Weighted Score of Threats (T) = sum of weighted scores for all threat factors.

Next, a qualitative SWOT analysis is conducted using the Balanced Scorecard model to interpret the results and determine the study area's strategic position. A SWOT analysis diagram is presented in Figure 2.

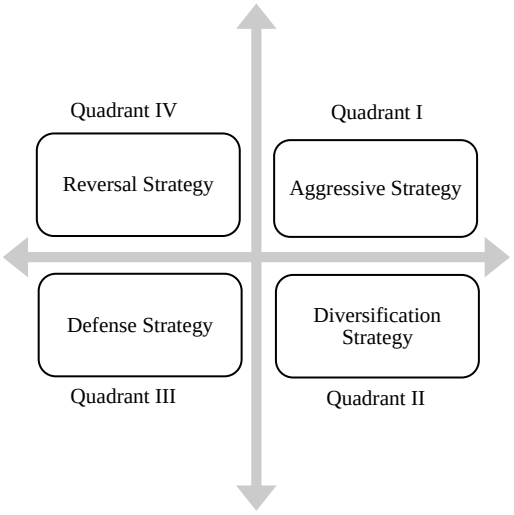


Figure 2. SWOT Analysis Diagram

RESULTS AND DISCUSSION

IFAS (Internal Factor Analysis Summary)

Nganteb Beach exhibits high geomorphological diversity, consisting of more than five coastal landform types, including cliffs, bays, headlands, sandy beaches, and estuarine zones. Based on the IFAS criteria, this condition places the study area in the highest geomorphological diversity class, contributing a weighted score of 1.05 to the internal factor assessment. The sandy beach terrain, gentle slopes, and cliffs provide a stunning backdrop, while the surrounding biodiversity enhances its ecological value (Hadmoko et al., 2021). Java's southern coast boasts towering headlands and limestone cliffs, set against coastal platforms and fringing reefs. These limestone cliffs feature notches and ridges at their base, as they developed on island banks and stacks, primarily through solutional processes. Satellite imagery shows the coastline formed at Nganteb Beach as a bay with pocket beaches. Cliff walls are present on the east and west sides of Nganteb Beach. These cliffs have changed over time due to waves from the south or the Indian Ocean. The presence of these cliffs also causes marine material to accumulate or settle in the center, creating a pocket beach.

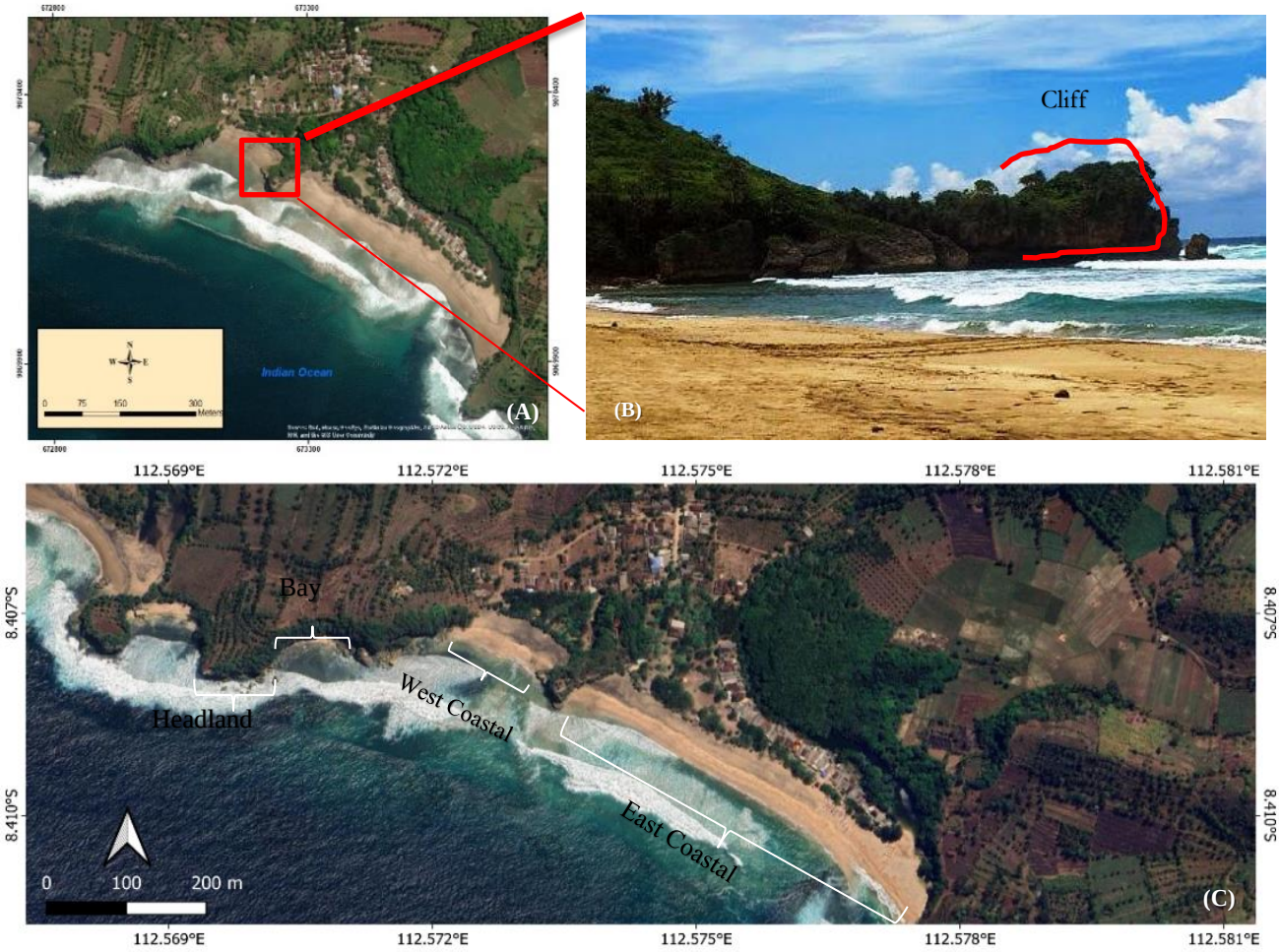


Figure 3. Landscape of Nganteb Beach: (a) satellite imagery showing the coastal location of Nganteb Beach, (b) coastal cliff morphology observed at the study site, and (c) geomorphological features of the coastline, including bay, headland west coastal, and east coastal zones. (Source: The authors)

Figure 3 illustrates the coastal landscape morphology of Nganteb Beach, which is characterized by several distinct geomorphological features, including coastal cliffs, sandy bays, and headlands. These landforms form a heterogeneous coastal landscape shaped by marine processes and geological structures. The cliff landscape represents erosional coastal landforms formed by the direct action of ocean waves on resistant rock formations. These cliffs are primarily composed of carbonate rocks belonging to the Wonosari Formation and form steep coastal slopes that directly face the Indian Ocean. Meanwhile, the bay landscape represents a depositional coastal environment where sediments accumulate under lower-wave-energy conditions between headlands. The sandy beach in the bay area is formed by the accumulation of sediments transported by rivers and marine processes. In contrast, the headland landscape consists of more resistant rock formations that protrude into the sea, controlling the overall shape of the coastline and influencing wave refraction patterns along the beach.

The morphology and type of the beach are determined primarily by the intensity, frequency, and strength of wave energy impacting the coastline. Based on its regional typology, Nganteb Beach can be classified as part of the Sub-Aerial Deposition Coast, which refers to coastal areas formed through the direct accumulation of sediments transported from terrestrial sources such as rivers, wind processes, or mass movement (Marfai et al., 2013).

This condition can be observed in the Nganteb coastal area, where sediment accumulation from river systems and the erosion of surrounding rocks contribute to the formation of sandy beach deposits. These sediments are transported from upstream areas and deposited along the coastline through fluvial and marine processes.

At a more local scale, Nganteb Beach can also be classified as a wave degradation coast, where marine erosion processes significantly influence coastal morphology. Continuous wave action gradually modifies the coastline by eroding exposed rock formations and redistributing sediments along the beach (Wibowo et al., 2022). As a result, the current coastal morphology reflects a combination of erosional and depositional processes that shape the spatial distribution of cliffs, bays, and sandy beach areas. In addition to marine sediment sources from the Indian Ocean, Nganteb Beach also receives sediment input from river systems that discharge into the eastern part of the study area.

These fluvial sediments are considered allogenic materials, originating from the weathering and erosion of volcanic and karstic rocks in the upstream region. The geological structure of Nganteb Beach is associated with the Wonosari Formation, which forms a karstic landscape composed of coral limestone, clay limestone, tuffaceous limestone, sandy limestone, marl, black peaty mudstone, and calcilutite (Sjarifudin & Hamidi, 1992). A cloudy white color characterizes coral limestone in this formation, which contains abundant fossil fragments and algae, with rough and sharp surfaces and layer thicknesses ranging from approximately 3 to 50 meters. Clay limestone is typically grayish-black and contains fossil fragments with interbedded layers several tens of centimeters thick. These lithological characteristics indicate that the formation represents carbonate platform deposits from the Middle Miocene to the Late Miocene.

Wave height is an important parameter influencing coastal vulnerability and shoreline dynamics, as it controls sediment transport processes and coastal erosion patterns. The average wave height at Nganteb Beach is approximately 0.7 m, with a significant wave height of about 1.4 m and average wind speeds of 11–13 km/h (Pasanglaut.com, 2025). These moderate wave conditions contribute to the redistribution of sediments along the coastline. In addition, an average wave height of 0.7 m, with significant waves of 1.4 m, is considered suitable for beginner-level surfing activities (Lapointcamps.com, 2025). The tidal range in the study area is categorized as relatively high according to the Coastal Ecosystem Vulnerability Index. Tidal fluctuations represent an important component of coastal processes because periodic sea-level changes influence coastal currents, sediment transport, and shoreline morphology (Wright, 1989). These tidal dynamics contribute to periodic changes in seabed conditions and the coastal profile.

Shoreline change analysis indicates that the total abrasion area between 2015 and 2024 was approximately 0.969 ha, corresponding to an average erosion rate of approximately 0.097 ha per year. This relatively low erosion rate suggests that the coastal profile of Nganteb Beach remains relatively stable. In the IFAS assessment, this condition is categorized as moderate-to-high coastal stability. Figure 4 illustrates shoreline changes observed between 2015 and 2024. The results indicate that there have been no significant changes in the overall beach area during the past decade. The limited abrasion observed along the coastline is offset by sediment deposition from the Sumberpelus River estuary, which contributes additional sediment to the coastal system. The estuary area also supports mangrove vegetation, which functions as a natural coastal protection system by reducing wave energy and stabilizing sediments.

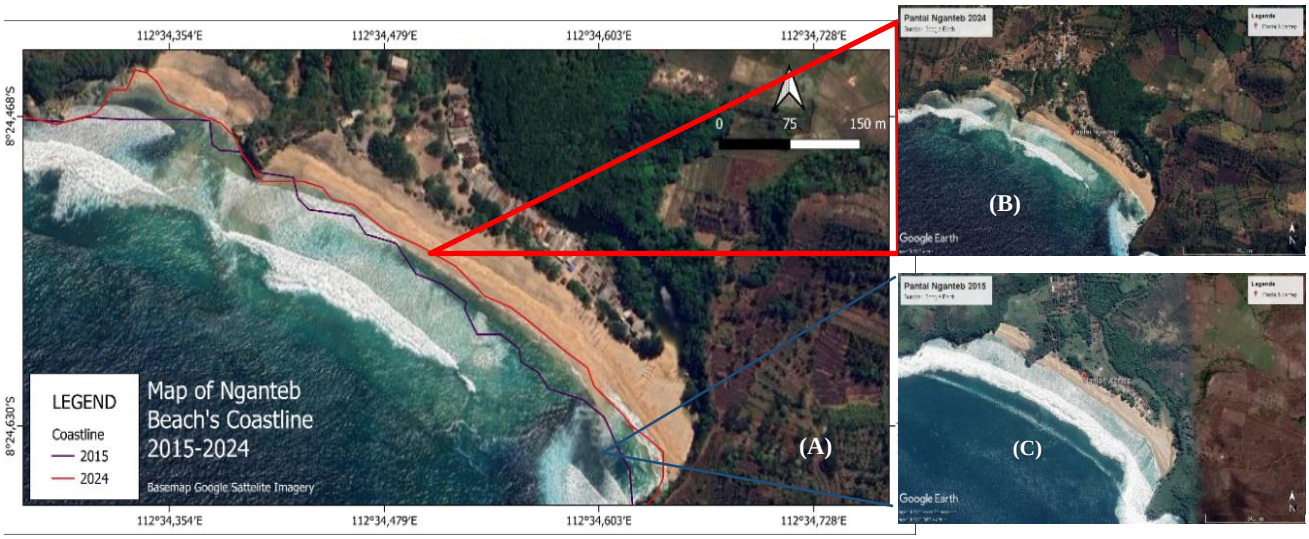


Figure 4. Map of Changes in the Nganteb Coastline 2015-2024:
(a) main shoreline change map, (b) satellite image 2015, (c) satellite image 2024. (Source: The authors)

Coastal vegetation plays a crucial role in preventing abrasion. Loss or damage to this vegetation can impact the surrounding ecosystem. Coastal plants typically have long, strong roots that help protect the substrate from wave action. (Feagin et al., 2019; Pantusa et al., 2022). Vegetation density from the coast to the land, coastal topography, substrate characteristics, and the condition of coral reef and seagrass ecosystems significantly influence the effectiveness of coastal vegetation in attenuating waves. The rich geomorphological landscape supports diverse ecosystems, such as mangrove forests. Furthermore, the coast offers a rich biodiversity and diverse natural resources. In addition to the

pretty good vegetation around the beach, Nganteb Beach also has Mount Batok, Mangrove Tourism, and Taman Ayu. Mount Batok stands at approximately 50 meters and offers religious tourism, featuring the oldest tomb tourists can visit. (Muluk et al., 2020). Mangrove Tourism is located at the Estuary of Nganteb Beach, which features several types of mangroves. Based on the results of a 2015 survey, the coastal ecosystem of Nganteb Beach is dominated by pioneer species (Sonneratia sp. and Nypa fruticans). The Mangrove Forest at Nganteb Beach does not directly border the beach but is approximately 100 meters from the shoreline. There are five main types of mangroves and two types of associated mangrove stands. Among them are Sonneratia alba Sm., Rhizophora mucronata Lamk., Excoecaria agallocha L., Xylocarpus granatum Koenig, and Nypa fruticans Wurmb (Lestyaningrum, 2016). Meanwhile, two types of associated mangroves are called Ringin Laut by the community because their shapes resemble a banyan tree with hanging roots.

The biodiversity of Nganteb Beach is also evident in Taman Ayu, which features numerous varieties of paper flowers, although they are unfortunately poorly maintained. Furthermore, a mangrove forest serves as an ecosystem for marine life, adding to its tourism value. The mangrove forest at Nganteb Beach was initiated by the Malang Regency Marine and Fisheries Department in 2015, with the planting of 14,100 mangrove (Rhizophora Mucronata) seedlings along the coastal area of Tumpak Rejo Village (Harahab & Setiawan, 2017). The local community then continues maintenance through the POKMASWAS (Community Development Group), fishermen's groups, and the LMDH (Forest Village Community Institution) Wana Karya (Wana Karya) of Tumpakrejo Village. In addition to its biodiversity, Nganteb Beach also boasts a rich religious culture, including the oceanic larung (larung samudra) held every 15 Suro. (Julianto, 2022), and the oldest tomb of Gunung Batok, which makes it a notable destination for religious tourism

EFAS (External Factor Analysis Summary)

Tourism statistics from BPS indicate a decline in tourist visits during 2023–2024 following a peak in 2022. This trend aligns with declining search interest in ecotourism, as measured by Google Trends, which was classified as a major external threat in the EFAS assessment. The number of tourist visits does not explicitly represent visits to Nganteb Beach, as no specific data is required. Therefore, the data collected is a general report of tourism visits to Malang Regency, which is considered the most representative of the number of tourist visits to Nganteb Beach and ecotourism in Malang Regency as a whole. A snapshot of tourist visits to Malang Regency, as reported by Statistics Indonesia (BPS), from 2019 to 2024, is shown in Figure 5 below.

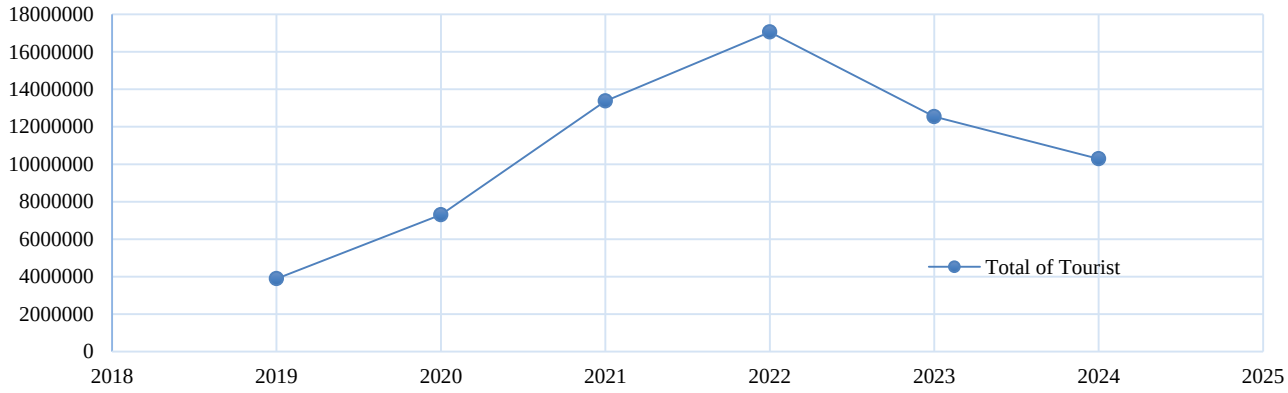


Figure 5. Graph of the number of tourist visits to Malang Regency
(Source: Statistics Indonesia - BPS Malang Regency, Tourism Statistics 2019–2024. https://malangkab.bps.go.id)

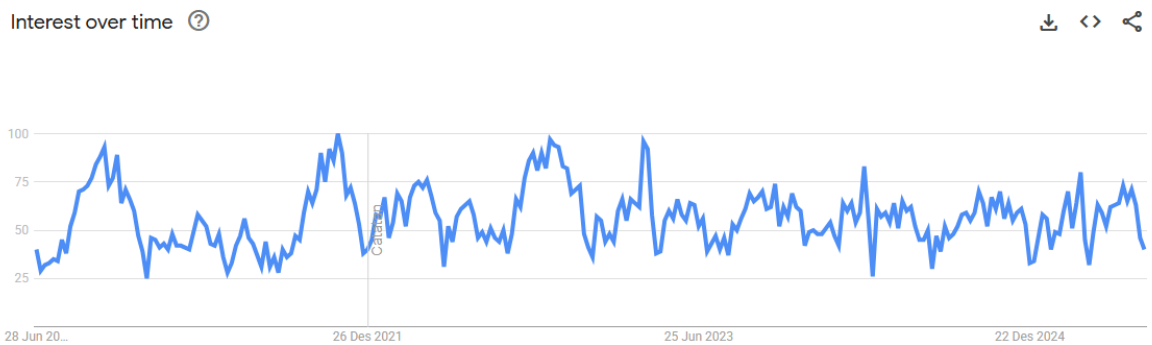


Figure 6. Google Trends results graph from ecotourism searches (Source: Authors' analysis based on Google Trends data (https://trends.google.com). Search keyword: Ecotourism) Time range: 2019–2024

In 2019 and 2020, tourism declined due to the COVID-19 pandemic and the implementation of large-scale social distancing measures across the region. A significant increase began in 2021 as COVID-19 cases subsided and large-scale social restrictions started to be relaxed. Tourism peaked in 2022, only to decline again in 2023 and 2024. This could be due

to several factors, including: 1. A lack of compelling innovation in ecotourism, resulting in a lack of repeat visits; 2. The deterioration of natural tourism due to the large number of visitors in the previous year and inadequate tourism management. The community's general economic situation has deteriorated, leading to a decline in tertiary needs, such as entertainment. This graph aligns with Google Trends searches for ecotourism, which indicate a decline in search volume since 2023 (Figure 6). Searching results from academic databases show trends in ecotourism research. The graph in Figure 8 presents the number of journal articles related to the keyword “ecotourism” indexed in Google Scholar and Scopus.

A total of approximately 200 articles were identified using the keyword “ecotourism” within the selected time period. The results indicate fluctuations in the number of publications related to ecotourism. Previous studies show that coastal communities in Indonesia have become an important focus in ecotourism research, with dominant themes including ecology, ecotourism development, planning, community participation, and ecosystem management (Sisriany & Furuya, 2020). Publications on ecotourism showed an upward trend around 2020, following a period of relatively low numbers after 2012. The number of studies increased steadily between 2014 and 2019 and then declined again between 2022 and 2024 (Hamidi et al., 2023), as illustrated in Figure 7. The Malang Regency Tourism and Culture Office (Disparbud) offers opportunities for the public and tourism managers to promote tourism in Malang Regency through its official website (https://matic.malangkab.go.id/) and Instagram social media, as shown in Figure 8.

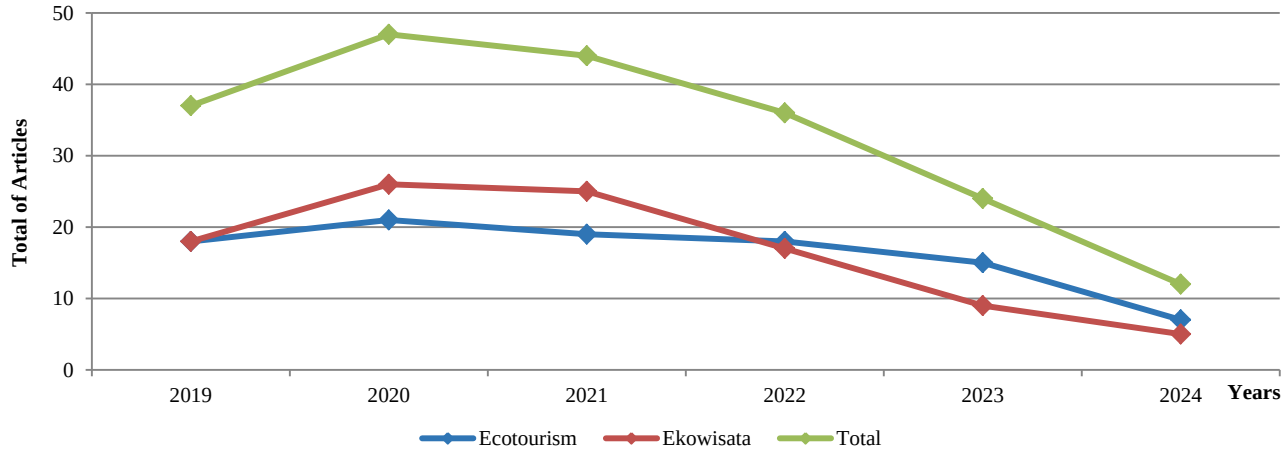
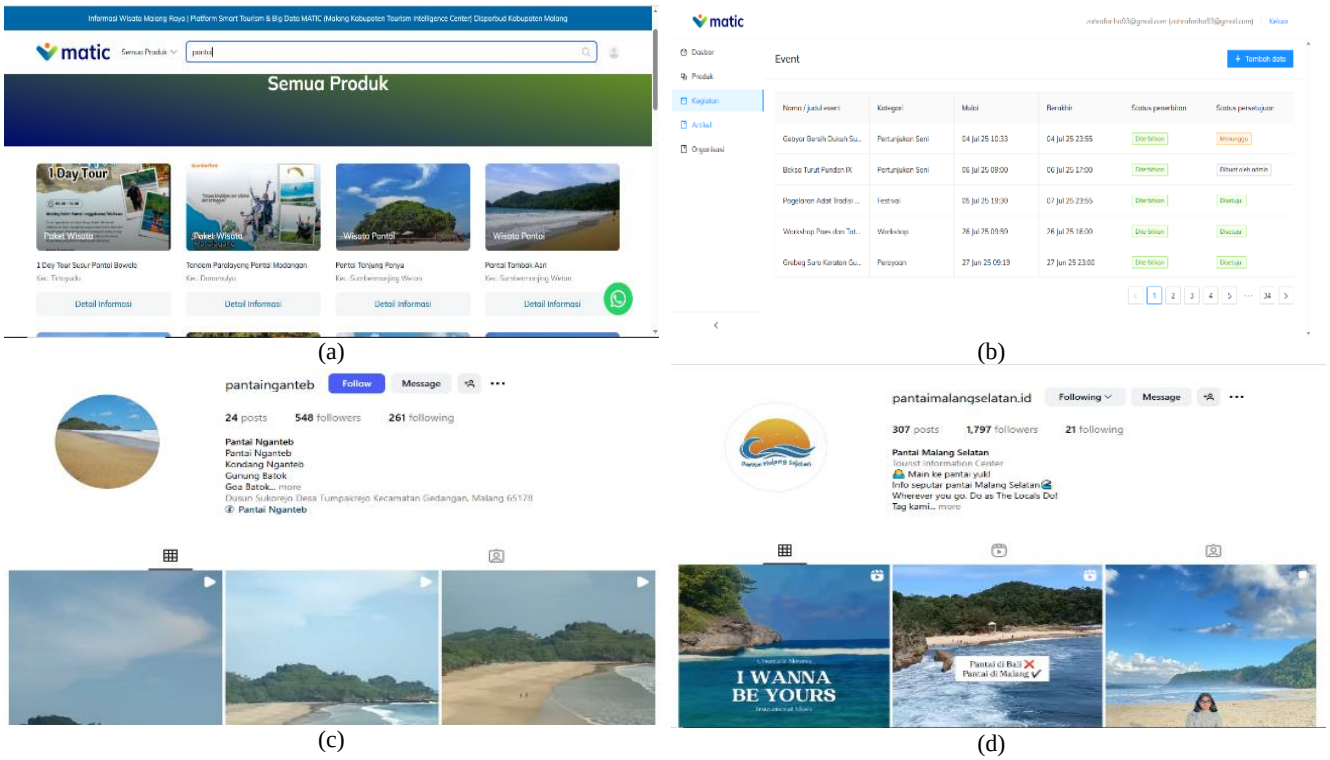


Figure 7. Graph of journal articles on the topic of ecotourism (Source: Authors’ analysis based on publication data retrieved from Google Scholar and Scopus databases using the keyword “ecotourism” (retrieved in January 2026)



(a) (b) (c) (d)

Figure 8. (a) User website interface page, (b) Admin website interface page, (c) and (d) Instagram account (Source: Authors’ documentation and compilation based on the official tourism website of Malang Regency (https://matic.malangkab.go.id) and the official Instagram account (@malangregencytourism)

The website provides opportunities for the general public and tourism managers to promote tourist attractions through news articles and engaging activities. Since 2005, both the business and tourism sectors have striven to increase the use of information technology and the internet, as evidenced by competition in the tourism market among developing countries (Untari & Satria, 2019). In addition, the ECDR noted that the major fundamental shift brought by e-tourism has increased the value of tourism, as evidenced by increased revenue in the tourism sector.

Additionally, there is a shift in information search from offline to online. Nganteb Beach is located in the subduction zone between the Indo-Australian and Eurasian plates, making it prone to earthquakes and tsunamis.

According to data from the Inarisk BNPB (National Disaster Mitigation Agency), as shown in Figure 9, the earthquake hazard at Nganteb Beach is classified as low to moderate. In contrast, the tsunami hazard is classified as high. The earthquake hazard was detected during processing of the focal mechanism in the South Malang region, which is characterized by a predominance of reverse and normal faults.

However, although this region is prone to earthquakes, the resulting earthquakes have limited potential to cause tsunamis because the earthquake hypocenters are located at depths of 30-100 km (Amalia, 2021; Prasetyo et al., 2024).



(a) (b)

Figure 9. (a) Tsunami Hazard at Nganteb Beach (b) Earthquake Hazard at Nganteb Beach (Source: Authors' compilation and interpretation based on hazard data from the InaRisk BNPB platform (https://inarisk.bnpb.go.id)

By emphasizing its unique geomorphological features and carefully managing potential threats, Nganteb Beach can be developed into a sustainable tourism destination that highlights the beauty and value of its natural landscape. Local communities continue to manage Nganteb Beach's tourism potential, but the government has yet to participate in beach management. Table 2 presents a SWOT analysis and strategies for enhancing Nganteb Beach's tourism potential, as follows.

Table 2. SWOT Analysis and Tourism Potential Strategy

	SWOT	Indicator	Weight	Score	Mark	Max Score
IFAS	Strengths	Unique Coastal Geomorphology	0.35	3	1.05	1.05
		Stable Beach Profile	0.15	2	0.3	0.45
		Biodiversity and cultural landscape	0.21	3	0.63	0.63
		Big beach waves with strong winds	0.11	3	0.33	0.33
		The beach sand is soft and white	0.18	3	0.54	0.54
		Total	1	14	0.95	3
	Weakness	Basic facilities	0.15	2	0.3	0.45
		Limited access to transportation	0.26	3	0.78	0.78
		Long distance from the city center	0.3	3	0.9	0.9
		Lack of safety equipment	0.1	2	0.2	0.3
		Lack of tourism promotion media	0.19	2	0.38	0.57
		Total	1	12	0.85	3
EFAS	Opportunity	Government and community support for tourism development	0.6	2	1.2	1.8
		Environmental Conservation Program	0.4	2	0.8	1.2
		Total	1	4	0.67	3
	Threats	Natural disasters	0.1	2	0.2	0.3
		Interest in ecotourism has declined in the last 2 decades	0.25	2	0.5	0.75
		Environmental Damage Due to Tourism	0.3	2	0.6	0.9
		Competition with Other Destinations	0.35	3	1.05	1.05
		Total	1	9	0.78	3
X-axis (SW)						0.10
Y axis (OP)						-0.12

The SWOT analysis places Nganteb Beach in Quadrant II (X = 0.10; Y = -0.12), indicating a Strengths–Threats (ST) strategic position. This condition suggests that diversification strategies are required to optimize internal strengths while

mitigating dominant external threats. Development efforts should prioritize leveraging geomorphological and ecological advantages to mitigate risks posed by declining ecotourism interest and potential natural disasters. The positive X-axis value reflects stronger internal strengths compared to weaknesses, whereas the negative Y-axis value indicates that external threats outweigh available opportunities. The SWOT quadrant position of Nganteb Beach is illustrated in Figure 10.

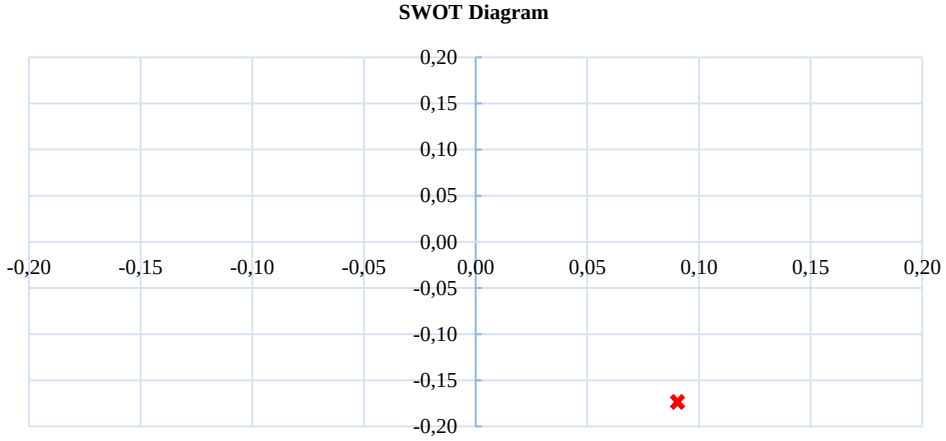


Figure 10. SWOT Quadrant Plot of Nganteb Beach

Based on the SWOT analysis in quadrant II, Nganteb Beach requires a diversification strategy for its development. In implementing this strategy, two primary principles are employed: leveraging internal strengths and mitigating external threats. Implementing these two principles is expected to lead to new opportunities through diversified commercial tourism activities, thereby mitigating pressure from external threats. Based on the results, internal strengths include unique coastal geomorphology, a stable coastal profile, biodiversity and culture, large waves with strong winds, and a soft, white beach. These factors must be maximized. Meanwhile, external threats include natural disasters, declining interest in ecotourism, environmental damage caused by tourism, and competition with other destinations. The details of the strategies, based on strengths and challenges, are presented in the following table.

Table 3. Details of diversification strategies for the development of Nganteb Beach tourism

Factor	Category	Diversification Strategy
Unique coastal geomorphology	The power to be optimized	Ensure that geomorphology is protected by implementing strict regulations and sanctions for visitors who damage geomorphological features.
Wave height 0.7-1.4 meters with strong winds		Optimized by holding a surfing training center for beginners
Beautiful view with a clean white sand beach		Optimized by providing a photobooth with an Nganteb beach background and affordable prices
Biodiversity and culture		Optimized with supporting fauna conservation, mangrove planting tourism, or a catalog of mangrove species in mangrove forests, so that it can be used as a conservation activity for education. Optimizing cultural preservation through tourism that applies the principle of "to do" tourism to add unique tourism value.
Tourism management by local communities		Forming tourism management that collaborates between local communities and the government.
Interest in ecotourism is declining.	Threats that must be faced	Increasing interest in ecotourism through optimizing social media as a promotional medium and improving transportation access to tourist locations that connect JLS with coastal tourism. Optimizing SEO on websites and YouTube ads for tourism promotion, as in the previous point, while increasing income from AdSense
Competition with other destinations		Emphasizing the conservation and cultural aspects to achieve diversified functions, namely as a tourist attraction and a center for research and education.
Potential natural disasters in the form of earthquakes and tsunamis		Reducing the risk of losses from natural disasters through structural and non-structural mitigation. For example, by expanding mangrove forest areas, providing evacuation signs and maps, and implementing an early warning system.
Environmental damage		Minimize environmental damage by implementing strict regulations, regular quality monitoring, and environmental conservation activities that serve as icons for tourism, such as Adiwiyata tourism.

Recommendations for developing the tourism potential of Nganteb Beach should be strategically aligned with the distinct roles and responsibilities of key stakeholders, namely government institutions, local communities, and academic actors. The SWOT analysis positions Nganteb Beach in the Strengths-Threats (ST) quadrant, indicating that development strategies must focus on leveraging strong internal capacities to mitigate dominant external threats. Although the area possesses significant internal strengths, particularly unique coastal geomorphology and high biodiversity, these advantages are not yet optimally supported by tourism infrastructure and are challenged by declining interest in ecotourism and environmental risks.

Infrastructure gaps and environmental sensitivity emerged as prominent weaknesses, while threats such as climate change pose significant challenges. Addressing these issues requires proactive measures, as outlined in Table 4. Key recommended actions include developing tailored ecotourism initiatives, strengthening local infrastructure to support sustainable tourism, and fostering collaboration with policymakers and stakeholders to ensure long-term resilience and adaptability.

Infrastructure limitations and environmental sensitivity are critical internal weaknesses, while external threats, including climate-related hazards and disaster risks, require immediate attention. Therefore, development efforts should prioritize strategic diversification by strengthening environmentally friendly infrastructure, improving accessibility, and integrating disaster risk mitigation measures. Investments in low-impact facilities, including pedestrian pathways, safety infrastructure, and zoning-based land-use regulations, are essential to protect sensitive geomorphological features while enhancing the visitor experience. By promoting responsible tourism that respects local customs and the environment, the area can attract tourists interested in both natural and cultural heritage (Marlina et al., 2022).

Key strategies involve fostering collaborative management by building partnerships between local communities, government agencies, and private stakeholders while ensuring participatory planning processes that strengthen community voice in decision-making. Infrastructure development is another key focus, aiming to improve accessibility and visitor experience through improved roads, transportation, and public facilities, all sustainably designed to reduce environmental impacts. Environmental protection is prioritized through the establishment of conservation zones, enforcement of regulations, and the promotion of eco-friendly tourism practices, including waste management and green accommodations. Furthermore, capacity development plays a crucial role in equipping residents with the skills necessary for hospitality and environmental management, empowering them to contribute actively to sustainable tourism initiatives. Financial support for conservation and community-based tourism initiatives is crucial for fostering long-term sustainability (Sumarmi et al., 2024).

Local communities play a crucial role in tourism, offering opportunities for income generation and preserving local traditions. Empowering residents through cooperatives for businesses, such as guided tours, eco-lodges, and handicrafts, can directly benefit communities. Cultural tourism should be promoted, showcasing local traditions and religious sites, such as Mount Batok, as unique attractions. Community-led conservation programs, such as tree planting and beach cleanups, can help maintain ecological balance while instilling environmental stewardship. Involving local communities in tourism planning and management has been highlighted as crucial. Training programs for residents in hospitality and environmental management can enhance service quality and promote conservation efforts (Arinta et al., 2022).

The role of academia is to provide research-based insights and innovative solutions that support sustainable tourism. Universities and research institutions can monitor geomorphological changes, biodiversity, and socioeconomic impacts, offering valuable data to guide development strategies. Educational programs for residents and tourists can help raise awareness about the preservation of Nganteb Beach's natural and cultural assets. Technology-based innovations such as virtual tours and mobile apps can further enrich the tourist experience. Collaboration with schools and universities on student-led projects can foster ecotourism initiatives and community engagement, while also ensuring a sustainable exchange of knowledge and skills. Detailed collaborations are shown in Table 4 below.

Table 4. Integrated Collaboration for Sustainable Tourism Development

Stakeholder Relations	Collaborative Action	Benefit	Challenge
Government ↔ Society	The government provides funding and infrastructure for community-managed tourism services.	Community-based tourism initiatives receive financial and logistical support, thereby improving residents' livelihoods.	Mismatch between government policies and community priorities. Lack of community participation.
Government ↔ Academics	Academic research to inform government policy on geomorphological conservation and tourism planning. Co-development of disaster management.	Evidence-based policies that reduce negative impacts. Improve disaster preparedness and mitigation.	Bureaucratic delays in implementing research findings—limited funding for academic collaboration.
Community ↔ Academics	Communities engage in educational programs and implement academic recommendations—local data support research.	Enhanced skills and knowledge in sustainable tourism. Community-driven conservation practices.	Lack of local awareness of academic contributions—financial barriers to collaboration.
Government ↔ Society ↔ Academics	Establish a multi-stakeholder forum for collaborative planning and decision-making. Create a joint action plan for conservation, tourism, and education.	A comprehensive tourism strategy. Alignment of goals among stakeholders. Sustainable regional growth.	Coordination challenges due to differing schedules and priorities. Resource allocation issues.

By aligning the efforts of these stakeholders with the government, community, and academics. Nganteb Beach can realize its full tourism potential. These collaborative approaches will maintain a balance between development and sustainability. Furthermore, a community-based approach must be integrated with environmental management to develop ecotourism that benefits both local communities and the environment (Arinta et al., 2023).

Furthermore, Marfai et al. (2022) explain that developing a comprehensive coastal management plan that considers both natural processes and human activities is crucial to ensuring the long-term stability and sustainability of the coastline. Establishing a regular monitoring program to track shoreline changes and sediment dynamics will facilitate timely decision-making and informed adaptive management strategies.

CONCLUSION

Nganteb Beach, characterized by its curved bay morphology and distinctive pocket beach formation, has significant potential for sustainable coastal tourism development. The geomorphological characteristics of the area, including cliffs, bays, and sandy beach deposits, contribute to the destination's unique landscape value.

These natural features not only enhance the beach's aesthetic appeal but also create favorable environmental conditions for recreational activities such as surfing and nature-based tourism. The relatively stable shoreline conditions and sediment inputs from nearby river systems further support the long-term sustainability of the coastal environment.

The results of the SWOT analysis indicate that Nganteb Beach possesses strong internal strengths, particularly its unique coastal geomorphology, natural landscape quality, and ecotourism potential.

However, several challenges remain, including limited infrastructure, accessibility constraints, and the need for improved tourism management. In addition, external threats, such as coastal hazards and environmental degradation, underscore the importance of implementing appropriate coastal management strategies. Therefore, sustainable tourism development at Nganteb Beach requires an integrated management approach that involves collaboration between government institutions, local communities, and academic stakeholders. Strengthening multi-stakeholder governance, improving tourism infrastructure, and promoting environmentally responsible tourism practices are essential steps to enhance the destination's competitiveness while preserving its ecological integrity. By integrating environmental conservation with strategic tourism planning, Nganteb Beach has the potential to become a model for sustainable coastal tourism development in South Malang and other coastal regions with similar characteristics.

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TOURIST PREFERENCES AND DESTINATION COMPETITIVENESS IN ALBANIA: AN EXPLORATORY FACTOR ANALYSIS - BEST WORST METHOD AND TOPSIS APPROACH

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Abstract: Sustainable tourism evaluates those destinations that balance economic growth with social well-being and environmental protection, rather than focusing solely on short-term economic gain. As a result, the management of natural resources and the preservation of social cohesion are becoming increasingly important in destination development. This study, using a combination of exploratory factor analysis (EFA) and hybrid multi-criteria decision-making methods, aims to identify and assess the factors influencing foreign tourists' selection of Albania as a tourist destination. Two hundred and seventy foreign tourists were surveyed to assess thirteen items that influence decision-making. EFA identified four main factors: destination sustainability practices, cultural attractions and facilities, perceived cost and value, and destination safety. Twelve tourism experts pair-wise compared criteria and sub-criteria obtained from the EFA on a scale of 1 to 9. The relative importance of the criteria and sub-criteria was determined using the Best–Worst Method (BWM). The Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method was used to rank the four destination alternatives considered based on these weights. The results showed that 'cultural attractions and facilities' was the most influential criterion, followed by criteria related to cost and safety considerations, while sustainable practices had the lowest relative importance. The TOPSIS ranking showed that the Heritage and Culture Destination is the most preferred, as a result of its high performance in tourism services and cultural values, despite its moderate results in sustainability. The Riviera and Coastal Destination ranked second most preferred, reinforcing Albania's dual attractiveness as both a cultural and a coastal destination. The findings provide important insights for managing and prioritizing tourism development in a rapidly growing and highly competitive market, while protecting long-term sustainability and natural resources.

Keywords: sustainable tourism, tourist destination, factor analysis, expert judgment, multi-criteria decision making

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INTRODUCTION

Tourism continues to play a significant role in supporting economic expansion, job creation, and regional development. The recovery of this sector after the COVID-19 pandemic showed how important tourism is for the economy and society in the long term. The growth of tourism affects business development and community development and is closely linked to cultural interaction between destinations (Qi & You, 2024). International tourism reached approximately 88% of pre-pandemic levels by 2023, highlighting the sustainability and long-term importance of the sector (UN Tourism, 2024). At the same time, increasing global competition between destinations has increased the need for strategic approaches that enhance destination attractiveness, service quality and overall competitiveness. Choosing a tourist destination is a complex decision-making process influenced by a number of factors that determine the attractiveness of a place. Tourists evaluate potential destinations based on their cultural and natural attractions, infrastructure quality, support service performance, and perceived cost and value for money (Kasapi & Nurja, 2019; Lamçe & Braimllari, 2025a). Perceived political stability and visitor safety are important factors that positively shape tourists' destination choices (Ding & Wu, 2022).

Technological development and digitalisation increasingly affect the competitiveness between destinations. The development of e-marketing strategies is a key determinant of competitiveness for tourism enterprises, especially in developing destinations such as Albania (Ramaj-Desku & Ukaj, 2021). Information and communication technology has changed the way tourism businesses communicate with markets, promote their services, and deliver offers, directly influencing service quality and tourists' perceptions (Gjika & Pano, 2020; Noti & Hasrama, 2025).

Understanding why tourists choose certain destinations is essential for tourism planners and destination managers, as it enables strategic improvements to match visitor preferences and improve competitiveness (Garcia et al., 2026).

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Destinations that leverage their strengths by offering attractions, high-quality service, safe and sustainable experiences, and good value are in a better position to attract and satisfy visitors in a highly competitive market, driving sustainable growth and long-term success (Cimbaljević et al., 2025). From a broader perspective, destination competitiveness is closely linked to sustainable tourism development and entrepreneurial dynamics in the local economy (Garcia et al., 2026). As an emerging Mediterranean destination, Albania provides a suitable empirical context for examining these dynamics. It shares borders with Montenegro, Kosovo, North Macedonia, and Greece, while its western edge opens to the Adriatic Sea and its southern coast to the Ionian Sea. In recent years, the number of international tourists has increased significantly, as has the country's visibility as a tourist destination in global tourism markets.

In addition, Albania is increasingly perceived by international visitors as an affordable Mediterranean destination, where relatively low travel and accommodation costs represent an important element of its growing attractiveness. National statistics show that the number of foreign citizens entering Albania reached approximately 11.7 million in 2024 (INSTAT, 2024), highlighting the growing importance of tourism for economic growth and employment (Merko et al., 2025). Enríquez et al. (2025) assess Albania as a developing 'Sun, Sea and Sand' destination. According to them, the destination is characterised by coastal tourism, rich cultural heritage and increasing development pressures, and these characteristics make it suitable for investigating how tourists value experience, cost, safety and sustainability when selecting it as a destination. To operationalise destination competitiveness in a structured manner, this study conceptualises Albania's tourism offer through four broad destination typologies that serve as analytical alternatives in the decision-making model. These typologies reflect dominant patterns of tourism development and visitor experience rather than individual locations.

- Tirana (Urban) Destination: The capital of Albania, famous for its nightlife, cultural events, and long history.
- Heritage and Culture Destination: Berat, Gjirokastra and Butrint, three UNESCO destinations, as well as Kruja with the Skanderbeg Castle, represent cultural and historical heritage as well as traditional identity.
- Riviera and Coastal Destination: This category includes major coastal destinations, such as Vlora, Himara, Dhermi and Durres.
- Mountain and Lake Destination: This group comprises natural mountain locations, national parks, lakes, winter sports, adventure, as well as rural tourism and local customs.

These alternatives enable a comparative assessment of how attractions, infrastructure, cost, safety and sustainability affect tourists' preferences in different destination profiles. Against this background, the purpose of this study is to identify the key factors influencing foreign tourists' decisions to choose Albania as a destination by integrating exploratory factor analysis (EFA) with the hybrid Best-Worst Method (BWM) and TOPSIS approach.

The objectives of this study are:

- Identification of the main factors that influence this decision-making through EFA.
- Evaluation of the weights of criteria and sub-criteria through the BWM method.
- Ranking of the alternatives included in the study through the TOPSIS method.

The study seeks to help the tourist structures in the country to be as competitive as possible in the international market. By combining tourists' perceptual evaluations with expert-based prioritisation within a single analytical framework, this study contributes methodologically to destination competitiveness research and offers a robust decision-support tool for emerging tourism destinations. This study provides both practical and academic value to stakeholders in tourist development. The results show destination managers and policymakers the most important factors to make a destination more competitive and to use resources better.

From an academic standpoint, the study enhances the field by combining tourists' impressions and expert evaluations into a unified analytical framework applicable to analogous tourism settings.

The article continues with a literature review on hybrid methods used for destination competitiveness assessment, the methodology with a clear overview of the methods used, the results, discussions and conclusions of this study.

LITERATURE REVIEW

Studies in recent years have focused on analysing the factors influencing tourist destination choice using statistical and multi-criteria decision-making (MCDM) methods (Boonmee & Arimura, 2026; Lamçe & Braimllari, 2025a; Šostar et al., 2026). These studies consistently show that destination choice is a multidimensional process influenced by both individual tourist motivations and destination attributes, such as historical and cultural attractions, infrastructure, service quality, service costs, destination safety, and sustainability considerations (Cuong et al., 2026; Dahiya & Batra, 2016). In addition, perceived safety has increasingly been recognised as an important dimension of tourist experience, since tourists' perceptions of security and urban environment can shape their evaluation of destinations (Ilieș et al., 2025).

Some studies have used factor analysis to identify the latent factors underlying the basic dimensions of destination attractiveness. Alam et al. (2015) combined confirmatory factor analysis and structural equation modelling to identify economic, environmental, cultural, and community-related factors as significant determinants of tourists' decisions to visit Melaka, Malaysia. Using exploratory factor analysis, Seyidov & Adomaitienė (2016) showed that destination amenities, tourism infrastructure, natural environment, human resources, and price levels were the main factors influencing domestic tourists' decisions to visit Azerbaijan. These results highlight the importance of factors related to cost, accessibility, local hospitality, and destination attractions across different tourism contexts. Similar conclusions have been reported in more recent studies. For instance, Chae (2026) showed that the perceived quality of tourism services and the overall visitor experience significantly influence tourists' behavioural intentions and the attractiveness of cultural destinations.

In addition to factor analysis, many studies have applied MCDM methods to identify the importance of destination attributes or rank tourism alternatives (Göksu & Kaya, 2014; Ramos et al., 2024; Lamçe & Braimllari, 2025b; Sanjaya et al., 2026). The Analytical Hierarchy Process (AHP) is one of the most widely used methods for evaluating criteria that influence destination choice in tourism (Ramos et al., 2024; Lamçe & Braimllari, 2025b). For example, Blešić et al. (2021) showed that coastal quality, safety, and service-related factors were more influential than traditional infrastructure in the choice of Croatian coastal destinations by Serbian tourists. Their findings show that, environmental and experiential factors can have a greater impact on a destination's attractiveness than its physical infrastructure alone.

In the last decade, new multi-criteria decision-making methods have been widely used in studies focusing on tourism development, especially the Best-Worst Method (BWM) introduced by Rezaei (2015). This method is distinguished by its reduced number of pairwise comparisons and improved robustness, making it the preferred method for determining criterion weights among researchers. Nejat & Lajimi (2022) used the BWM method to assess the importance of factors influencing the return of foreign tourists to Iran. Their study showed that social environment and perceived value were more influential than factors related to infrastructure or marketing. It was observed that criteria related to sustainability and innovation had lower weights, suggesting a gap between conceptual awareness and decision-making.

Hybrid MCDM methods have also been widely used in this context. In their study, Mohamad & Jamil (2012) combined factor analysis with the hybrid AHP–fuzzy TOPSIS method and found that destination safety and cultural attractions had the greatest impact on tourists' destination choice. Lopes & Rodríguez-López (2022) combined the PROMETHEE II visual analysis with GAIA to rank wellness tourism destinations in Portugal. The authors showed that the most important factors were tourist attractiveness, cultural heritage, and service costs. Yang et al. (2022) applied a Bayesian BWM model combined with a PROMETHEE-based grey model to evaluate medical tourism operators. According to them, service quality, digital readiness and communication skills were the main determinants of performance evaluation. These studies illustrate the increasing methodological sophistication in tourism research and the suitability of hybrid MCDM models for evaluating complex destination systems. In his study, Çiçekdağı (2022) used the BWM-TOPSIS methods to evaluate the geo-tourism potential in Turkey. The author showed that natural attractiveness dominated other criteria such as adventure or socio-cultural features. Lamçe (2024) applied the hybrid AHP-TOPSIS-2N method to examine decision-making by domestic tourists when choosing a weekend destination. The author showed that factors such as tourist attractions and infrastructure had a greater influence on decision-making, whereas sustainability criteria had a lower impact. These results are also reported in other studies, suggesting that sustainability is often not given priority in short-term travel decisions (Nejat & Lajimi, 2022; Çiçekdağı, 2022). Similar observations have been reported in studies analysing tourists' perceptions of sustainable destinations. For example, Suhud et al. (2025) found that although sustainability initiatives can positively influence tourists' attitudes toward destinations, they do not always represent the primary determinant of visit intention.

In recent years, other hybrid multi-criteria decision-making methods have been applied to evaluate tourism destinations and support strategic planning. For instance, Šostar et al. (2026) combined Principal Component Analysis with the AHP method to analyse how promotional channels influence destination choice in Croatia, highlighting the increasing use of statistical and decision-making methods in tourism research. Similarly, Boonmee & Arimura (2026) proposed a hybrid evaluation framework combining AHP-weighted multi-criteria decision-making methods with data-driven techniques to assess the performance of cultural tourism destinations in Northern Thailand, highlighting the importance of structured evaluation models for improving destination competitiveness and sustainability.

In addition, Aria et al. (2025) used a stochastic multi-criteria acceptability analysis to evaluate tourism sustainability across Italian regions, showing that advanced multi-criteria models can support stronger, more policy-relevant tourism planning. These recent contributions confirm the increasing importance of integrating statistical techniques with MCDM methods for analysing complex tourism decision-making problems.

Overall, the literature shows strong agreement on the main factors influencing destination choice, especially cultural and natural attractions, service quality, safety, and value for money. Recent studies also indicate that tourist preferences are increasingly influenced by sustainability awareness, particularly among younger travellers. Šenková et al. (2026) found that generations Y and Z are more interested in sustainable tourism products and services. However, sustainability often has a smaller influence on real tourist decisions, especially in developing or emerging destinations. Although hybrid multi-criteria decision-making methods are widely used, relatively few studies combine empirically derived tourism factors with expert-based weighting and ranking within a single hybrid framework, particularly in the context of developing tourism destinations such as Albania. Recent studies focusing on the Albanian tourism sector also emphasise the importance of understanding destination performance and seasonality dynamics from a stakeholder perspective (Dhimitri et al., 2025). Therefore, this study employs an integrated EFA–BWM–TOPSIS framework to analyse factors influencing destination selection and evaluate tourism destination competitiveness.

RESEARCH METHODOLOGY

To conduct this study, initially based on the literature (Alam et al., 2015; Seyidov & Adomaitienė, 2016; Blešić et al., 2021), and in consultation with a tourism expert, thirteen items were selected that could influence foreign tourists' decisions to select Albania as a tourist destination. Three hundred questionnaires constructed in English, based on a five-point Likert scale ranging from 1 (not important) to 5 (very important), were distributed to foreign tourists accommodated in hotels in three main coastal destinations in Albania: Saranda, Durres and Vlora, in the summer of 2024, using a non-probability convenience sampling approach. After eliminating incomplete questionnaires and those

with contradictory answers, 270 valid questionnaires were retained for further analysis. According to the recommendation of Hair et al. (2009), a minimum sample size of at least five observations per variable is sufficient for factor analysis, the final sample size ensured an appropriate level of reliability and statistical robustness. An exploratory factor analysis was conducted on this data, the results of which served in the second phase of the study, where the BWM-TOPSIS method was used based on the judgments of 12 Albanian tourism experts to evaluate the criteria and sub-criteria that most influence the choice of a tourist destination, as well as to rank the alternatives. The criteria and sub-criteria used in the BWM analysis were taken directly from the factors and items identified through exploratory factor analysis, ensuring consistency between tourists' perceptions and the expert-based weighting process.

Exploratory Factor Analysis

EFA was performed on the data of 270 surveys included in this study. First, the suitability of the data for this analysis was assessed through the Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity. In the following, EFA enabled the discovery of factors that tourists consider when choosing a destination, among a set of thirteen observed items by grouping those that are highly correlated (Howard & Henderson, 2023). As an extraction method, principal axis factorisation was used, since the goal was to discover hidden factors rather than reduce the number of items considered. Oblique rotation Promax was employed, as the factors influencing the selection of a tourist location may exhibit correlations (Hair et al., 2009; Howard & Henderson, 2023). The quantity of factors was ascertained based on eigenvalues above 1. No items were excluded, as all had factor loadings above 0.50 and no significant cross-loadings greater than 0.30. The internal consistency of each factor was assessed using Cronbach's alpha values. Thus, the exploratory analysis identified the main criteria that influence tourists' destination choices in the Albanian context.

BWM for Criteria Weighting

After identifying the main decision-making factors, the study assessed their relative importance and incorporated them into a decision-making model. To determine the weight of each criterion and sub-criterion, the BWM was used, a relatively new multi-criteria decision-making technique proposed by Rezaei (2015), which has found widespread use in contemporary literature (Deng et al., 2020; Varchandi et al., 2024). One of the main advantages of this method is the reduced number of pairwise comparisons, only $2n - 3$ comparisons per n criteria, which makes BWM more efficient, less tedious for decision-makers, and contributes to improving the robustness of the results (Rezaei, 2015; Rezaei et al., 2016). A new questionnaire with 28 pairwise comparisons was distributed to 12 tourism experts with more than 8 years of professional or academic experience, including university professors, hotel managers and travel agency executives. Based on the factor structure identified through factor analysis, the questionnaire included 5 pairwise comparisons for the criteria and 23 for the sub-criteria**.** This sample size is considered appropriate for BWM applications in tourism research, as previous studies indicate that a panel of 10–15 experienced experts is sufficient for reliable BWM and MCDM analyses (Rezaei, 2015; Mardani et al., 2016). The individual judgments from the experts were aggregated using the geometric mean to obtain a single group-comparison matrix for the BWM analysis, a common approach in group decision-making applications. The implementation of BWM includes the following steps (Rezaei, 2015):

- The set of criteria that serves for decision-making is identified.
- Experts select the best criterion and the worst criterion.
- The preference of the best criterion over the other criteria is determined, and the preference of each criterion over the worst criterion is also determined, based on a 9-point scale from 1 (equally important) to 9 (extremely important).
- The calculation and normalisation of optimal weights are performed by solving a linear optimisation model that minimises the maximum absolute differences between the extracted weight ratios and the pairwise judgments of the experts.
- The consistency ratio (CR) was subsequently calculated, and values below the recommended threshold of 0.1 indicate acceptable consistency of the experts' judgments.

The resulting linear programming model was performed in RStudio, using the 'lpSolve' package.

TOPSIS for Ranking Alternatives

The TOPSIS method was used to rank the four alternatives in this study, based on the identified sub-criteria and their weights. This method is well-suited to such problems because it evaluates each alternative against an ideal reference point. In TOPSIS, the best alternative is the one with the shortest distance from the hypothetical ideal solution and the greatest distance from the negative-ideal solution (Hwang & Yoon, 1981). The performance of the tourist destinations with respect to each criterion was evaluated by the same panel of tourism experts involved in the BWM analysis. All criteria were treated as benefit-type and assessed using a nine-point Likert scale. When multiple expert evaluations were available, the geometric mean was used to aggregate individual scores for each alternative and criterion.

The implementation of TOPSIS includes the following steps (Hwang & Yoon, 1981):

- For our analysis, a decision matrix of four alternatives was initially constructed with respect to the 13 sub-criteria included in the analysis.
- A normalised matrix of the initial decision matrix was constructed.
- By multiplying the normalised weights of each sub-criterion, calculated with the BWM method, by the values of the corresponding column of the normalised matrix, the normalised weighted decision matrix was constructed.
- According to the TOPSIS procedure, the ideal solution (highest score for each factor) and the negative-ideal solution (lowest score) were identified, and the Euclidean distance of each alternative from these values was calculated.

- The relative closeness to the ideal solution was calculated for each alternative, and the highest value indicated the most preferred alternative, allowing for a ranking from best to worst.

The analysis was run in RStudio using the 'topsis' package. The study framework is presented in Figure 1.

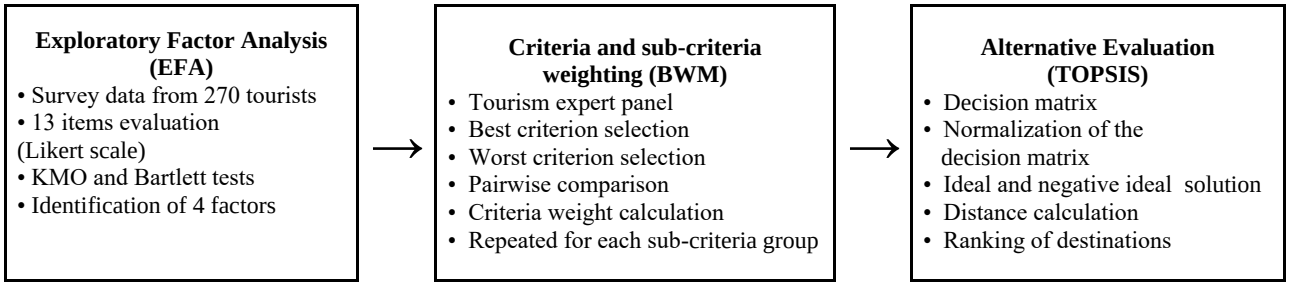


Figure 1. Research framework methodology (Source: Authors' elaboration)

By integrating BWM weighting and TOPSIS steps, we implemented a hybrid decision-making model: BWM provided the weights of the criteria, and TOPSIS provided the ranking of destinations using those weights. This hybrid EFA and BWM–TOPSIS approach represents an integrated decision-making framework applied in the context of tourism research in Albania. It enabled us not only to identify the main factors influencing destination choice but also to quantitatively prioritise decision-making alternatives (such as destinations to be developed or promoted) based on these factors. The combination of methods ensures that the conclusions are data-based and robust: the factor analysis phase bases the study on the empirical perceptions of tourists, while the multi-criteria decision-making analysis phase provides a rational tool for decision-makers to evaluate options in light of those empirically derived priorities.

RESULTS

Descriptive analysis of tourist profiles and item evaluations

The analysis of this study's results reveals the preferences and perceptions of foreign tourists who visited Albania over the last two years. In terms of their age, 27.75% were between 18 and 30 years old, 38.89% were between 31 and 50 years old, and 33.33% were over 50 years old. In terms of gender, males accounted for the largest share of the survey, about 53%. EU countries contributed 70.38% of all tourists, mainly from Italy and Germany. Among non-EU countries tourists, most came from Kosovo and Ukraine. Figure 2 shows the percentages by country of origin.

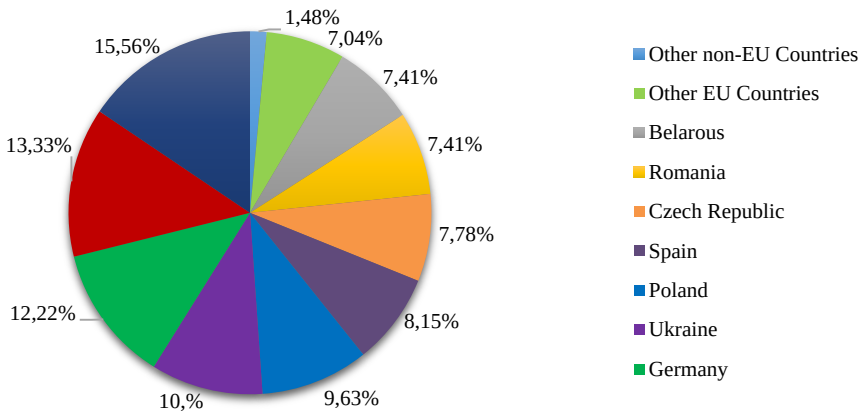


Figure 2. Distribution of tourists by country of origin (Source: Authors' elaboration based on survey data from 270 respondents)

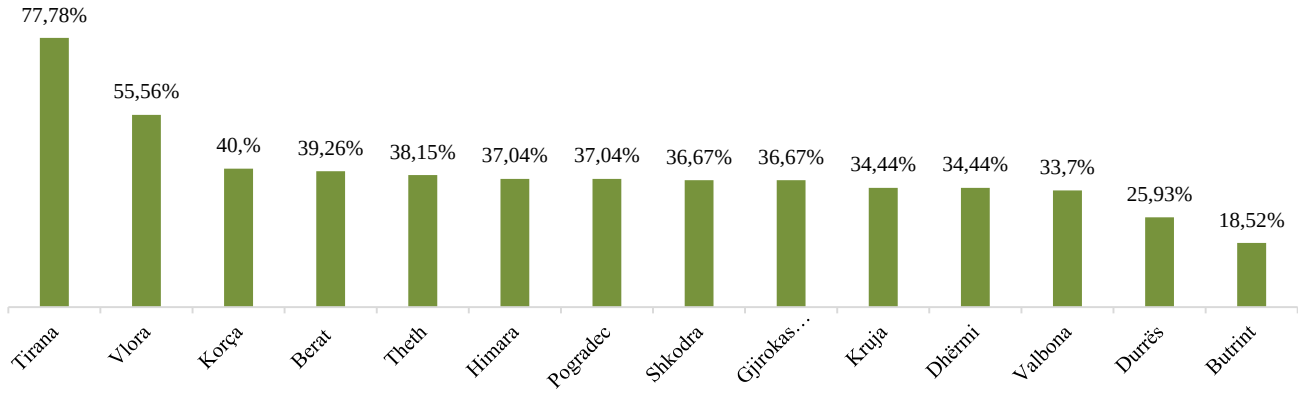


Figure 3. Destinations visited by tourists (Source: Authors' elaboration based on survey data from 270 respondents)

Albania, as a tourist destination, was visited by 43.7% of respondents through promotions by tourist agencies, 29.63% through acquaintances' recommendations, and 26.67% through social networks. Only 49.63% stated that it was their first time visiting Albania. The question of which of the listed destinations they had visited was answered as in Figure 3.

Tirana is the most visited destination (77.78%), reflecting its role as the capital and the location of Albania's primary international airport. The analysis shows that only 11.1% of tourists have visited exactly two destinations, while 41.9% and 46.3% have visited three and four destinations, under study respectively.

These results demonstrate that the tourism experience in Albania is largely multi-dimensional, thereby justifying the selection of four destination types as an analytical alternative. A 5-point Likert scale was used in the survey to rate 13 items that influence tourists' destination choices. The results of the descriptive analysis presented in Table 1 showed that, based on the mean values, the most highly rated items were 'Food and gastronomy experience', 'Quality of tourism services', and 'Road infrastructure quality'. The Cronbach's alpha reliability coefficient for each item ranged from 0.871 to 0.890. This coefficient for the total data was 0.885, suggesting a high internal consistency.

Table 1. Descriptive statistics for items in selecting a tourist destination (Source: Authors' calculations based on survey data from 270 respondents)

Items	Mean	St. Dev	Cronbach's Alpha
Accommodation price accessibility	**3.93**	1.05	0.872
Travel-related costs	3.62	1.17	0.871
Expenses for tourist activities	3.79	1.09	0.877
Perceived crime risk	3.55	1.15	0.881
Availability of emergency services	**3.95**	1.07	0.877
Sustainable accommodation practices	3.60	0.96	0.871
Environmental resource protection	3.57	1.09	0.875
Cultural heritage preservation	3.73	1.25	0.872
Tourism intensity and crowding	3.32	1.13	0.877
Food and gastronomy experience	**4.33**	0.84	0.879
Historical importance	3.82	1.02	0.890
Road infrastructure quality	**4.14**	0.98	0.874
Quality of tourism services	**4.15**	1.03	0.879

EFA results and factor structure

Exploratory Factor Analysis was used in the first part of the study to figure out how the hidden factors that affect the choice of a destination are structured. Two standard tests were applied to assess whether the data for the 13 items included in the survey were suitable for this analysis. The Kaiser–Meyer–Olkin measure of sampling adequacy was 0.81, which is higher than the ideal value of 0.6, as suggested by Kaiser (1974). Bartlett's test of sphericity ($\chi^2(253) = 3858.37$, $p < .001$) confirmed that the correlation matrix is not an identity matrix (Bartlett, 1951). Table 2 shows the results of the factor analysis, which found four factors accounting for 63.11% of the variance. The factor 'Destination sustainability practices' has four items with factor loadings between 0.6 and 0.803, and accounts for 19.30% of the variance.

Table 2. The results of factor analysis (Source: Authors' calculation based on survey data from 270 respondents)

Factors and Items	Factor loading	Eigenvalue	Variance (%)
Destination sustainability practices		5.607	19.30
Sustainable accommodation practices	0.726		
Environmental resource protection	0.803		
Cultural heritage preservation	0.600		
Tourism intensity and crowding	0.667		
Cultural attractions and facilities		1.627	16.04
Food and gastronomy experience	0.738		
Historical importance	0.608		
Road infrastructure quality	0.594		
Quality of tourism services	0.785		
Cost and perceived value		1.202	15.22
Accommodation price accessibility	0.878		
Travel-related costs	0.598		
Expenses for tourist activities	0.701		
Destination safety		1.011	10.59
Perceived crime risk	0.760		
Availability of emergency services	0.715		

The factor 'Cultural attractions and facilities' has four items with factor loadings between 0.594 and 0.785. It accounts for 16.04% of the variance. Three items with factor loadings between 0.595 and 0.878 define the factor 'Cost and perceived value', which explains 15.22% of the variance. Two items define the factor 'Destination safety', which explains 10.59% of the variance. For each factor, the Cronbach's alpha reliability coefficient was higher than 0.79 (Shrestha, 2021).

Weighting and ranking of criteria through the BWM–TOPSIS method

In the second phase of the study, a questionnaire was constructed with a structure of criteria and sub-criteria based on the factors and items identified through the EFA analysis, making it suitable for the application of the BWM-TOPSIS method. The assessments of the twelve tourism experts served as the basis for the analysis of the hybrid multi-criteria decision-making method. The BWM method was used to calculate the weights of the four factors and the local and global weights of their respective items, enabling their ranking. The calculated consistency ratio values at both the criteria and sub-criteria levels were below the recommended threshold of 0.1. The mean consistency ratio was below 0.052, and the maximum value did not exceed 0.073. The results are presented in Table 3.

Table 3. BWM weights and sub-criteria ranking (Source: Authors' calculations based on survey data from 270 respondents)

Criteria	Criteria weight	Sub-criteria	Sub-criteria local weight	Sub-criteria global weight	Ranking
Destination sustainability practices	0.113	Sustainable accommodation practices	0.166	0.019	12
		Environmental resource protection	0.254	0.028	11
		Cultural heritage preservation	0.441	0.049	8
		Tourism intensity and crowding	0.139	0.016	13
Cultural attractions and facilities	0.468	Food and gastronomy experience	0.209	0.095	5
		Historical importance	0.126	0.058	7
		Road infrastructure quality	0.253	0.116	3
		Quality of tourism services	0.412	0.188	1
Cost and perceived value	0.222	Accommodation price accessibility	0.706	0.177	2
		Travel-related costs	0.174	0.044	9
		Expenses for tourist activities	0.120	0.030	10
Destination safety	0.196	Perceived crime risk	0.599	0.108	4
		Availability of emergency services	0.401	0.072	6

'Cultural attractions and facilities' resulted the criterion with the highest weight (0.468), followed by 'Cost and perceived value' (0.222). The least valued criterion was 'Destination sustainability practices' with a weight of 0.113. The weights of the criteria and sub-criteria were used to calculate the global weights of the latter. According to the global sub-criteria weights, 'Quality of tourism services', 'Accommodation price accessibility', 'Road infrastructure quality', and 'Perceived crime risk' had the greatest influence on tourists' selection of Albania as a tourist destination.

The following sub-criteria, 'Tourism intensity and crowding' and 'Sustainable accommodation practices', had the lowest influence on the decision-making process. The TOPSIS method was used to evaluate four alternative tourist destinations in Albania: Tirana (urban) destination, Heritage and Culture destination, Riviera and Coastal destination, and Mountains and Lakes destination. The evaluation was based on the weighted criteria obtained from the BWM analysis and expert assessments of destination performance. These results are shown in Table 4 and are based on the distances to the positive ideal solution (D^+) and the negative ideal solution (D^-), as well as the closeness coefficient (C_i).

The Heritage and Culture Destination has the highest C_i value and is therefore ranked as the most preferred option.

Table 4. The results of the TOPSIS method (Source: Authors' calculations based on survey data from 270 respondents)

Alternatives	D^+	D^-	C_i	Ranking
Tirana (Urban) Destination	0.036	0.026	0.415	3
Heritage and Culture Destination	0.012	0.042	0.776	1
Riviera and Coastal Destination	0.030	0.026	0.462	2
Mountains and Lakes Destination	0.040	0.016	0.294	4

The ranking obtained using the TOPSIS method confirms the multidimensional nature of the destination's attractiveness. Destinations representing 'Heritage and Culture', such as Berat, Gjirokastra, and Butrint, are the most preferred as a result of their high performance in tourism services and cultural values, despite moderate results in sustainability. The Riviera and Coast areas were ranked as the second most preferred destination, reinforcing the dual attractiveness of Albania as a cultural and coastal destination.

DISCUSSION

To present a comprehensive picture of destination choice in the context of a developing destination like Albania, this study presents the advantages based on expert judgments through the BWM–TOPSIS method and tourists' ratings derived from exploratory factor analysis. The analysis through factor analysis in collaboration with hybrid multi-criteria decision-making methods is in line with current studies in the field of tourism (Khan et al., 2023). The dominance of cultural attractions and service-related attributes is consistent with previous findings that highlight social interaction, cultural experiences, and service quality as key drivers of tourism behaviour (Nejat & Lajimi, 2022).

Similar to the results reported by Çiçekdağı (2022), tourists in Albania showed a stronger preference for experience-related attributes than for sustainability-oriented concerns, such as eco-friendly accommodation or overtourism.

These findings are further supported by Blešić et al. (2021), who identified gastronomy, infrastructure, and destination image as essential elements of destination attractiveness. In the Albanian context, these results are consistent with studies that highlight destination infrastructure and image as important determinants of tourism preference (Godolja & Spaho, 2014; Braimllari, 2017; Kasapi & Nurja, 2019).

The high ranking of food and gastronomy experience further confirms that local cuisine plays an increasingly important role in destination competitiveness (Dulja et al., 2025; Phrammanachot et al., 2026). In tourists' ratings, items related to sustainability accounted for the largest share of the variance, whereas expert ratings ranked destination sustainability practices as the least influential criteria in destination choice. This result indicates a gap between sustainability awareness and decision-making behaviour, consistent with previous studies suggesting that sustainability is conceptually recognised but not prioritised in short-term travel decisions, especially in developing destinations (Dwyer, 2024; Guga & Qiqi, 2025; Suhud et al., 2025). Cost and perceived value, and destination safety were the other two factors identified by factor analysis, reinforcing previous findings that highlight price sensitivity, perceived value for money, and safety as fundamental criteria for international tourism demand (Mohamad & Jamil, 2012; Alam et al., 2015; Dębski & Nasierowski, 2017; Son et al., 2023; Ilies et al., 2025). This result also reflects Albania's emerging reputation as a low-cost destination in the Mediterranean region, where affordability and value for money play a significant role in tourists' destination choices.

Overall, tourist and expert assessments indicated that cultural attractions and facilities represent key competitive advantages for Albania. The quality of tourism services proved to be the most influential item, indirectly reflecting the growing role of organisational efficiency and digital readiness in enhancing tourist satisfaction and destination competitiveness (Gjika & Pano, 2020; Noti & Hasrama, 2025; Chae, 2026).

Furthermore, this study contributes to the literature by empirically confirming the divergence between sustainability awareness and actual decision-making, while assessing the applicability of the integrated EFA-BWM-TOPSIS framework for assessing destination competitiveness in new tourism contexts.

CONCLUSION

From a methodological perspective, this study contributes to the tourism literature by demonstrating the effectiveness of integrating EFA with the hybrid BWM-TOPSIS model to capture, within a single decision-making framework, the perceptions of 270 foreign tourists who visited Albania and the preferences of 12 Albanian tourism experts. In this way, the results provide a multidimensional understanding of the factors influencing the selection of Albania as a tourist destination and allow comparisons between tourists' perceptions and experts' preferences. Destination sustainability practices, cultural attractions and facilities, cost and perceived value, and destination safety were the four factors identified by the EFA analysis. Although 'cultural attractions and facilities' was not the dominant factor in terms of explained variance, it emerged as the most influential criterion in the experts' assessments and was reflected in the TOPSIS ranking, where heritage and cultural destinations were identified as the most preferred alternatives. Perceived cost and value, along with safety-related considerations, emerged as the main determinants of destination choice, indicating that affordability and perceived safety remain essential conditions for Albania's competitiveness as an international tourist destination.

The results of this study provide several suggestions for tourism policy in Albania. For example, cultural infrastructure and tourism services should continue to improve, with investments in road conditions and heritage preservation. Safety should remain an important element, particularly when promoting Albania to international tourists. Although sustainability ranks lower in short-term decision-making, it should not be neglected. As tourist expectations evolve, sustainability credentials may become more important, especially among young, environmentally conscious travellers (Šenková et al., 2026). Culture, cost, and safety had the greatest impact on decision-making, while sustainability, although conceptually assessed, remains a secondary driver in selecting a tourist destination. These findings are in line with recent literature on tourism planners in Albania seeking to increase competitiveness while maintaining authenticity and environmental responsibility. The proposed EFA–BWM–TOPSIS framework offers a robust and transferable tool for evaluating destination competitiveness across different tourism contexts.

Study limitations: Regarding this study's limitations, we can mention the sample size, which limits the generalizability of the findings, and the non-random but appropriate sample. The study focused only on Albania, limiting comparisons with other countries in the region and beyond to identify similarities or characteristics among similar destinations. Also, the survey data collection method did not avoid subjective responses influenced by tourists' recent experiences. Directions for future research: For further studies, it is recommended to expand the study to the Balkan region and to increase the number of respondents, tourists, and tourism experts. It is also of interest to apply more multi-criteria decision-making methods in order to enable comparison of their results. To better understand tourist preferences, the survey could be expanded to include new items.

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Glossary: AHP – Analytic Hierarchy Process; BWM – Best–Worst Method; CR – Consistency Ratio; EFA – Exploratory Factor Analysis; GAIA – Geometrical Analysis for Interactive Aid; ICT – Information and Communication Technology; KMO – Kaiser–Meyer–Olkin; MCDM – Multi-Criteria Decision-Making; PCA – Principal Component Analysis; PROMETHEE – Preference Ranking Organization Method for Enrichment Evaluations; SDGs – Sustainable Development Goals; TOPSIS – Technique for Order Preference by Similarity to Ideal Solution.

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DIGITAL ECONOMY AND TOURISM GROWTH IN SUB-SAHARAN AFRICA

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Abstract: Tourism in Sub-Saharan African nations holds significant potential to drive economic growth. However, unstable economic growth, inadequate infrastructure, environmental degradation, and exchange rate volatility hinder the trajectory of tourism growth. Moreover, the digital economy's role in transforming tourism dynamics is an emerging destination in the SSA. Therefore, to gain a focused understanding of how these macroeconomic factors, i.e., economic growth (EG), infrastructure (INF), environment (ENV), digital economy (DGE), and exchange rate (ER) affect tourism in the top 5 tourist SSA nations is vital for crafting sustainable and inclusive growth tourism strategies. We employed the novel Method of Moments Quantile Regression (MMQR) to estimate heterogeneous effects at short-, medium-, and long-run quantiles for the period from 1995 to 2023. Additionally, we utilized the Dumitrescu and Hurlin panel causality test to assess causality. The MMQR estimates evidenced that economic growth and the digital economy have a favorable impact on tourism at all quantiles. The favorable effect across short-, medium-, and long-term quantiles can be attributed to higher disposable incomes and better access to digital platforms that facilitate travel planning, information dissemination, and service delivery. However, the rise in environmental degradation and higher exchange rates has a detrimental effect on the tourism industry. Environmental degradation reduces the aesthetic and ecological value of tourist destinations. Higher exchange rates make travel more expensive, reduce purchasing power, and discourage international travel. The practical implications include prioritizing economic development, allocating resources to digital transformation, and adopting thoughtful tactics for environmental sustainability. Policymakers should consider the complexities of exchange rate swings, which may create inflationary pressures from currency depreciation.

Keywords: tourism, digital economy, environmental degradation, exchange rates, Sub-Saharan African Nations, MMQR estimator

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INTRODUCTION

The tourism industry offers an essential opportunity for African economies to achieve economic growth and structural transformation by promoting economic diversification, thereby increasing economic stability (Ekeocha et al., 2021). According to the tourism-led economic development hypothesis (TLGH), tourism contributes to economic growth through various channels. Indeed, tourism generates foreign-exchange earnings (Suhud et al., 2024), infrastructure investment, and employment (Antonakakis et al., 2015). It is widely acknowledged that Africa's natural resources play a significant role in driving its economy (Sharpley, 2002), and the COVID-19 pandemic has imposed substantial limitations on global trade, adversely affecting African economies (Ekeocha et al., 2021).

Although tourism declined in 2019-2020, it has shown a resurgence in 2021, offering a promising opportunity for recovery. In fact, the UNWTO[1] has observed an increase in international arrivals in Africa from 2021 (19.65 million) to 2022 (46.61 million). The upward trend in the tourism sector not only demonstrates resilience but also offers a potential solution to counteract the negative economic consequences of the lasting crisis. Thus, the tourism industry provides African economies which rely on the export of raw minerals and primary goods, with a way to protect themselves from unforeseen fluctuations in demand. Several African countries have popular tourist destinations due to their diversified, rich cultural heritage and distinctive landscapes. Among these African countries, Egypt, South Africa, Morocco, Kenya, and Tunisia rank among the top 5 tourist destinations (Okoroafor, 2023).

These countries not only offer a wide range of cultural and natural attractions but also serve as prime examples of the dynamics and trends that shape the overall tourism scene in Africa. Previous studies on tourism development in Africa did not include certain countries that exert substantial influence in the continent's tourism sector. This exclusion highlights a significant deficiency in the existing body of empirical literature, as these nations, which are actively involved in tourism,

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can provide valuable instances for analysis. Hence, it is imperative to include these countries in the empirical analysis, as their experiences and strategies could offer invaluable empirical insights for the holistic advancement of tourism in Africa. Notably, there is limited empirical research on the relationship between tourism and economic growth in Africa, specifically focusing on the continent's involvement in the tourism sector and the factors that could improve the tourism industry. Indeed, some macroeconomic factors influence tourism development. First, the correlation between economic growth, as measured by GDP, and the tourism industry is intricate. An increase in GDP frequently results in higher disposable income, which in turn can boost demand for tourism. The digital age has ushered in a period of digitalization and connectivity that has had a profound influence on the tourism industry (Kuo et al., 20[1]9), a crucial element to be examined. Similarly, it cannot be neglected that trends in infrastructure can have a significant impact on tourism.

Rapid urbanization can lead to increased infrastructure development, potentially enhancing a region's overall attractiveness to tourists (Ma & Tang, 2023). Then, tourism can have negative environmental consequences, most notably increased carbon emissions from transportation and infrastructure development (Gössling, 2021). It is imperative to explore at how environmentally responsible policies affect tourist arrivals. Moreover, acknowledging the dynamics of exchange rates and their effects on tourism is critical for understanding these African countries' competitiveness in the global tourism market (Bahmani-Oskooee & Hegerty, 2008). Figure 1, plot (a) to (f) illustrates the graphical represention of variables.



Figure 1. (a) to (f) plot the graphical trends of economic growth, digital economy, infrastructure, carbon emissions, exchange rate, and tourism in the top 5 tourist SSA nations (a) Economic growth trends; (b) Digital economy trends; (c) Infrastructure trends; (d) Carbon emissions trends; (e) Exchange rates trends; (f) Tourism trends (Source: World Bank Development Indicators (WDI, 2025)

The objective of this study is to address the research gap in the existing empirical literature acknowledged earlier. The findings of this study will not only improve our understanding of tourism in the selected regions, but will also provide policymakers, businesses, and stakeholders with the data-driven insights they need to make informed decisions and implement strategies for long-term tourism development, economic growth, and increased global competitiveness in Africa.

The main aim of this study is to examine how macroeconomic factors influence the growth of the tourism sector in the top five Sub-Saharan African economies using panel data from 1995 to 2023. The primary goals are as follows: (i) to analyze the influence of economic growth, digital economy, infrastructure, carbon emissions, and exchange rate on tourism; (ii) to establish the causal relationship between these macroeconomic factors and tourism. To accomplish these goals, the study employed the method of moments quantile regression (MMQR) and panel Granger causality, respectively.

The subsequent sections of the paper are arranged as follows. Section 2 provides an overview of the empirical literature, while Section 3 demonstrates the specific data and methods used in the study. Section 4 provides the empirical findings, whereas Section 5 concludes the paper by offering policy suggestions.

EMPIRICAL LITERATURE REVIEW

Economic Growth and Tourism

Tourism is a significant contributor to the economy of many countries (Suhud et al., 2025). However, whether tourism drives economic growth is an important macroeconomic question for both policymakers and investors. Hence, exploring the link between tourism and economic growth has increased the interest of potential researchers. For instance, Albaladejo et al. (2023) examined data from 144 countries and found that increases in tourist arrivals are associated with higher GDP per capita. This positive relationship was observed across countries with varying levels of economic development. Wijesekara et al. (2022) suggested a reciprocal causal relationship, indicating that tourism can both contribute to economic growth and be influenced by it. Narayan et al. (2010) investigated the link in six (6) South Pacific island nations and found that the size of the tourism sector, as a percentage of GDP, has a significant and positive impact on economic growth in these small, tourism-dependent economies. Moreover, Hoti et al. (2005) investigated the impact of tourism diversification on Caribbean economic growth. Their research demonstrated that diversification strategies can improve the sustainability of economic growth, particularly in tourism-dependent regions. Also, Nyasha et al. (2021) investigated the impact of tourism diversification on economic growth in sub-Saharan Africa, emphasizing that diverse tourism products can reduce vulnerability to external economic shocks while also boosting GDP growth. Therefore, expanding tourism through the development of novel offerings and markets can enhance economic adaptability. Moreover, seasonal fluctuations in tourism can have a variety of effects on economic growth. Martín et al. (2014) examined data from Spain and found that tourism seasonality adversely affects economic growthin the regions that are heavily dependent on toursim. However, Wang et al. (2023) analyzed Chinese data and found that seasonality has an insignificant effect on the correlation between tourism and economic growth under certain conditions. Velikova & Tzvetkova (2018) investigated the impact of seasonality on Bulgarian tourism and GDP. The study emphasized the importance of managing seasonality to minimize fluctuations in GDP and ensure year-round economic stability. Tourism's contribution to GDP goes beyond direct contributions. In empirical research, the "multiplier effect" is well documented. Based on the literature we postulate that:

$\mathbf{H_1}$ Economic growth has a positive and significant effect on tourism in the top 5 SSA tourist economies.

Digital Economy and Tourism

The digital economy and tourism are two important sectors that are closely related and mutually beneficial. The digital economy acts as a catalyst for tourism. For instance, Siuta-Tokarska (2010) emphasized the critical role of technology in shaping modern tourism, driving innovation, and facilitating tourists' experiences. According to Sustacha et al. (2023), technology is reshaping the entire tourism value chain, from information search and trip planning to booking, in-destination experiences, and post-trip sharing. This comprehensive viewpoint emphasizes technology's transformative impact on tourism.

Moreover, Liu et al. (2020) found that tourists can use mobile technology to access real-time information, interact with reviews, and share their experiences, all of which influence their travel decisions. Similarly, Minazzi & Minazzi (2015) emphasized that mobile technology's multifaceted impact on the tourism industry, from information dissemination to real-time engagement. Additionally, Lim et al. (2024) found that augmented and virtual reality technologies can significantly enhance the quality of tourist experiences and increase satisfaction and intent to return. Beck et al. (2019) affirmed the outcomes of the Lim et al. (2024). Moreover, the empirical literature recognizes both the opportunities and challenges that technology presents in tourism. According to Gössling (2021), it is critical to address issues such as information overload, privacy concerns, and the digital divide. They do, however, emphasize the potential of technology to enable personalized travel experiences and improve destination management. Saprov (2023) also discussed the changing landscape of tourism technology and the need to address issues like cybersecurity, privacy concerns, and the digital divide. At the same time, they highlight the potential for technology to enable personalization, improve destination management, and provide new business models. Hence, based on this, we have postulated the hypotheses as under:

$\mathbf{H_2}$ The digital economy is a significant contributor to tourism in the top 5 SSA tourist economies, but a challenge in others.

Infrastructure and tourism

The infrastructure is a key facilitator of tourism, according to empirical research. Colacchio & Vergori (2023) studied the link between infrastructure and regional tourism development in Italy. Their findings emphasized the importance of well-developed transportation networks and other tourism-related infrastructure in attracting visitors and

driving regional economic growth. Similar outcomes have been reported by Adeola & Evans (2020). They emphasized that adequate infrastructure makes destinations more accessible and appealing to tourists. Similarly, Cheung & Law (2001) stated that the availability and quality of hotel infrastructure increases the length of stay and overall spending by tourists. Moreover, Sánchez-Sánchez et al. (2021) found that a well-developed cultural infrastructure attracts tourists. Then, the relationship between tourism and infrastructure is fraught with difficulties. Shafiee et al. (2023) investigated the concept of "smart tourism" and the integration of technology into destination infrastructure. Their research focuses on the importance of balancing infrastructure expansion with sustainability, with an emphasis on the role of smart infrastructure solutions. Also, sustainable tourism practices have emerged as an important consideration in infrastructure development. Based on this, we have postulated that:

H_3 Developed infrastructure is a significant contributor to tourism in the case of top 5 SSA tourist economies.

Exchange Rate and Tourism

The exchange rates have a consistent impact on international tourism demand. Empirical research by Tung (2019) indicates that local currency depreciation can make a destination more appealing to international tourists, whereas an appreciation can have the opposite effect in Vietnam. Moreover, currency fluctuations affect not only tourist arrivals but also their spending habits. Irandoust (2019) conducted research across 10 European countries on the relationship between tourism spending and exchange rates. According to the study, fluctuations in exchange rates can significantly alter tourist spending behavior, thereby affecting the overall economic impact of tourism. Alleyne et al. (2020) also investigated the impact of fluctuating exchange rates on international tourism demand in the United States. According to the study, exchange rate fluctuations can deter tourists, particularly those from countries with devalued currencies. Thirdly, the competitiveness of tourism destinations is influenced by exchange rates. Loganatan et al. (2019) investigated the relationship between Malaysia's tourism competitiveness and exchange rates. According to their findings, exchange rate movements have a significant impact on destination competitiveness, affecting a country's ability to attract tourists and compete with other destinations. In the same paper, they also examined the ramifications of Malaysia's exchange rate policies on the tourism industry. The study emphasized the importance of exchange rate stability and the role of government policies in fostering a favorable environment for tourism development. Hence, we postulate that:

H_4 Exchange rate fluctuation has a significant effect on tourism in the top 5 SSA tourist economies.

Environmental Degradation and Tourism

The issue of carbon emissions and their impact on tourism has garnered significant attention in recent years, as the tourism industry is both a contributor to and a recipient of the effects of climate change. Ali et al. (2024) found that tourism contributes substantially to global carbon emissions. However, Churchill et al. (2021) found that the aviation industry's impact on CO_2 emissions has been steadily increasing, posing environmental challenges for the tourism sector. Hence, the importance of considering the environmental impacts of tourism. Moreover, seasonal variations in tourist arrivals can affect CO_2 emissions. Le & Nguyen (2021) found that increased passenger volumes during peak tourist seasons can result in higher carbon emissions, underscoring the importance of sustainable management practices to minimize environmental impacts. Empirical research has also examined the effectiveness of CO_2-reduction policies and strategies in the tourism industry. Wang & Xi (2023) investigated the European Union's emissions trading scheme (EU ETS) and its consequences for the aviation industry. The study looked at the potential of emissions trading as a policy tool for reducing carbon emissions in the tourism industry.

H_5 Environment Degradation have a significant effect on tourism in the top 5 SSA tourist economies.

Conceptual framework

Based on the theoretical and empirical literature review, we developed the conceptual framework for our study as shown in Figure 2.

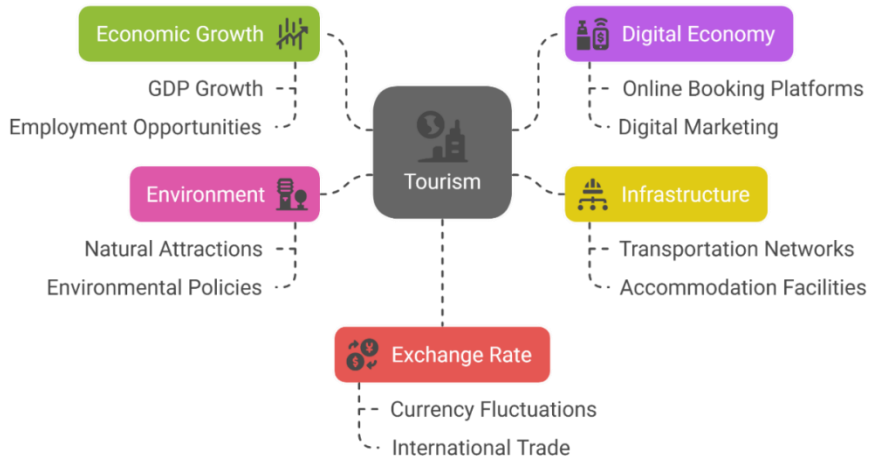


Figure 2. Conceptual Framework

MATERIALS AND METHODS

Data and Variables

Economic growth is a sustained increase in a country's real output over time, reflecting improvements in productivity, investment, technology, and labor efficiency (Ali et al., 2025a). The tourism sector contributes to economic growth by stimulating physical and human capital and driving technological innovation (Wu et al., 2026). However, economic growth plays a key role in stimulating tourism development by increasing income levels, boosting investment in infrastructure such as airports, roads, hotels, and transport systems, and enhancing service quality, thereby making destinations more attractive to international visitors (Alfehaid, 2026). The development of infrastructure significantly improves accessibility and connectivity, which are critical drivers of tourist arrivals (Smith, 2026). The development of the digital economy has become an important driver of tourism growth by increasing information accessibility, online booking systems, digital marketing, and smart tourism services (Liu & Zhao, 2026), which enhances tourist's travel experience and destination visibility (Liu & Huang, 2026). Besides, exchange rate fluctuations, for instance, currency depreciation, can make a destination cheaper for inbound visitors, thereby stimulating tourism inflows (Wickramaarachchi & Jayathilaka, 2026). Additionally, environmental quality has become an increasingly important factor affecting tourism sustainability, as pollution can reduce destination attractiveness and influence tourists' preferences toward environmentally sustainable destinations (Wang et al., 2026). Therefore, following the recent studies of Wu et al. (2026), Alfehaid (2026), Smith (2026), Liu & Zhao (2026), Wickramaarachchi & Jayathilaka (2026), and Wang et al. (2026), this study has developed the following econometric model:

$$\text{TOUR} = \text{f (EG, DGE, INF, ENV, ER)} \quad (1)$$

In Equation (1), TOUR, EG DGE, INF, ENV, and ER represent the economic growth, digital economy, infrastructure, environment, and exchange rate, respectively. Moreover, authors transformed equation (1) to:

$$TOUR_{it} = \forall_0 + \forall_1 EG_{it} + \forall_2 DGE_{it} + \forall_3 > INFS_{it} + \forall_3 ENV_{it} + \forall_4 ER_{it} + \mu_{it} \quad (2)$$

Where *i* denotes cross-section (i.e., top five sub-Saharan African tourist economies), *t* denotes time period of the study (1995 – 2023), $TOUR_{it}$ denotes tourism measured by international tourism (number of arrivals), eg_{it} represents the increase in economic output measured by GDP per capita (constant 2015 US dollars), DGE_{it} denotes the digital economy measured by total Patent applications, $INFS_{it}$ denotes infrastructure measured by population in the largest city (% of urban population), $CO2_{it}$ denotes environment measured by CO_2 emissions (metric tons per capita), and ER_{it} denotes exchange rate measured by official exchange rate (LCU per US$, period average). ∀0 denotes intercept, ∀1, 2, 3, 4 denote coefficients, and μit denotes the error term. The detailed description for all variables is listed in Table 1.

Table 1. Data synopsis (Source: "WDI = World development Indicators (2025), data is retrieved from https://databank.worldbank.org/reports.aspx?source=World-Development-Indicators")

Abbreviations	Variable	Measurement	Source
TOUR	Tourism	International tourism, number of arrivals	WDI (2025)
EG	Economic Growth	GDP per capita (constant 2015 US$)	
DGE	Digital Economy	Total Patent applications, non-residents and residents	
INF	Infrastructure	Population in the largest city (% of urban population)	
ENV	Environment	CO_2 emissions (metric tons per capita)	
ER	Exchange Rate	Official exchange rate (LCU per US$, period average)	

Econometric Model Selection Process: The selection of the suggested econometric model is categorized into three categories: Stage 1: Preliminary tests, Stage 2: Model Choice, and Stage 3: Robustness Check.

Stage 1. Preliminary Test: In stage 1, we first employed the Cross-sectional dependency (CSD) test to assess cross-sectional dependence. Neglecting this test may lead to a lack of consistency, reliability, accuracy, impartiality, and practicality. Second, due to the presence of CSD, we employed second-generation tests, such as CADF, CIPS, and RALS-ADF, to investigate the non-stationarity in the data. Third, we employed the Slop Heterogeneity test to assess coefficient slopes. Finally, to assess the long-term association among the variables, this research employed RALS-EG cointegration test.

Stage 2. Model Choice: Based on the characteristics of the data determined in stage 1, we selected the Method of Moments Quantile Regression approach. The classical quantile regression is characterized by its semiparametric nature, which allows it to operate without dependence on distributional assumptions and to exhibit resilience to irregularities in the data. Binder & Coad (2011) argue that the validity of Q.R. remains unaffected even when there is no conditional mean association between the variables being studied. This study employed a novel MMQR method to capture the conditional heterogeneity of the explained facet (Machado & Silva, 2019). The approach utilized in this study offers several benefits in effectively addressing the influence of individual effects and endogeneity within the parameters (Ali et al., 2025b; Khalid et al., 2026). Samour et al. (2024) suggested that the MMQR is the most suitable method for analyzing heterogeneity across quantiles. The formulation of the conditional quantile model incorporates estimations of the altered location and scale parameters (Machado & Silva, 2019).

$$Y_{it} = \delta_i + X_{it}' a + \left(\mathrm{B}_i + \mathrm{Q}_{it}' \sigma\right) \omega_{it} 0.75 em \quad (3)$$

The probability that the random variable $\left(B_i + Q'_{it}\sigma\right) > 0$ and equal to one. However, the parameters to be estimated are denoted as δ_i, α, B_i and σ. The variables δ_i and B_i represent the fixed effects of the model, while Q_{it} refers to the

differentiable transformation of the m-dimensional vector X. Following (Machado & Silva, 2019), the mathematical definition of a concept can be expressed as follows:

$$S_c = S_c(X), c = 1,2,3 \ldots., m \quad (4)$$

The subsequent approach is utilized to make estimations within the quantile context (Machado & Silva, 2019).

$$Q_y\left(\mathcal{T}/_{X_{it}}\right) = (\delta_i + B_i(q(\mathcal{T})) + X'_{it}a + Q'_{it}\sigma_q(\mathcal{T}) \quad (5)$$

In Equation 5, $Q_y\left(\mathcal{T}/_{X_{it}}\right)$ represents the conditional quantile $\mathcal{T}$ of the dependent variable given the vector of explanatory variables X'_{it}. The term δ_i denotes the individual-specific fixed effects capturing unobservable heterogeneity across units. X'_{it} is a vector of explanatory variables for country i at time t, while a represents the associated slope parameters. $B_i(q(\mathcal{T})$ term captures the heterogeneous distributional effect across quantiles and $Q'_{it}\sigma_q(\mathcal{T})$ term represents the conditional scale function that allows the variation of the error term to vey across the quantiles. This formulation enables the model to estimate the heterogeneous impact of independent variables across different points of the conditional distribution of the dependent variable. The tth quantiles of the data set are obtained by minimizing the given solution proposed by (Machado & Silva, 2019).

$$min_q \sum_i \sum_t \upsilon_{\mathcal{T}}(Z_{it} - (\mathrm{B}_i + \mathrm{Q}'_{it}\sigma_q)q) \quad (6)$$

In Equation (6), Z_{it} denotes the dependent variable for cross-section i and time t. The term B_i represents the individual-specific fixed effect capturing unobservable heterogeneity across the cross-sectional units. Q'_{it} refers to the vector of explanatory variables for cross-section i and time t, whereas $\sigma_q$denotes the conditional quantile level, typically ranging from 0 to 1. The function $\upsilon_{\mathcal{T}}$ represents the quantile loss function used in the estimation procedure.

Robustness Check: We have used the Dumitrescu-Hurlin Panel Causality Tests to assess the direction of causality between the study's components and to assess the robustness of the MMQR outcomes. Figure 3 depicts the framework of the methodologies employed in the present study. Figure 3 illustrates the methodological framework adopted in this study.

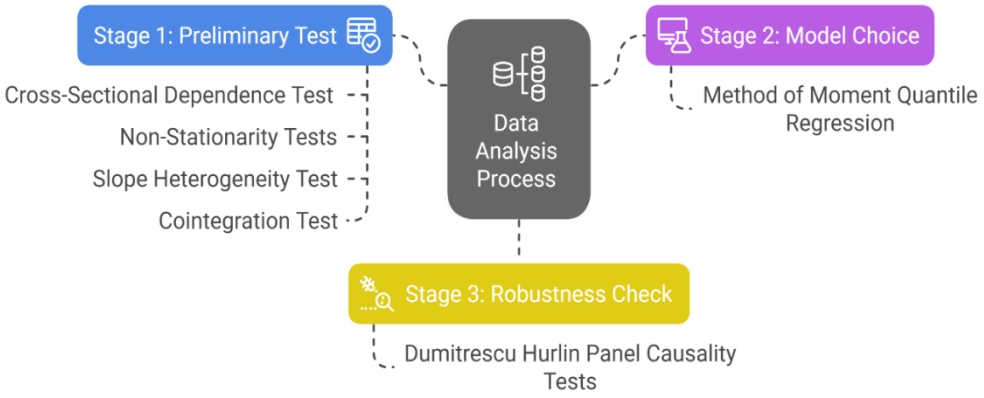


Figure 3. Methodological framework

RESULTS AND DISCUSSION

Descriptive Statistics

The descriptive statistics are presented in Table 2. The central tendencies for tourism, economic growth, the digital economy, infrastructure, carbon emissions, and the exchange rate are 6470768, 3202.996, 2071.024, 27.65913, 2.69438, and 22.15771, respectively. However, degree of dispersion of values from the central tendency for tourism, economic growth, digital economy, infrastructure, environment, and exchange rate are 3891729, 1475.851, 2617.274, 11.39786, 2.464544, and 31.55506, respectively. Moreover, Jarque-Bera outcomes indicate that the data are not normally distributed.

Table 2. Descriptive statistics estimations (Source: Author's compilation: Outcomes retrieved from EViews 13)

	TOUR	EG	DGE	INF	ENV	ER
Mean	6470768	3203	2071.02	27.6591	2.69438	22.1577
Median	5999500	3064.25	961.5	27.763	1.95913	8.41175
Maximum	15121000	6263.1	10960	45.6079	8.44665	117.866
Minimum	894000	1165.17	53	10.2094	0.20248	0.94575
Std. Dev.	3891729	1475.85	2617.27	11.3979	2.46454	31.5551
Skewness	0.393744	0.57903	1.42983	0.16693	1.22961	1.65368
Kurtosis	2.350785	2.51112	3.67162	1.79496	3.12234	4.17396
Jarque-Bera	6.076115	9.21725	50.3341	9.12084	35.3658	71.8479
Probability	0.047928	0.00997	0.000	0.01046	0.000	0.000
Sum	9.06E+08	448419	289943	3872.28	377.213	3102.08
Observations	140	140	140	140	140	140

CSD and Stationary Outcomes

Findings obtained from the CD test are displayed in Table 3, indicating that the null hypothesis of cross-sectional independence is rejected. Therefore, the results confirm that CSD exists. Given that we employed "second-generation panel unit root" methods. CIPS and CADF results indicate a mixed order of integration. Moreover, the RALS-ADF cointegration outcomes in Table 4 indicated mixed results with CIPS and CADF.

Table 3. CSD, CIPS, and CADF outcomes (Source: Authors compilation data retrieved from Stata 17; Note: *** denotes significance levels at 1% significance level. TOUR = tourism; EG = economic growth; DGE = digital economy; INF = infrastructure; CO2 = carbon emission; ER = Exchange rate)

CSD			CIPS		CADF	
Variables	CD-test	p-value	I(0)	I(1)	I(0)	I(1)
TOUR	12.72***	0.000	-2.775***	-	-2.345**	-
EG	14.9***	0.000	-0.333	-4.079***	-0.532	-2.676***
DGE	9.29***	0.000	-1.663	-3.108***	-2.457**	-
INF	-3.06***	0.002	-4.383***	-	-3.069***	-
ENV	12.96***	0.000	-3.409***	-	-2.537**	-
ER	10.77***	0.000	-2.378**	-	-2.812***	-

Table 4. RALS Unit Root outcomes (Source: Authors compilation data retrieved from EViews; Note: ***, ** and * indicate significance at 1%, 5% and 10% respectively. The 1%, 5% and 10% critical values for the ADF are -3.58, -2.93 and -2.60 respectively. The 1%, 5%, and 10% critical values for the RALS-ADF are -3.75, -3.30 and -3.05 respectively. TOUR = Tourism; EG = Economic Growth; DGE = Digital Economy; INF = Infrastructure; ENV = Environment; ER = Exchange Rate)

variables	**ADF**	**RALS-ADF**	ρ^2
TOUR	0.21	-1.01	0.57
ENV	0.48	-6.54***	0.63
EG	0.73	0.36	0.60
ER	0.43	-1.50	0.69
DGE	0.93	0.00	0.69
INF	0.55	-0.76	0.79
∆TOUR	-2.61*	-7.49***	0.84
∆ENV	-2.87*	-9.26***	0.73
∆EG	-2.69*	-6.33**	0.87
∆ER	-2.61*	-9.75***	0.85
∆DGE	-2.071*	-10.82***	0.69
∆INF	-2.85*	-3.06*	0.65

SH and Cointegration Outcomes

The outcomes of the slope-heterogeneity test are shown in Table 5. The findings reveal that both Delta and adjusted Delta stitistics are statistically significant at the 1% level. The RALS-EG cointegration test is more effective at identifying cointegration relationships among variables. Furthermore, Table 6 presents the cointegration test's estimations. At the 10% level of significance, the test statistic for the EG cointegration test is -4.01, which is below the critical value (-3.98). Based on the evidence, the null hypothesis of no cointegration is invalid. The test statistic for RALS-EG is -4.23, which is less than the critical value of -4.19 at the 5% significance level. Thus, the null hypothesis is refuted. In conclusion, the findings provide empirical support for the existence of a cointegrating relationship among tourism, economic growth, the digital economy, infrastructure, carbon emissions, and the exchange rate.

Table 5. SH estimations (Source: Authors compilation data retrieved from Stata 17)

		p-value
Delta	6.318	0.000
Adj. Delta	7.296	0.000

Table 6. RALS-EG estimations (Source: Authors compilation data retrieved from EViews; Note: ***, ** and * indicate the significance in 1%, 5% and 10% respectively; K shows the optimum lag length found using recursive statistics; the 1%, 5% and 10% critical values for the EG test are -5.02, -4.32 and -3.98 respectively; the 1%, 5%, and 10% critical values for the RALS-EG test are -4.80, -4.19 and -3.88 respectively)

Methods	K	Test statistics	ρ^2
EG	0	-4.01*	–
RALS-EG	0	-4.23**	0.91

MMQR Estimations

The outcomes of MMQR estimators are presented in Table 7. Outcomes of MMQR stated that economic growth has positively significant effect on the tourism throughout the quantiles such as lower quantiles (q1(1.318), q2(1.304), q3(1.293)) medium quantiles (q4(1.283), q5(1.274) q6(1.263)), and upper quantiles (q7(1.253), q8(1.245), q9(1.234)).

This implies that economic growth is associated with an increase in tourism activity. This finding is supported by prior scholarly works, such as the studies conducted by (Dogan & Zhang, 2023; Dritsakis, 2004; Kyara et al., 2021).

The outcomes affirmed the H_1. The notion of economic growth can be seen as a catalyst for tourism development in the top five sub-Saharan African tourist economies. As a nation undergoes economic expansion, it often results in higher incomes, improved infrastructure, and higher living standards. Africa's multifaceted tourism offerings, encompassing wildlife, cultural heritage, and natural landscapes, establish the continent as an appealing destination.

Moreover, outcomes suggest that African countries that experience economic development become more capable of highlighting and marketing their distinctive attractions, thereby fostering the expansion of the tourism industry. When a country's economy is thriving, the government can actively advance various sectors, including tourism. This involvement entails allocating the necessary funds to enhance activities within the sector, such as constructing more attractive infrastructures and investing in comprehensive marketing strategies to promote the country. For example, during the COVID-19 pandemic in 2020, the Moroccan government implemented measures to support tour operators, hotels, and domestic airlines. Additionally, during periods of economic prosperity, the local population has the financial resources to establish businesses and develop distinctive cultural activities, thereby attracting visitors to the country.

Table 7. MMQR regression

Variables	Coefficient	Std. err.	P-value	Variables	Coefficient	Std. err.	P-value
Quantile 1				**Quantile 6**			
EG	1.318	0.259	0.000	EG	1.263	0.149	0.000
DGE	0.071	0.069	0.305	DGE	0.232	0.037	0.000
INF	0.002	0.006	0.711	INF	-0.002	0.004	0.623
ENV	-0.123	0.054	0.023	ENV	-0.175	0.031	0.000
ER	-0.006	0.002	0.002	ER	-0.007	0.001	0.000
C	4.506	1.881	0.017	C	4.593	1.081	0.000
Quantile 2				**Quantile 7**			
EG	1.304	0.218	0.000	EG	1.253	0.151	0.000
DGE	0.112	0.052	0.031	DGE	0.26	0.036	0.000
INF	0.001	0.005	0.808	INF	-0.002	0.004	0.494
ENV	-0.136	0.045	0.002	ENV	-0.184	0.031	0.000
ER	-0.006	0.002	0.000	ER	-0.007	0.001	0.000
C	4.528	1.587	0.004	C	4.608	1.097	0.000
Quantile 3				**Quantile 8**			
EG	1.293	0.191	0.000	EG	1.245	0.159	0.000
DGE	0.143	0.046	0.002	DGE	0.285	0.038	0.000
INF	0.000	0.005	0.917	INF	-0.003	0.004	0.418
ENV	-0.147	0.039	0.000	ENV	-0.192	0.033	0.000
ER	-0.006	0.001	0.000	ER	-0.007	0.001	0.000
C	4.545	1.39	0.001	C	4.621	1.157	0.000
Quantile 4				**Quantile 9**			
EG	1.283	0.171	0.000	EG	1.234	0.176	0.000
DGE	0.172	0.041	0.000	DGE	0.315	0.044	0.000
INF	-0.0002533	0.004	0.951	INF	-0.004	0.004	0.363
ENV	-0.156	0.035	0.000	ENV	-0.202	0.036	0.000
ER	-0.006	0.001	0.000	ER	-0.007	0.001	0.000
C	4.561	1.24	0.000	C	4.637	1.283	0.000
Quantile 5							
EG	1.274	0.157	0.000	Note: *** denotes significance levels at 1% significance level, and ** denotes significance levels at 5% significance level. TOUR = tourism; EG = economic growth; DGE = digital economy; INF = infrastructure; ENV = Environment; ER = Exchange rate.			
DGE	0.198	0.039	0.000				
INF	-0.001	0.004	0.810				
ENV	-0.164	0.032	0.000				
ER	-0.006	0.001	0.000				
C	4.575	1.142	0.000				

Additionally, the digital economy has a positive and significant relationship with tourism from lower quantiles (q2(0.112), q3(0.143), middle quantiles (q4(0.172), q5(0.198), q6(0.232)), and upper quantiles (q7(0.260), q8(0.285), q9(0.315)). However, the q1 outcome (0.071) is not significant. It is evident from the outcomes that the magnitude of the effect increases gradually from q2 to q9, suggesting that the digital economy plays a greater role in accelerating and attracting tourism in Sub-Saharan African nations. This outcome is confirmed by last studies like (Sustacha et al., 2023; Tang, 2023). Outcome affirmed H_2. The proliferation of connectivity and digital platforms has the potential to augment marketing endeavors, thereby facilitating the process of tourists' exploration and reservation of destinations within Africa.

The increasing prevalence of technology adoption has the potential to influence individuals' travel choices, particularly those in technologically proficient demographics, who may be more inclined to visit destinations aligned with current digital trends. Technological advancements, including virtual reality, mobile applications, and other innovations, are crucial factors in attracting and satisfying contemporary tourists. Undoubtedly, we find ourselves in a

contemporary era characterized by pervasive globalization, in which technology plays a pivotal role in facilitating it. The relevance of technology in tourism lies in its ability to shape individuals' desire to visit a particular country and to engage in firsthand experiences informed by prior observations.

This influence is primarily facilitated through the utilization of technology. For example, Kenya has formulated customized marketing strategies and allocated resources to enhance the tourism sector from 2021 to 2025.

Furthermore, technological advancements have greatly enhanced the travel experience for tourists. This is evident in the ease with which they can make reservations before visiting the host country, such as African countries, as well as their ability to plan their activities in advance, resulting in significant time savings. Additionally, the integration of technology has streamlined the payment process, ensuring it is both adequate and efficient.

Furthermore, there is a strong and negative correlation between environment degradation and tourism across all quantiles such as in lower quantiles q1(-0.123), q2(-0.136), q3(-0.147), medium quantiles q4(-0.156), q5(-0.164), q6(-0.175) and upper quantiles q7(-0.184), q8(-0.192), q9(-0.202). The consistent inverse and substantial correlation across all quantiles indicate that increased environmental degradation is associated with a decline in tourism. This result was observed in previous studies, including (Gössling, 2021). The outcomes affirmed H_4. In the realm of tourism in Africa, environmental considerations are highly relevant. The continent is renowned for its varied ecosystems, fauna, and scenic splendor, rendering it a prominent hub for ecotourism. A significant segment of Africa's tourism industry is dedicated to ecotourism, which involves tourists actively seeking immersive experiences in natural environments.

But environmental degradation, pollution, and concerns about climate change discourage tourists, particularly those who prioritize eco-friendly, sustainable tourism. The findings underscore the significance of carbon emissions management for African countries striving to establish themselves as sustainable tourism destinations. African countries can align their tourism strategies with changing global preferences by comprehending the adverse effects of carbon emissions. Tunisia, for example, as the fourth Arab nation to have released its Intended Nationally Determined Contributions (INDC) outlining plans to reduce greenhouse gas emissions, has demonstrated a strong commitment to addressing climate change, making it a prominent priority within its political and economic framework. Furthermore, this nation stands as a pioneer in the region by incorporating explicit acknowledgement of climate change into its recently revised Constitution: a sound and balanced environment, while contributing to the safety of the climate by all available means.

Besides, MMQR estimates that the exchange rate exhibits a significant negative association with tourism across all quantiles such as lower quantiles q1(-0.006), q2(-0.006), q3(-0.006), middle quantiles q3(-0.006), q4(-0.006), q6(-0.007), and upper quantiles q7(-0.007), q8(-0.007), q9(-0.007). The consistent inverse and substantial correlation across all quantiles suggest that a decrease in the exchange rate (leading to depreciation of the domestic currency) is associated with an increase in tourism. We observed this outcome in previous studies (De Vita, 2014; Irandoust, 2019; Song et al., 2018). The outcome affirmed H_5. A depreciated domestic currency can enhance the affordability of travel for international tourists, potentially increasing tourist arrivals. In Africa, where a substantial proportion of tourism relies on international visitors, these findings suggest that a devalued domestic currency can attract tourists. Cost-effectiveness becomes a pivotal factor, particularly for tourists from nations with stronger currencies. A more advantageous exchange rate can encourage people to travel to African destinations. Moreover, the MMQR outcomes showed that infrastructure does not affect tourism in the top five Sub-Saharan African tourist nations across the quantiles.

Outcomes that reject H_3 have been observed in previous studies (Arumugam & Abd Majid, 2023; Labadi et al., 2021). It affirms that tourists are attracted to the natural beauty of countries rather than to artificially developed infrastructure. Additionally, the causality outcomes are depicted in Table 8. According to the results, tourism has unidirectional causality with economic growth, the digital economy, and carbon emissions. Infrastructure has unidirectional causality with tourism, and the exchange rate and tourism have bidirectional causality.

Table 8. Dumitrescu and Hurlin panel causality test estimations Note: ** P-Value< 5%; EG= economic growth; TOUR= tourism; DGE= digital economy; INF= infrastructure; ENV= Environment; ER= exchange rate

Null Hypothesis	T-Stat	P-Value	Null Hypothesis	T-Stat	P-Value
EG ≠ TOUR	2.038	0.875	TOUR ≠ URB	0.688	0.166
TOUR ≠ EG	5.235	0.006	ENV ≠ TOUR	4.116	0.083
TEC ≠ TOUR	2.396	0.866	TOUR ≠ ENV	12.631	0.000
TOUR ≠ TEC	19.214	0.000	ER ≠ TOUR	1.772	0.690
URB ≠ TOUR	4.549	0.033	TOUR ≠ ER	3.991	0.105

CONCLUSION

This research paper investigates the impact of multiple variables, such as economic growth, digital economy, infrastructure, environment, and exchange rate, on tourism in the top five sub-Saharan African tourist economies between 1995 and 2023 with the help of econometrics methods. We used CSD for the cross-sectional dependency test, and CADF, CIPS, and RALS for the unit root tests. The present study uses the RALS-EG cointegration test to examine the enduring relationship between the variables under examination. The present study examines the short, medium, and long-term coefficients using the MMQR method. Moreover, empirical results from MMQR regression indicated that economic growth enhances tourism in the studied economies in the long run.

This result confirms that the effect of economic growth on tourism is accurate and significant. In addition, the outcome reveals that the digital economy boosts tourism in the long run. The results confirm that environmental

degradation has a substantial and adverse correlation with tourism. The consistent inverse and substantial correlation observed across all quantiles indicates that increased environmental degradation is linked to a decline in tourism.

Finally, as expected, the exchange rate has a negative and significant relationship with tourism. A high exchange rate decreases the tourism. Moreover, the Pairwise Dumitrescu-Hurlin Panel Causality Tests results reveal that Tourism has a unidirectional causal relationship with economic growth, the digital economy, and environmental degradation. Infrastructure has unidirectional causality with tourism, and the exchange rate and tourism have bidirectional causality.

Based on the findings presented, this study proposes the following policy recommendations:

First, Sub-Saharan African governments and policymakers must prioritize economic growth initiatives to invigorate the tourism sector. The implementation of proactive economic policies can create a favorable environment that supports tourism development. Also, implementing sustainable practices in the extraction of natural resources is crucial to securing enduring environmental and economic benefits. By effectively managing natural resources, the risk of depletion is mitigated, thereby fostering long-term economic stability.

Second, governments and stakeholders may deliberate on the allocation of resources towards the development of digital infrastructure, to bolster and augment the virtual representation of tourism-related services and attractions. The tourism industry must adopt and allocate resources towards digital transformation strategies. This encompasses various strategies such as online marketing, mobile applications, and e-tourism initiatives, all aimed at augmenting the overall tourist experience. Promoting the integration of digital technologies in the tourism industry, including initiatives related to e-tourism and digital payment systems, has the potential to enhance the positive outcomes.

Third, it is imperative to adopt a mindful approach towards preserving and advancing environmental sustainability. Preserving Africa's natural allure serves the dual purpose of safeguarding its ecological heritage and attracting tourists seeking genuine, untainted experiences. African nations have the potential to cultivate sustainable tourism, celebrate their cultural diversity, and generate long-term positive effects on their economies and the global perception of the continent by effectively managing the interplay between infrastructure development and the preservation of natural landscapes. Fourth, the African governments should promote eco-friendly initiatives, invest in green technologies, promote sustainable practices, and incorporate environmental considerations into tourism planning.

Finally, strategic exchange rate management should be pursued to enhance the growth of the tourism industry by attracting foreign currency and positively influencing the broader economy. While a more favorable exchange rate can stimulate tourism, policymakers must consider the complexities of currency devaluation, including the potential for inflationary pressures. It is imperative to strike a balance between the benefits of increased tourism and its broader economic ramifications. The study has some constraints, such as being limited to the top five tourist Sub-Saharan African Nations. We used the MMQR model to estimate outcomes using limited data from 1995 to 2023.

Moreover, the economic model specified in this research is based on the five macroeconomic factors. Hence, future studies can be carried out across all African nations and the top 10 European tourist nations using the CS-ARDL estimator. Additionally, potential researchers can expand our econometric model by adding more macroeconomic factors, such as inflation, political stability, and socio-economic factors.

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List of Abbreviations: EG = Economic Growth; Infrastructure = INF; Environment = ENV; Digital Economy = DGE; Exchange Rate = (ER); TOUR = Tourism; SSA = Sub-Saharan Africa; MMQR = Method of Moments Quantile Regression Model; TLGH = Tourism Led Economic Development Hypothesis; UNWTO = United Nations World Tourism Organization; EUETS = European Union's Emissions Trading Scheme; WDI = World Developing Indicators; CSD = Cross Sectional Dependence Test; CADF = Cross Sectional Augmented Dicky Fuller Test; CIPS = Im-Persaran-Shin test; RALS-EG = Residual Augmented Least Square Engle Granger Test; RALS-ADF = Residual Augmented Least Square Augmented Dicky Fuller Test; CS-ARDL = Cross Sectional Autoregressive Distributed Lag Model

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TRI HITA KARANA: THE KEY TO SUSTAINABLE TOURISM AND CONSERVATION AT GUNUNG KAWI TEMPLE IN GIANYAR REGENCY, BALI, INDONESIA

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Abstract: This study aims to develop and evaluate a strategic model for sustainable tourism grounded in the Balinese philosophy of Tri Hita Karana. Hita Karana is a strategy to maintain a balance between tourism and conservation. This study uses qualitative research methods. This study is located in Tampaksiring Village, Gianyar Regency, Bali. Informants include community leaders, managers of the Gunung Kawi Cliff Temple site, village officials, and visiting tourists. Data collection was conducted through interviews, observations, and documentation. Data analysis in this study used the interactive model of Miles and Huberman, which comprises three main steps: data reduction, data presentation, and conclusion drawing/verification. The CHGF model synchronises the government's role as an institutional anchor for spatial planning (Palemahan), the community's role as guardians of intrinsic cultural values (Pawongan), and the private sector's role as a catalyst for ethical innovation. This model does not eliminate the sanctity (Parahyangan) or structural integrity of the site. Therefore, this model is oriented toward high-value conservation to maintain a dynamic balance between 21st-century prosperity and 11th-century preservation. This study concludes that the sustainability of tourism at Pura Tebing Gunung Kawi fundamentally depends on the successful implementation of the Collaborative Heritage Governance Framework (CHGF), grounded in the Tri Hita Karana philosophy. The CHGF model explains that, in the modern era, preserving Pura Tebing Gunung Kawi requires integrating policies, market innovations, and social capital in line with Bali's characteristics.

Keywords: sustainable tourism, ecotourism, Tri Hita Karana, environmental conservation, sustainable development

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INTRODUCTION

Bali, the world's premier tourism destination, offers cultural and natural diversity. Therefore, there needs to be an interesting development with unique characteristics to enhance the value of Indonesia's tourist destinations (Sumarmi et al., 2023). Tourism offers significant potential for developing the ecosystem and the national economy (Rivza et al., 2022). The transition of Tebing Gunung Kawi Temple from a place of worship to a tourism sector can boost the economy, empower the community, preserve the ecology, and preserve local culture (Ciacci et al., 2023). Perubahan penggunaan lahan untuk pariwisata jika dikelola dengan baik akan memberikan dampak positif baik pada budaya, struktur sosial, ekonomi dan lingkungan. Keberhasilan pengembangan pariwisata sangat tergantung pada partisipasi masyarakat local, karena masih dipegang teguhnya nilai-nilai tradisional (Putra et al., 2021). It is known that destinations in Bali receive positive feedback from tourists (80.36%) due to their natural beauty (Ramadhani et al., 2024).

The development of tourist destinations in Gianyar, including Pure Tebing Gunung Kawi, is still in the planning stage due to constraints caused by the pandemic and the lack of a legal framework for spiritual tourism (Wirawan et al., 2023). Tebing Gunung Kawi Temple is a geological and spiritual heritage site, making it one of the most popular tourist destinations in Bali, where local residents earn a living through spiritual and nature-based tourism. According to Wang et al. (2014), geological diversity has a non-renewable heritage. Tourism in Bali, rooted in local traditions and temples, is nature-based spiritual tourism linked to local wisdom, including the community's religious lifestyle, religious rituals, and temple architecture (Wirawan et al., 2023). The development of geotrails that integrate cultural, geological, and biological diversity has proven to boost tourism through environmental conservation education and artistic preservation. Therefore, conservation is necessary to preserve culture and the environment, as they are interrelated (Lestari et al., 2025).

Gunung Kawi Cliff Temple tourism is located on the banks of the Pakerisan River. It requires a deep understanding of sustainable management, given the environmental impact of tourism development (Amerson & Parsons, 2018).

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The Balinese community has an environmental conservation strategy that integrates cultural values, ethics, and religious perspectives. Results of Mgbeadichie's research (2025), which found that the Uli tribe in Nigeria and the Chin community in Myanmar have a cultural heritage that is implemented in daily life, based on traditional knowledge and rituals, and that contributes to sustainable resource management and biodiversity conservation as a conservation policy. Cultural heritage conservation requires a balance of interdisciplinary methods, public participation, and a balance between tangible and intangible aspects, with the aim of sustainable development (Li & Tang, 2023; Mekonnen et al., 2022). Advances in sustainable conservation, marked by innovative monitoring technologies and materials, have made a significant contribution to cultural heritage preservation efforts (Di Turo & Medeghini, 2021; Pérez-Gandarillas et al., 2024).

Tri Hita Karana is a Balinese Hindu philosophy that explains harmony among three interrelated areas: God, humans, and the natural environment. This philosophical principle encourages responsible environmental management, social cohesion, and sustainable development by emphasising spiritual, social, and ecological relationships (Hisyam et al., 2024; Mildawani et al., 2024a). Various aspects of life in Bali uphold this philosophy, including religious activities, cooperation, urban planning, environmental management, tourism development, and cultural heritage preservation (Ardani et al., 2025; Mildawani et al., 2024a; Suryono, 2021). This philosophy encourages the government, the private sector, and the community to achieve sustainable tourism. Its implementation takes the form of land management in Bali, preservation of cultural heritage, use of natural resources, and legal practices (Kiriana et al., 2025; Wiryawan, 2024). Through synergy between government policy, local wisdom practices such as irrigation and vegetation management, and visitor education programmes, Pura Tebing Gunung Kawi aims to balance 21st-century economic prosperity with the protection of local wisdom for future generations (Jawabreh et al., 2024).

Research on conservation and sustainable tourism at Gunung Kawi Cliff Temple remains limited, highlighting several challenges and gaps. This is because the relationship between land use and cultural and natural values has not been thoroughly researched. Research on the relationship between spirituality, local customs, and nature remains very limited, for example, Tri Hita Karana, which influences conservation and natural resource management in Bali (Rosalina et al., 2023). In addition, literature reviews on sustainable tourism remain incomplete due to insufficient exploration of resilience, multi-stakeholder cooperation, and localization challenges (Zhang et al., 2022). The lack of exploration into the impact of environmentally friendly behaviour by tourists, mediated by cultural ties, at Gunung Kawi Cliff Temple, results in a lack of understanding of sustainable visitor practices (Cheng & Chen, 2022). Furthermore, other studies have also overlooked governance and socio-political complexities, including unequal participation by government and communities, which affect environmental conservation and cultural heritage (Lawasi et al., 2025). Research on the impact of conservation and biodiversity outcomes on tourism in Mount Kawi remains limited, underscoring the need for further empirical and interdisciplinary studies to sustain cultural preservation and sustainable tourism development (Kiriana et al., 2025).

Tourism facilities are often constructed without regard for environmental impact, disrupting ecosystems (Sutrisno et al., 2024). In addition, it causes gradual degradation of natural capital and the environment, including environmental pollution, changes in land use, and increased waste, thereby threatening the balance of biodiversity and ecosystems (Baloch et al., 2023). The gap between government policy and stakeholder cooperation in balancing tourism development with environmental conservation results in socio-environmental vulnerability (Javan et al., 2023). The limited empirical research on the environmental impact of infrastructure development thereby hinders evidence-based decision-making aimed at reducing negative consequences (Murphy & HUallacháin, 2025). The absence of comprehensive ecological assessments and facility monitoring will hinder sustainable management (Gavrilaș et al., 2025). Overall, the problem lies in policy enforcement, inadequate planning, and an interdisciplinary approach that emphasises the need to develop facilities to support economic growth without damaging the ecosystem. If sustainable tourism is not implemented, it will lead to a decline in tourist satisfaction. Therefore, sustainable tourism management can address environmental impacts through conservation, ensuring tourists are always satisfied with the natural and cultural conditions (Bentz et al., 2016). There is a gap in understanding and implementing the Tri Hita Karana concept, leading to an imbalance among ancestors, humans, and nature, which, in turn, impacts the environment and society. In addition, the lack of strong collaboration between the government, community, and private sector hinders effective, sustainable tourism.

The urgency of this research lies in the lack of consideration of ecological aspects in sustainable tourism management practices, which has resulted in an imbalance between cultural heritage and the environment. This study offers a new approach: integrating Tri Hita Karana into environmental conservation and sustainable tourism management, supported by multi-stakeholder collaboration, such as the pentahelix framework. The objective of this study is to utilise Tri Hita Karana as a strategy to maintain a balance between tourism development and environmental preservation, and to promote sustainable and responsible tourism. The application of this philosophy encourages ecological innovation and green human resource management in Bali's tourism sector, thereby contributing to long-term environmental and cultural sustainability. Broadly speaking, this study addresses the gap in systematically applying traditional Balinese wisdom to modern tourism challenges, aiming to harmonise economic growth with culture and ecological conservation.

Although various studies have examined the relationship between local wisdom, collaborative governance, and sustainable tourism development, there remain conceptual and empirical gaps in the existing literature. Previous studies have shown that the Tri Hita Karana philosophy plays a significant role in fostering harmony between humans and God (parahyangan), fellow humans (pawongan), and the environment (palemahan), and can serve as a source of legitimacy in the practice of international relations at the subnational level. However, such research remains largely descriptive and normative, and has yet to provide a comprehensive empirical analysis of the concrete implementation of these values in the management of tourist destinations (Intentilia & Utomo, 2025). Other research on forest-based ecotourism in Indonesia

indicates that sustainable tourism can contribute to environmental conservation and improved well-being among local communities. However, its implementation still faces various challenges, particularly regarding collaborative governance, conflicts of interest, and infrastructure disparities (Apriyanto et al., 2025). Furthermore, studies on the values of Balinese local wisdom, such as Tat Twam Asi and Menyama-Braya, indicate that the involvement of local communities is a key factor in the development of culture-based tourism; however, as these studies are limited to a single religious tourist destination, the generalisability of the findings to the broader context of tourism in Bali remains limited (Mulyana, 2025). Meanwhile, research on the governance of cultural heritage tourism through a collaborative governance approach in the Majapahit House Heritage Area indicates that collaboration among stakeholders can enhance tourism resilience; however, most of this research has not yet integrated the values of local wisdom as a key conceptual framework within models of sustainable tourism governance, nor has it comprehensively examined the relationship between environmental conservation, spiritual values, and tourism development within a single integrated strategic framework (Basyar et al., 2025). Therefore, this study aims to address this gap by developing a model for sustainable tourism and conservation strategies based on the Tri Hita Karana philosophy, applied to the Pura Tebing Gunung Kawi area in Tampaksiring, through a robust collaborative governance approach that integrates the roles of the government, local communities, and the private sector in maintaining a balance between cultural preservation, environmental protection, and the development of sustainable tourism.

This study aims to develop and evaluate a model for sustainable tourism and cultural heritage conservation in the Pura Tebing Gunung Kawi area, located in Tampaksiring, Bali, by integrating the local philosophy of Tri Hita Karana as the primary conceptual framework. Specifically, this study aims to analyse the interrelationships among spiritual values, community participation, and environmental management in tourism practices within this cultural heritage site, and to evaluate the roles of multi-stakeholder actors, including the government, local communities, and the private sector, in establishing sustainable collaborative governance. Furthermore, this study also aims to formulate the Collaborative Heritage Governance Framework (CHGF) as a strategic model capable of balancing the needs of environmental conservation and the preservation of cultural values with the demands of modern tourism development. As such, this study is expected to make a theoretical contribution to the literature on sustainable heritage tourism and to offer a practical framework for the management of cultural heritage sites grounded in local wisdom and multi-stakeholder collaboration.

MATERIALS AND METHODS

This study uses qualitative methods to explore complex social phenomena through in-depth, human-centred insights. (Denny & Weckesser, 2022). The research location is in Tampaksiring Village, Gianyar Regency, Bali. Gianyar Regency is located in Bali Province, between 08°18'48" – 08°38'58" South Latitude and 115°13'29" – 115°22'23" East Longitude (Figure 1).

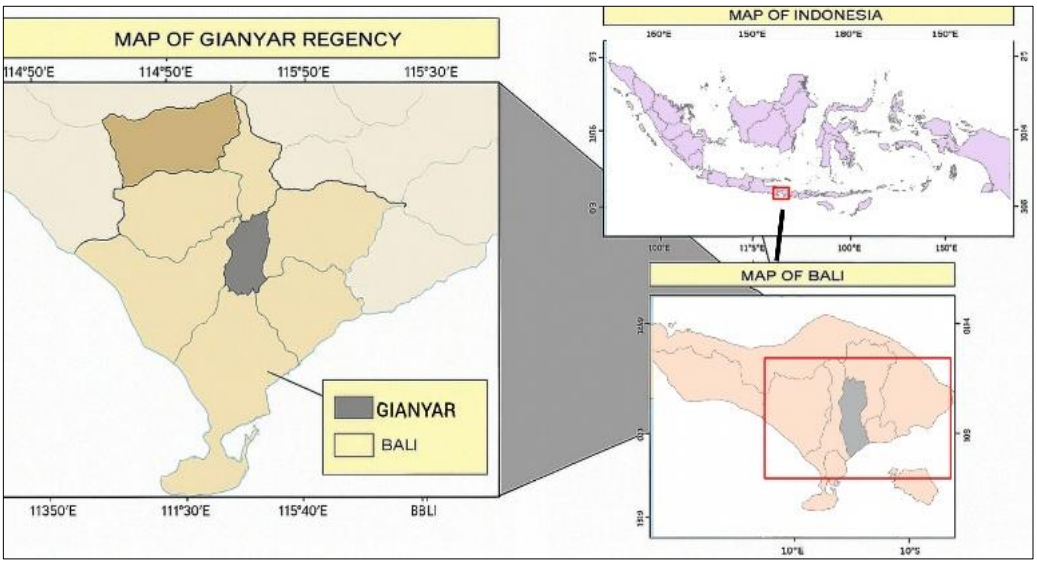


Figure 1. Research Location, Gianyar, Bali

The data sources in this study were primary and secondary data. Primary data were collected through in-depth interviews with key informants who had direct relationships with the research subjects, including community leaders, managers of the Gunung Kawi Cliff Temple site, village officials, and visiting tourists. Sampling was purposive, aimed at selecting informants with relevant experience (Mustadi et al., 2024). The characteristics and demographic information of the key informants are presented in Table 1.

Table 1. Informant Data

informant	informant's name
Tourism Manager	I Ketut Nuarke (75 years old)
Community Member	Mr. Rana (68 years old), Dadong (65 years old), Ajik Teguh (59 years old)
Tourist	Carlos (34 years old), Kyein (31 years old), Carla (28 years old)

These informants provided contextual insights into cultural values, community participation, and the opportunities and challenges of sustainable tourism development in the Gunung Kawi Temple area. Secondary data in this study include various relevant documents and archives, such as historical records of temples, cultural preservation policy documents, regional tourism reports, previous research results, scientific articles, and books and publications related to cultural heritage and sustainable tourism management, to strengthen written information. Observations through direct observation (da Costa et al., 2024) on the physical condition of the temple in geological terms and on tourism activities in both social and economic terms. To maintain the validity and legitimacy of the data, this study uses data triangulation techniques. The triangulation used involves combining diverse data sources to improve the validity and authenticity of the data through cross-verification, thereby obtaining unbiased data (Schlunegger et al., 2024). Data derived from interviews, observations, and documentation were combined to provide a more comprehensive understanding of the phenomenon under study (Papavasileiou & Dimou, 2025). Through this triangulation approach, the reliability of the data obtained is expected to increase, enabling a more comprehensive description of reality. The data, derived from interviews, observations, and documents, were analysed using Miles and Huberman's interactive model, which consists of three main steps: data reduction, data presentation, and conclusion drawing/verification. The stages of data analysis based on the Miles and Huberman interactive model are presented in Table 2. Data reduction is achieved through selection, simplification, focusing, and transformation, aiming to make data easier to manage and more meaningful.

Data presentation is achieved by organising and displaying data in an easily understandable manner, using tables, graphs, and narratives. The final step is to draw conclusions and verify them through data interpretation to identify patterns, while continuously checking for consistency and validity (Mustadi et al., 2024; Papavasileiou & Dimou, 2025).

Table 2. Data analysis from the Miles and Huberman model

Analysis Stage	Description
Data Reduction	Sort, simplify, and select data relevant to the research focus.
Data Presentation	Organise data in the form of descriptive narratives, interview excerpts, and thematic tables.
Conclusion Drawing	Interpret data, find patterns, and draw verifiable conclusions.

RESULTS AND DISCUSSION

Tebing Gunung Kawi Temple is a historical site believed to have been built in the 11th century, during the reign of King Udayana of the Warmadewa Dynasty. Located on the banks of the Pakerisan River, this temple consists of 10 buildings carved directly into the rock cliffs. The spatial distribution of the Gunung Kawi Temple complex and the location of the temple monuments carved into the northern and southern cliff faces are illustrated in Figure 2.

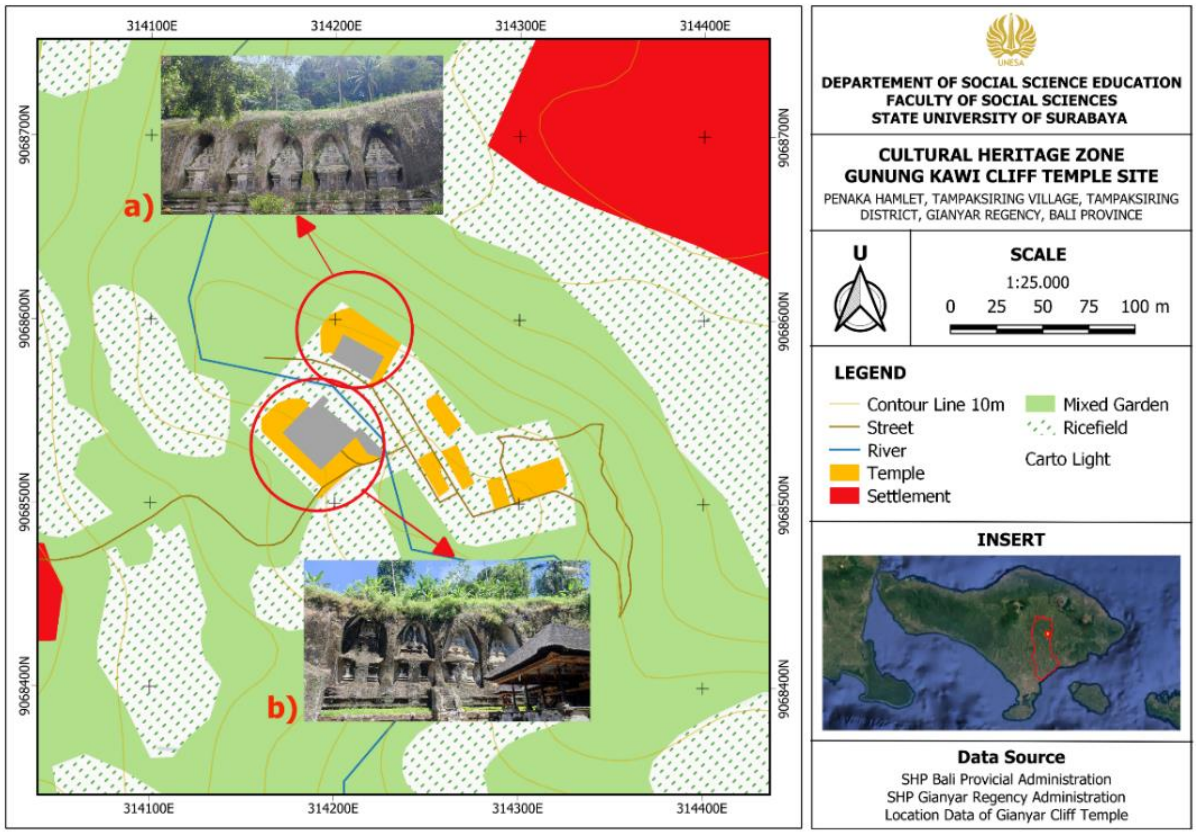


Figure 2. Spatial distribution of the cultural heritage site of Pura Tebing Gunung Kawi, Tampaksiring a) Temple monuments carved into the northern cliff face of the temple complex; b) Temple structures carved into the cliff face located in the southern part of the temple courtyard (Source: GIS data from the Provincial Government of Bali and the Regency Government of Gianyar; field photographs taken by the authors)

The photographs were taken during a field survey on 29 April 2025 in Tampaksiring Village, Tampaksiring Sub-district, Gianyar Regency, Bali Province, Indonesia. The Gunung Kawi Cliff Temple site offers a unique integration of human engineering and significant geological features. Based on field documentation, the temple structure was built on volcanic rock formations formed by ancient magmatic activity on Mount Batur. Stratigraphically, the rocks are arranged in layers following the principle of Lateral Continuity, which provides natural structural stability for the ten monuments carved directly into the cliff walls. Although these volcanic materials have high density and strong physical resistance, their intrinsic rock characteristics indicate they are particularly vulnerable to biochemical and physical weathering processes. The volcanic rock structure of Mount Batur is characterised by complex subsurface features, including shallow and deep magma chambers, as revealed in magnetic and gravity modelling studies on the island of Bali. These models also indicate the presence of intrusive rocks between Mount Agung and Mount Batur, as well as volcanic deposits covering the graben structure to a depth of 6 km, reflecting the eastward migration of volcanic activity (Suryanata et al., 2024).

The degradation of volcanic rock at sites such as Gunung Kawi Cliff Temple is influenced by environmental factors, including humidity, which can accelerate weathering and surface damage, posing challenges for conservation efforts. Although specific studies on rock degradation at Gunung Kawi Cliff Temple are limited, volcanic rock weathering is generally known to be influenced by humidity, temperature fluctuations, and biological activity, which can weaken rock structure over time. Understanding volcanic processes and the properties of volcanic rocks, as seen in eruptions such as Mount Batur, is essential for assessing the long-term stability and conservation needs of cultural heritage sites built on or near volcanic material. Integrating geological insights with environmental monitoring can help develop strategies to reduce the risk of degradation at significant historical sites (Malawani et al., 2021).

The main challenge in conserving this site is the degradation of materials caused by microclimatic factors, particularly high humidity and intense rainfall in the Pakerisan River area. Analysis shows that water infiltration into rock pores and cliff cracks accelerates the weathering process of the temple structure. This condition is exacerbated by biological threats, such as taproot tree growth, which can penetrate rock crevices, thereby increasing the risk of more extensive structural fractures.

As an environmental mitigation measure, the local community has implemented preventive local wisdom practices. This strategy includes modifying land use, such as converting Rice fields into dry plantations at the top of the cliff to minimise groundwater seepage towards the temple. In addition, community regulations prohibit the planting of vegetation with deep root systems in the cliff area to protect the integrity of the rock. These findings confirm that the sustainability of the Gunung Kawi Cliff Temple is highly dependent on the synergy between natural geological resilience and community-based conservation interventions. Although naturally solid, these rocks are susceptible to weathering due to high rainfall and humidity. Local communities apply ecological wisdom (the Palemahan aspect) by converting Rice fields into dry plantations to reduce water absorption, which accelerates rock weathering.

In addition, a strict ban on planting trees with taproots is enforced to prevent damage to the cliff structure through rock fractures. The involvement of local communities in participatory management is a key pillar of sustainability. The community plays an active role as guides, artisans, and guardians of tradition, preserving cultural values and improving local economic welfare. Spiritually, this site is maintained as a sacred place through the performance of regular rituals and unwritten rules that prohibit the destruction of reliefs, reflecting a commitment to Parahyangan values. The conservation rules and practices implemented at Gunung Kawi Temple to support the preservation of its cultural heritage and sustainable tourism are summarized in Table 3. The location of Gunung Kawi Cliff Temple, situated atop volcanic rock formed by ancient eruptions of Mount Batur, provides a naturally solid foundation due to the rock layers' lateral continuity. However, its position in the valley along the Pakerisan River makes the site vulnerable to high humidity and erosion, common challenges for volcanic structures in similar environments. Studies of volcanic landforms show that erosion processes develop over time, with the development of river basins and fluvial activity playing a key role in shaping volcanic rock surfaces and contributing to degradation. High humidity in river valleys can accelerate the weathering and erosion of volcanic rocks, potentially threatening the structural integrity of cliff temples carved directly into the rock.

Table 3. Conservation Rules and Practices

Conservation Rules and Practices Stage	Description
Natural Mitigation	Prohibiting the planting of trees to prevent roots from damaging the cliff structure.
Water Management	Converting Rice fields into dry plantations to reduce water absorption, which accelerates rock weathering.
Modern Technology	Regular evaluation and modern conservation by the Bali Cultural Heritage Conservation Centre are required to maintain the temple structure.
Visitor Control	Implementing a reservation system and limiting visitor numbers to reduce the impact of physical damage.

Understanding the geomorphological and hydrological dynamics of volcanic landscapes is essential for developing conservation strategies that reduce erosion and preserve such cultural heritage sites. Although specific erosion assessments for Mount Kawi are limited, insights from volcanic-erosion studies highlight the importance of monitoring drainage patterns and environmental conditions to protect these significant cultural structures.

The environmental conditions at the Gunung Kawi temple site are vulnerable to degradation from uncontrolled human activities, erosion, and infrastructure development that often disregard ecological balance. Modern conservation efforts emphasise the importance of regular environmental assessments and strict spatial planning to prevent damage to the site's authenticity and ecological harmony (Németh et al., 2021). Research on heritage sites in mountains and cliffs shows that environmental factors, such as humidity, erosion, and land-use changes, significantly affect the preservation

of cultural sites, requiring careful management to maintain sustainability (Saha et al., 2021; Yan et al., 2025). The study also shows that tourism pressure can exacerbate sites' vulnerability through increased foot traffic and inadequate visitor management, highlighting the importance of community involvement and awareness in conservation strategies (Flyen et al., 2023). In addition, salt weathering in humid conditions can accelerate the deterioration of stone heritage, suggesting that microclimate factors should be considered in conservation plans (Despotovic & Hauser, 2025). Overall, integrating environmental monitoring, sustainable tourism practices, and spatial controls is critical to maintaining the ecological and cultural integrity of the Kawi Temple site. The implementation of the Tri Hita Karana philosophy in supporting sustainable tourism and cultural heritage conservation at Gunung Kawi Temple is summarized in Table 4.

Table 4. Tri Hita Karana in Tourism & Conservation

Tri Hita Karana in Tourism & Conservation	Description
Parahyangan	Preserving the temple's function as a place of worship and sacred site through rituals that honour its spiritual values.
Pawongan	Involving the community as guides, artisans, and guardians of tradition to raise awareness of historical preservation.
Palemahan	Emphasising the harmony between natural forces (volcanic rock) and the environment surrounding the Pakerisan River.

Discussions on Tri Hita Karana in tourism and conservation emphasise its role in fostering harmony between spiritual, social, and environmental dimensions. The spiritual aspect (Parahyangan) involves preserving temples as sacred sites through ceremonies that honour their spiritual significance, ensuring cultural and religious continuity. The social aspect (Pawongan) highlights community involvement as guides, artisans, and guardians of tradition, thereby raising awareness and supporting historical preservation. The environmental aspect (Palemahan) focuses on maintaining harmony between natural elements, such as volcanic rock and the Pakerisan River ecosystem, and promoting sustainable interaction with the environment. Studies show that applying Tri Hita Karana in tourism management enhances sustainable development by integrating government roles, community empowerment, green marketing, and corporate social responsibility, leading to more responsible and inclusive tourism practices (Widhiasthini et al., 2025). Based on the findings of this study, an integrated strategy for sustainable tourism and cultural heritage conservation at Gunung Kawi Cliff Temple, Bali, is presented in Figure 3. This philosophy also underpins environmentally friendly innovations in Bali's tourism sector by balancing cultural values with environmental conservation. The concept of Palemahan in the Tri Hita Karana philosophy emphasises harmony between humans and the natural environment, promoting ecological balance as a key aspect of overall well-being. This principle encourages sustainable environmental practices rooted in local wisdom, such as converting terraced Rice fields on cliffs into dry plantations to reduce water seepage that can accelerate rock weathering, and prohibiting the planting of deep-rooted trees near cliffs to prevent root damage to rock structures (Astuti et al., 2021; Mildawani et al., 2024b). To achieve this strategy, multi-stakeholder synergy is required in cultural heritage governance: integration of government, community, and private sector.



Figure 3. Sustainable Tourism and Conservation Strategy at Gunung Kawi Cliff Temple, Bali

The sustainability of the Gunung Kawi Cliff Temple site depends heavily on a robust collaborative governance model that integrates the roles of the government, local communities, and the private sector. This synergy ensures that the historical integrity of the site is maintained while socio-economic growth can continue to be stimulated. The integration of the roles of the government, local communities, and the private sector in supporting sustainable tourism management and cultural heritage conservation at Gunung Kawi Cliff Temple is presented in Table 5.

Table 5. Integration of Government, People (Community), and Private Sector

Tri Hita Karana in Tourism & Conservation	Description
Government	Strengthening cultural heritage zoning policies, spatial planning regulations, and infrastructure development control in cultural heritage areas
Community	Serving as a key pillar in community-based tourism that supports local welfare without compromising historical values
Private Sector	Engaging in the development of sustainable tourism and creative industries that support Bali's cultural identity

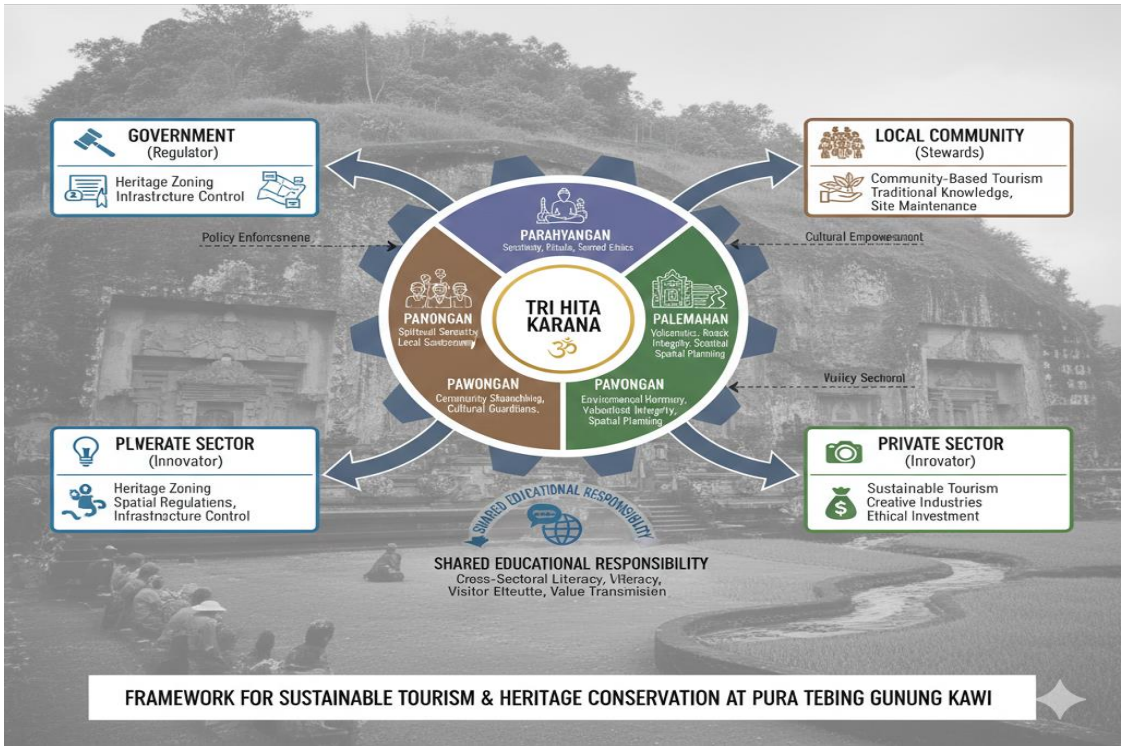


Figure 4. Cooperative Heritage Governance (CHG) Framework: Pura Tebing Gunung Kawi, Bali) (Source: The authors' conceptualisation based on field observations, interviews with stakeholders, and a review of the literature)

Based on the findings of this study, the proposed Cooperative Heritage Governance (CHG) Framework for Pura Tebing Gunung Kawi, Bali, is presented in Figure 4. The author is responsible for the conceptualisation, development of methodology, field research, data analysis, visualisation, and manuscript writing, including the conceptualisation and initial design of the Governance Framework. Cooperative Heritage Governance (CHG), as outlined in this study, explains the integration of cultural values, environmental conservation, and collaborative tourism governance at Pura Tebing Gunung Kawi, Bali, based on the philosophical principles of Tri Hita Karana. This research contributes to the study of sustainable cultural heritage tourism by proposing a Collaborative Cultural Heritage Governance Framework that integrates local philosophical values with stakeholder-based governance mechanisms. This framework demonstrates how the principles of Tri Hita Karana can be implemented as a practical governance model to balance cultural heritage conservation, environmental sustainability, and tourism development. The role of the government is to establish a regulatory and spatial control framework. The government acts as the primary regulator, focusing on strengthening cultural heritage zoning policies. This includes implementing strict spatial regulations and strategic control over infrastructure development within and around protected cultural heritage sites. By establishing clear legal boundaries, the government mitigates the risks of excessive commercialisation and unauthorised land-use changes that could threaten the site's authenticity.

This top-down institutional support is essential for maintaining physical and environmental stability in the Pakerisan Watershed Area (Wang et al., 2023). The Community as the Main Pillar of Community-Based Tourism (CBT): At the grassroots level, local communities are the central pillar of sustainable tourism. Through the Community-Based Tourism (CBT) model, residents are not merely passive spectators but active participants who serve as cultural guides, artisans, and guardians of tradition. This participatory approach ensures that income from the tourism sector contributes directly to local welfare without compromising the site's historical and spiritual values (Lajçi et al., 2022).

The community's proximity to this site creates a layer of organic protection, as their livelihoods are closely intertwined with the preservation of this cultural heritage, the Private Sector as Sustainable Development, and the Creative Industry. The private sector contributes to this ecosystem by developing sustainable tourism products and promoting creative industries that align with Bali's cultural identity. Instead of pursuing a mass tourism model, private entities are encouraged to invest in high-value, low-impact tourism experiences that respect the site's carrying capacity. This collaboration stimulates local entrepreneurship and increases Mount Kawi's global visibility by marketing ethical cultural experiences (Raihan, 2024) educational Synergy as Cross-Sector Literacy. A critical component of this integration is the creation of educational synergy across all sectors. Collaborative initiatives are designed to improve visitors' understanding of local ethics, religious values, and the temple's historical significance. By educating tourists about etiquette at sacred sites, stakeholders collectively reduce the risk of cultural desecration and physical degradation. This integrated management strategy demonstrates that preserving 11th-century monuments in the 21st century requires a careful balance between strict regulation, communal ownership, and ethical private investment (Mihardja et al., 2023).

Preserving Tebing Gunung Kawi Temple in the 21st century requires shifting from conventional site management to a Collaborative Heritage Governance framework. This model integrates the unique strengths of the government, local communities, and the private sector into a cohesive ecosystem that balances economic aspirations with conservation

imperatives. The government serves as a vital institutional anchor, enforcing strict cultural heritage zoning policies and spatial regulations designed to mitigate the risks of anthropogenic degradation and uncontrolled infrastructure encroachment within the Pakerisan Watershed Area. This regulatory framework is essential to preserving the structural integrity of the 11th-century volcanic stone temple from environmental and modern land-use pressures. By establishing a clear legal mandate, the state ensures that the historical authenticity of the site remains protected from the detrimental effects of unregulated commercial expansion (Fairbrass et al., 2024).

Complementing this top-down governance, local communities serve as the primary guardians of the site's intrinsic value, spearheading community-based tourism initiatives that align socio-economic well-being with the preservation of tangible and intangible cultural heritage. By positioning residents as active managers rather than passive participants, this model fosters a deep sense of ownership, ensuring that traditional rituals and spiritual functions continue to animate these physical monuments (Chiarini et al., 2022). Simultaneously, the private sector acts as a catalyst for sustainable innovation, shifting the tourism paradigm from mass consumption to a high-value, low-impact creative industry that respects Bali's cultural identity. This tripartite integration is ultimately realised through a nexus of shared educational responsibility, in which cross-sector collaboration transforms visitor behaviour. By synchronising government historical archives, communal traditional knowledge, and private sector communication platforms, a comprehensive framework is formed to make tourists aware of the ecological fragility and sanctity of the site, ensuring that 21st-century economic prosperity and the conservation of ancient architectural treasures coexist in a state of dynamic equilibrium (Ruban et al., 2023; Demkova et al., 2022).

CONCLUSION

This study concludes that the sustainability of tourism at Pura Tebing Gunung Kawi fundamentally depends on the successful implementation of the Collaborative Heritage Governance Framework (CHGF), grounded in the Tri Hita Karana philosophy. The CHGF model explains that, in the modern era, preserving Pura Tebing Gunung Kawi requires integrating policies, market innovations, and social capital in line with Bali's characteristics.

The government, as the palemahan aspect, has strict zoning policies to protect the structural integrity of volcanic rocks from the threat of anthropogenic degradation and infrastructure encroachment in the Pakerisan River Basin. The community, as the pawongan aspect, has the strength of the site's intrinsic values. The community also actively participates in governance, ensuring that economic growth does not neglect the principles of preventive conservation.

Private sector involvement as a catalyst for the creative industry within the CHGF framework also strengthens destinations' competitiveness without exceeding environmental carrying capacity, thereby creating an ethical, non-exploitative tourism ecosystem. Ultimately, CHGF serves as an instrument for preserving the Parahyangan dimension, ensuring that spiritual sanctity remains at the core of all activities at this site. This tripartite synergy offers a solution to the dichotomy between current economic needs and the need to conserve the past. By integrating local values into modern governance policies, this model ensures the achievement of a sustainable dynamic balance. These findings make a significant theoretical contribution to global cultural heritage management, affirming that multi-stakeholder collaboration grounded in local wisdom is key to addressing future challenges in preserving world heritage sites.

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Use of Generative AI: During the drafting of this manuscript, the authors used Grammarly to assess and improve the quality of the English, and ChatGPT 5.5 to assist with formatting the visualisations based on the authors' original data (Figure 4). After using these tools, the authors reviewed and edited the content of the manuscript thoroughly as required, and take full responsibility for all aspects of the published article.

Glossary: CBT (Community-Based Tourism); CHG (Cooperative Heritage Governance); CHGF (Collaborative Heritage Governance Framework); GIS (Geographic Information System)

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SPATIAL DISTRIBUTION OF TOURISM RESOURCES IN UDON THANI, THAILAND: A GIS-BASED APPROACH FOR SUSTAINABLE AND COMMUNITY-ORIENTED TOURISM PLANNING

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Abstract: Contemporary tourism is increasingly shifting from a volume-based model toward a quality-oriented approach that emphasizes sustainability, local identity, and the redistribution of tourism activities to secondary cities and rural areas. This study aims to quantitatively assess the spatial distribution patterns and clustering dynamics of tourism resources in Udon Thani Province using geospatial analytical techniques, including the Nearest Neighbor Index (NNI), hot spot analysis (Getis-Ord Gi*), and Kernel Density Estimation (KDE). The analysis is based on a georeferenced dataset of tourism resource points derived from field surveys and secondary spatial databases. The NNI results indicated that tourism resources in Udon Thani exhibited a statistically significant dispersed pattern (NNI = 1.5689, $p < 0.001$), suggesting that the observed distribution was not random but reflected underlying spatial contexts and community settlement patterns. However, hot spot analysis identified areas of significant clustering of tourism activities, particularly in Mueang Udon Thani District, as well as in parts of Ban Dung and Nam Som Districts, which hosted specialized attractions with strong drawing power. Meanwhile, the KDE analysis confirmed the role of Mueang Udon Thani District as the provincial tourism core and highlighted the potential of secondary areas to support linked cultural and community-based tourism activities. The findings provide spatial evidence to inform the delineation of tourism development zones, the design of integrated tourism routes, and the formulation of balanced and sustainable tourism policies at the provincial level. This study contributes to the growing body of cultural and community-based tourism research by providing a data-driven framework for identifying spatial heterogeneity and supporting evidence-based tourism planning in emerging secondary destinations.

Keywords: tourism resources, GIS, spatial analysis, sustainable tourism, spatial clustering

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INTRODUCTION

Over the past decade, global tourism has shifted from a volume-based model toward a quality-oriented approach that places greater emphasis on sustainability, diverse experiences, and place-based tourism. Travelers increasingly seek destinations with distinctive local characteristics and are dispersing from primary cities to secondary cities and rural areas to reduce congestion and environmental impacts (Lane el al., 2022). At the same time, advances in digital technologies and the availability of spatial data have transformed the analysis of travel behavior, route planning, and destination management (Zeng et al., 2025). Consequently, geospatial tools and spatial analysis have become integral to tourism planning and policy formulation in many countries (Šoltésová et al., 2025). In Thailand, recent tourism development strategies have similarly prioritized income redistribution to regional areas, the promotion of secondary cities, and the expansion of cultural (Manosuthi, 2024), community-based, and nature-based tourism (Yodsurang et al., 2021). These strategies operate within broader frameworks of sustainable development and the creative economy and aim to reduce disparities between major tourism destinations and emerging areas with development potential. Prior to the COVID-19 pandemic, tourism played a crucial role in Thailand's economy, generating approximately USD 60.5 billion in revenue from international tourists and accounting for around 18% of GDP (Sangkaew et al., 2025). The pandemic, however, caused a significant decline in tourism revenue in 2022 before recovery began in 2023 and 2024 (Sangnak, 2025). During this period, Thailand recorded approximately 35.5 million international tourists and a total tourism revenue of about 1.67 to 1.8 trillion Thai baht.

These developments underscore the importance of effective spatial planning and tourism management, particularly at the provincial level (Bozdağ, 2023). Udon Thani Province, for example, possesses a wide range of tourism resources but

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still lacks systematic quantitative analyses of their spatial distribution. In particular, limited empirical evidence explains whether tourism resources are clustered, dispersed, or randomly distributed across space.

Understanding these spatial patterns is essential for guiding infrastructure development, managing tourism pressure, and formulating area-based tourism policies (Luo & Peng, 2024). Recent advances in Geographic Information Systems (GIS) enable more efficient and systematic spatial analysis, making GIS a critical tool for tourism planning and policy development (Gao et al., 2025; Akay, 2026). The Nearest Neighbor Index (NNI) is widely used in point pattern analysis to classify spatial distributions as clustered, random, or dispersed (Ding et al., 2024). In parallel, Kernel Density Estimation (KDE) supports the visualization of spatial intensity by producing density surfaces that highlight areas of concentration and areas with development potential (Xu et al., 2024). Together, these techniques provide a robust analytical framework for examining the spatial structure of tourism resources. Accordingly, this study analyzes the spatial distribution patterns of tourism resources in Udon Thani Province, Thailand, by applying the NNI and KDE within a GIS-based analytical framework (Wang et al., 2026). The findings aim to enhance spatial understanding of tourism distribution structures and to provide empirical evidence to support tourism development planning, resource allocation, and the formulation of sustainable, area-based tourism policies at both provincial and regional levels (Chalkidou & Mavridis, 2026).

MATERIALS AND METHODS

Study Area

Udon Thani Province is a major regional hub in northeastern Thailand, located between latitudes 17°13′ and 18°10′ north and longitudes 102°00′ and 103°30′ east. The province plays an important role in the regional economy, transportation, and tourism, and hosts a wide range of tourism resources distributed across both urban and rural areas.

Cultural and historical tourism constitutes a key component of the province's tourism profile, with prominent attractions such as the Ban Chiang Archaeological Site in Nong Han District, a UNESCO World Heritage Site that reflects the development of prehistoric human civilization (Noichan et al., 2024). In addition, Udon Thani contains numerous religious sites and local cultural landmarks located in both urban centers and rural communities.

The province also offers diverse natural and ecotourism resources, including forested areas, mountainous landscapes, and water bodies. Notable examples include Phu Phra Bat Historical Park, which features distinctive natural rock formations integrated with archaeological remains, and Huai Luang Reservoir, a popular recreational destination for residents and visitors. Moreover, several community-level natural attractions show strong potential for further development as conservation-oriented tourism sites. Community-based and lifestyle tourism represents another important dimension of tourism in Udon Thani Province, reflecting the distinctive identity of Thail Isan culture.

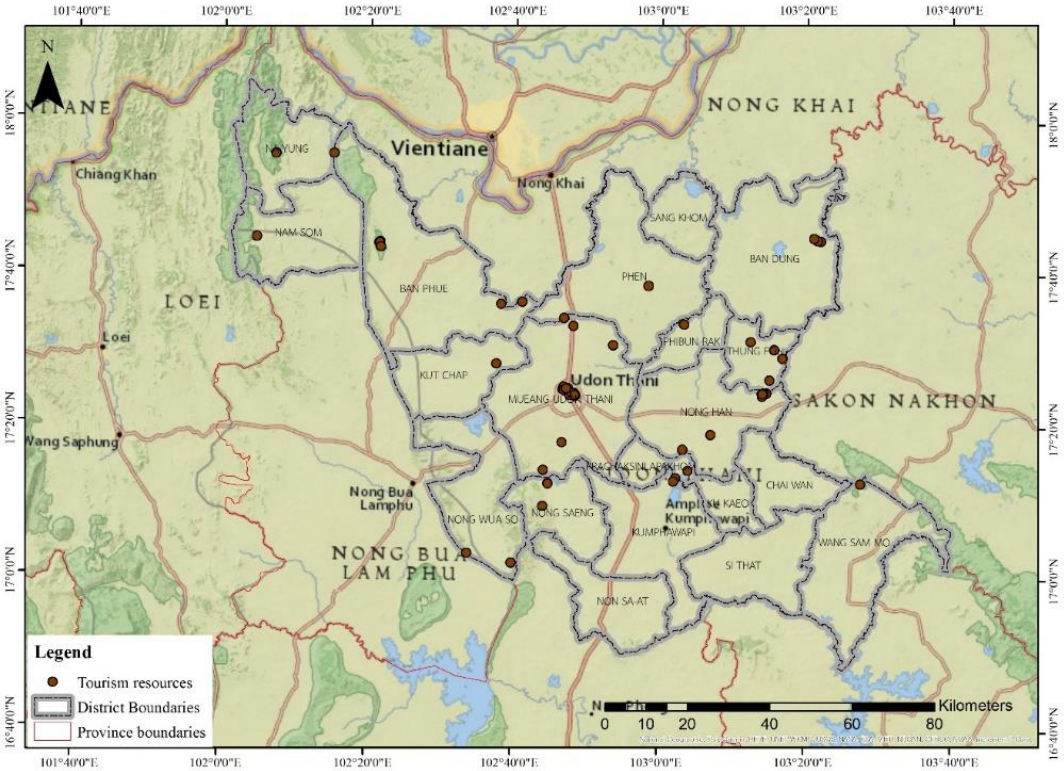


Figure 1. The Study Area Map

Local communities surrounding the Ban Chiang area in Nong Han District, as well as agricultural communities across various districts, offer opportunities to integrate tourism activities with learning experiences related to local livelihoods, traditional knowledge, and the grassroots economy (Suriyankietkaew et al., 2025). At the same time, urban tourism and

cross-border trade are concentrated primarily in Mueang Udon Thani District, which functions as a transportation, service, and commercial center and serves as a key link to neighbouring countries in the Greater Mekong Subregion (Kokkhangplu et al., 2025). Given this diversity of tourism resources, understanding spatial distribution patterns and density is essential for effective tourism development planning and appropriate spatial management. As shown in Figure 1.

Data Collection

This study employed spatial data on tourism resources represented as point features, with each point indicating the geographic location of a tourism site. The data were obtained from field surveys and reliable spatial databases. All location data were verified for positional accuracy and standardized to a common coordinate reference system to ensure consistency and accuracy in subsequent spatial analyses.

The dataset subsequently underwent spatial data preparation following standard analytical procedures. First, duplicate point locations were identified and removed to prevent potential bias in spatial index calculations. Next, all spatial data were transformed into a single projected coordinate system appropriate for distance measurement and quantitative spatial analysis. Finally, an initial assessment of spatial distribution patterns was conducted through exploratory mapping to evaluate overall distribution characteristics and to prepare the dataset for subsequent analyses using the NNI and KDE.

METHODS

This study adopted a quantitative research design, integrating spatial analysis with spatial statistics to examine the spatial distribution patterns and density of tourism resources in Udon Thani Province, Thailand. The analysis focused on point-based spatial data and applied Exploratory Spatial Data Analysis (ESDA) to systematically identify clustering patterns of tourism resources and assess their spatial density within the study area.

Spatial distribution patterns were examined using the NNI, which was used to determine whether the distribution of tourism resources exhibited clustered, random, or dispersed patterns (Yu et al., 2025). The NNI was calculated as the ratio between the observed mean nearest-neighbor distance and the expected mean distance under a random spatial distribution (Xu & Wang, 2021), as shown in Equation 1:

$$NNI = \frac{d_{observed}}{d_{expected}} \quad (1)$$

where:

$d_{observed}$ = the average distance between each point and its nearest neighbor

$d_{expected}$ = the expected mean distance assuming a random spatial distribution

NNI values were interpreted as follows: NNI < 1 = clustered pattern, NNI ≈ 1 = random pattern, and NNI > 1 = dispersed pattern. Statistical significance was further assessed using Z-scores to determine whether the observed spatial pattern differed significantly from a random distribution.

In this study, spatial statistical analysis using the Getis-Ord Gi* method was applied to examine the distribution of point-based spatial data in order to identify areas with statistically significant concentrations that are higher or lower than the surrounding average. This method is particularly suitable for cultural tourism analysis, especially when identifying cultural cores such as clusters of temples or historical heritage sites. The Getis-Ord Gi* analysis produces Z-scores and p-values (Zikirya et al., 2024) which are used to identify Hot Spots, defined as areas with high concentrations of tourism activities or resources, and Cold Spots, defined as areas that remain underutilized (Zhao et al., 2023).

The results of the Getis-Ord Gi* analysis were used to support the design of tourism routes, planning for the development of new tourism attractions, prioritization of areas for conservation, and evidence-based policy decision-making. This approach is particularly relevant in areas characterized by strong and complex cultural dimensions, such as temple communities in historic urban areas or riverside zones that reflect traditional community livelihoods. The Getis-Ord Gi* statistic is expressed as Equation 2. The arithmetic mean Xand the standard deviation S\ are defined in Equations 3 and 4 (Ord & Getis, 1995; Anselin et al., 2010; Yuan et al., 2025), respectively.

$$G*_i = \frac{\sum_{j=1}^{n} w_{i,j} - \overline{X}\sum_{j=1}^{n} w_{i,j}}{S\sqrt{\frac{\left[n\sum_{j=1}^{n} w_{i,j}^2 - \left(\sum_{j=1}^{n} w_{i.j}\right)^2\right]}{n-1}}} \quad (2)$$

$$\bar{X} = \frac{\sum_{j=1}^{n} x_j}{n} \quad (3)$$

$$S = \sqrt{\frac{\sum_{j=1}^{n} x_j^2}{n} - \overline{(X)^2}} \quad (4)$$

where:

x_j = the attribute value of location j, such as the number of temples or density values;

$w_{i,j}$ = the spatial weight between locations i and j, such as proximity; $\bar{X}$ = the mean of all attribute values;

S = the standard deviation of the attribute values; n = the total number of spatial points. Furthermore, spatial density analysis using KDE was applied to assess the spatial density of tourism resources by transforming point-based data into a continuous density surface per unit area. This approach enables the identification of areas with varying levels of concentration of tourism resources (Pang et al., 2025). The general KDE function is expressed in Equation 5:

$$KDE\ (X)\ =\ \sum_{i=1}^{n} K\left(\frac{d_i}{h}\right) \qquad (5)$$

where:

d_i = the distance from the location of interest to point i,

h = the bandwidth parameter, which defines the spatial influence of each point; K = the kernel function

The selection of the bandwidth parameter was determined based on the spatial distribution characteristics of the data and the scale of the study area in order to reflect density patterns that are appropriate for spatial and policy interpretation.

The results derived from the NNI and the KDE technique were synthesized to explain the spatial distribution patterns of tourism resources and to systematically classify density levels across the study area. These results provide an empirical basis to support spatial tourism development policies, the allocation of resources and infrastructure, and the redistribution of tourism activities toward emerging potential areas to reduce spatial concentration and promote sustainable tourism development at the provincial level. The analytical framework of this study is illustrated in Figure 2.

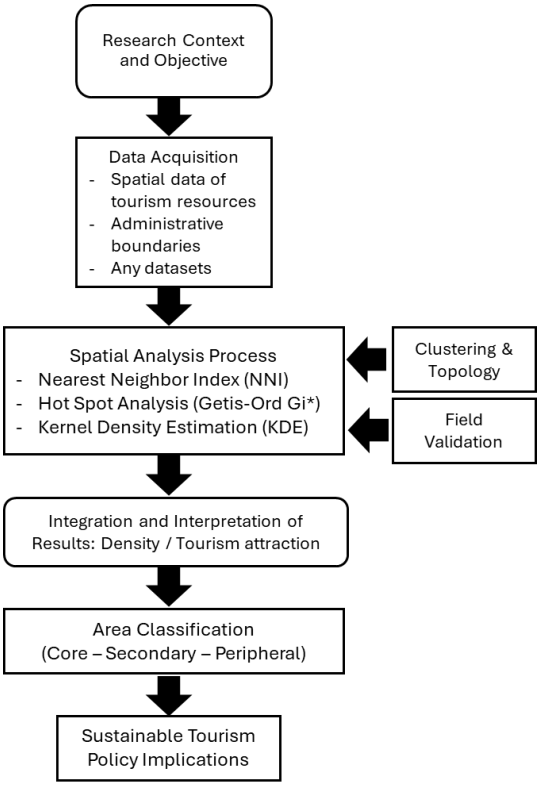


Figure 2. The Conceptual Framework

RESULTS AND DISCUSSION

Spatial Distribution Analysis of Tourism Resources Using the Nearest Neighbor Index (NNI)

The survey of tourism resources in Udon Thani Province identified a large number of tourism sites. From this dataset, 60 tourism sites with high potential and strong attractiveness to visitors were selected and classified into eight categories. The distribution is summarized below:

- Historical tourism sites: 4 sites
- Cultural tourism sites: 2 sites
- Community-based tourism sites: 5 sites
- Market-based tourism sites: 6 sites
- Memorial sites: 1 site
- Museum-based tourism sites: 3 sites
- Natural tourism sites: 10 sites
- Religious tourism sites: 29 sites

A spatial analysis of these tourism resources was then conducted using GIS and the NNI to assess whether their spatial distribution exhibited clustered, random, or dispersed patterns. The analysis produced a Nearest Neighbor Ratio (NNR) of 1.568879, indicating a dispersed spatial pattern. The corresponding z-score was 8.499937, demonstrating a statistically significant deviation from a random distribution. In addition, the p-value was 0.000000, indicating a very high level of statistical significance and an extremely low probability that the observed pattern occurred by chance. These results indicate that tourism resources in Udon Thani Province are more widely spaced than would be expected under a random spatial distribution and that the observed dispersion is not the result of random variation. The spatial distribution pattern of tourism resources is illustrated in Figure 3, which presents the results of the Average Nearest Neighbor analysis.

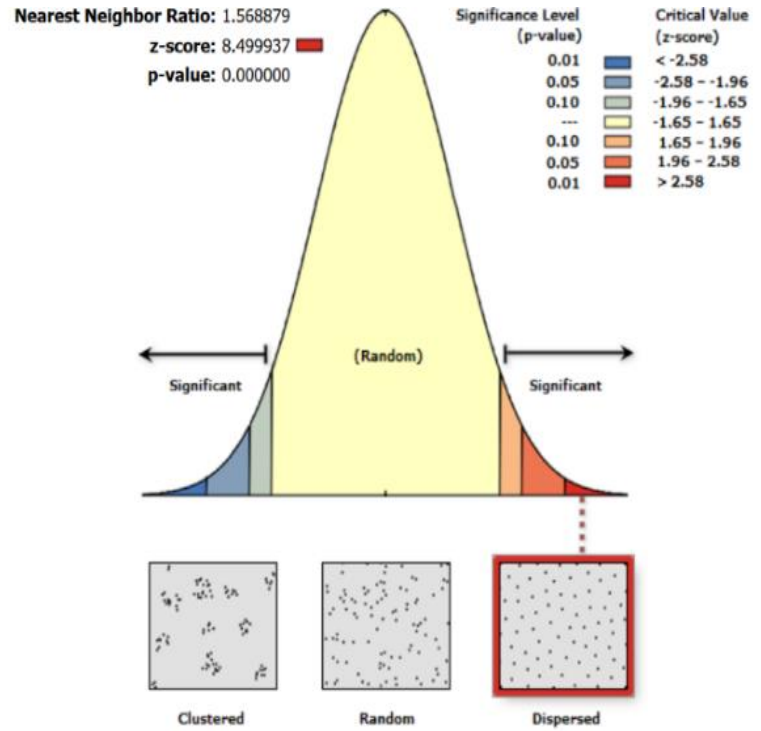


Figure 3. Results of the Average Nearest Neighbor Analysis

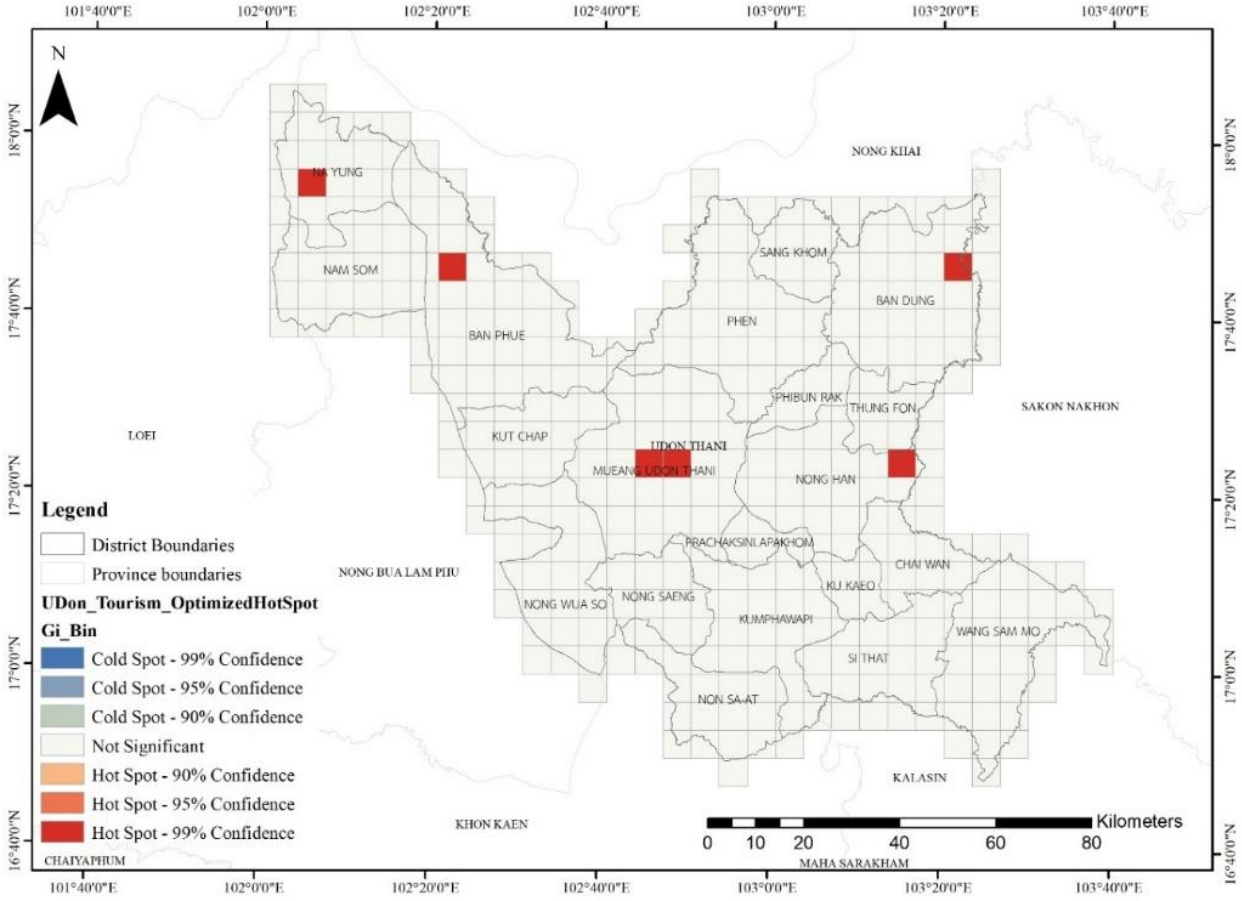


Figure 4. Hot Spot Map of Tourism Resources in Udon Thani

Subsequently, tourism resources in Udon Thani Province were analyzed using the Optimized Hot Spot Analysis tool. The entire study area was divided into uniform square grids to facilitate statistical analysis using the Getis-Ord Gi* statistic

(Gi_Bin). This approach enabled the identification of spatial patterns of tourism resource concentration by classifying areas into different levels of statistical significance, including Cold Spots (low concentration), Not Significant Areas, and Hot Spots (high concentration). These categories were identified at confidence levels of 90%, 95%, and 99%, respectively.

The results derived from the spatial analysis map indicate that the area identified as a hot spot at the highest confidence level (99%) is Mueang Udon Thani District, which functioned as the provincial center for economic activities, services, and transportation. This area exhibited a high density of tourism-related activities. Additional hot spots were identified in the northern part of the province near Nam Som District, which was characterized primarily by nature-based tourism, and in the northeastern area, likely within Ban Dung District. A key attraction in this area was Kham Chanod, a site associated with belief-based and spiritual tourism linked to local reverence for the Naga, In Thai cultural belief, the Naga is a revered mythological serpent associated with sacred sites and water landscapes, contributing to the development of belief-based and spiritual tourism, which attracted a continuous flow of visitors.

Hot spot areas were also observed along the boundary between Thung Fon and Nong Han Districts, where distinctive forms of cultural tourism were present, including Ban Chiang and the handicraft community of Ban Non Sa-at.

These areas demonstrated strong potential for the development of community-based and ecotourism-oriented tourism activities that continued to attract visitors. The spatial distribution of these hot spot areas is illustrated in Figure 4.

The identification of these areas as statistically significant clusters of tourism resources provides a basis for delineating priority tourism development zones at the provincial level.

This information can also be used as an empirical reference for the design of area-based tourism promotion policies, particularly for the development of new tourism routes that link surrounding areas with high-potential hot spots.

Spatial Density Analysis of Tourism Resources Using Kernel Density Estimation (KDE)

Spatial density analysis of tourism resources in Udon Thani Province was conducted using KDE. The results illustrate the spatial distribution of tourism resources across the province, with density values classified into five levels and visualized using a color gradient ranging from dark blue, indicating low density, to dark red, indicating high density.

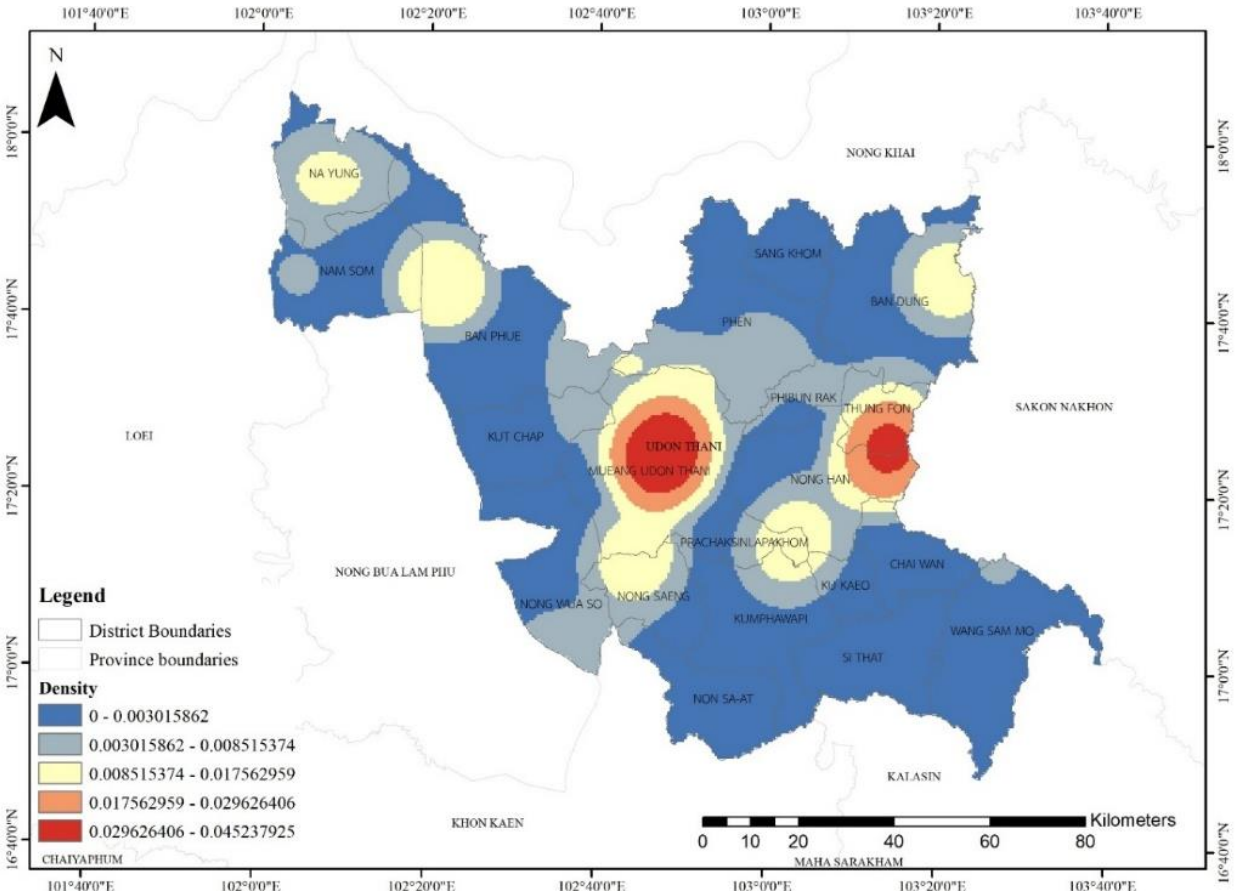


Figure 5. Spatial Density Analysis of Tourism Resources in Udon Thani

The analysis revealed that the area with the highest concentration of tourism resources was Mueang Udon Thani District, which serves as the provincial core. This was followed by Thung Fon District, where the Ban Non Sa-at sedge weaving community is located, indicating strong potential for further development as a cultural tourism and creative economy destination. Nong Han District, situated southwest of Thung Fon, exhibited a comparable level of tourism density and represents an area with opportunities for linkage with Thung Fon in terms of transportation routes, cultural

connections, and community-based activities. Nong Han District is also recognized for its potential in agricultural and historical tourism. In addition, surrounding districts such as Kumphawapi, Prachaksinlapakhom, and Phen demonstrated moderate to high density levels, suggesting opportunities to extend and connect cultural tourism activities associated with local handicraft groups to adjacent areas. In contrast, peripheral districts, including Si That, Wang Sam Mo, and Kut Chap, exhibited relatively low tourism density. These areas may require additional support in terms of infrastructure development or creative tourism initiatives to enhance their long-term tourism potential. The spatial density patterns of tourism resources identified through KDE analysis are illustrated in Figure 5.

DISCUSSION

The spatial distribution analysis of tourism resources in Udon Thani Province using the NNI indicates that the 60 identified tourism sites, classified into eight categories, exhibited a statistically significant dispersed pattern. The NNR of 1.568879, together with a high z-score of 8.499937 and a p-value of 0.000000, confirms that the observed spatial arrangement of tourism resources significantly deviates from complete spatial randomness, following the standard interpretation of the Average Nearest Neighbor method (Zhang et al., 2022). Instead, this pattern reflects underlying structural factors, including physical geography, transportation networks, settlement patterns, and socio-cultural development across the province (Wang et al., 2022; Du et al., 2024).

The dispersed spatial pattern observed in this study appears to be closely associated with the distinctive characteristics of Udon Thani Province, particularly the high proportion of religious and natural tourism sites. Religious tourism sites alone accounted for 29 of the 60 identified locations and were typically embedded within local communities distributed throughout the province rather than concentrated in a single urban core (Sae-Ngow et al., 2025). This finding contrasts with the spatial structure of highly commercialized urban tourism and is consistent with rural tourism frameworks, in which tourism resources are spatially dispersed and strongly anchored in place-based identities (Wang et al., 2023).

However, when considered alongside the results of the Optimized Hot Spot Analysis using the Getis-Ord Gi* statistic, a more nuanced spatial pattern emerged (Kato, 2025). While the overall distribution of tourism resources was dispersed, statistically significant clusters of tourism activity were evident in specific locations. The most prominent hot spot, identified at the 99% confidence level, was located in Mueang Udon Thani District. This result underscores the district's role as the provincial center for economic activity, transportation, and services, which facilitates the concentration of diverse tourism activities, including cultural attractions, museums, and commercial tourism (Xu et al., 2025).

The spatial density analysis using KDE further complements the hot spot analysis by providing a continuous representation of tourism density rather than discrete cluster classifications (Li et al., 2024). The KDE results confirm that Mueang Udon Thani District had the highest concentration of tourism resources, while Thung Fon and Nong Han Districts exhibited secondary density levels. This pattern suggests a gradual outward expansion of tourism activities from the urban core to surrounding areas through cultural, community-based, and occupational tourism initiatives (Kun et al., 2025).

Meanwhile, peripheral districts such as Si That, Wang Sam Mo, and Kut Chap displayed relatively low tourism density, revealing spatial imbalances in tourism development across the province. These disparities may be attributed to limitations in infrastructure, accessibility, or the absence of clearly differentiated tourism activities. From a policy perspective, the findings highlight opportunities to utilize areas with moderate tourism density as "linkage" or "buffer zones" between high-density hot spots and lower-potential areas (Vanhuele & Vanneste, 2025). Such an approach could help distribute tourism benefits more evenly and reduce spatial concentration (Adamczyk & Wałdykowski, 2022).

These results will have a significant impact on the area's tourism policy and growth. Provincial tourism plans should not exacerbate the already crowded urban core. Instead, they should focus on functional differentiation and spatial linkage. For instance, the Mueang Udon Thani District should be the main place for services, transportation, and coordination. Secondary districts like Thung Fon and Nong Han should be turned into cultural and community-based tourism corridors (UNWTO, 2018). Putting money into infrastructure that links different parts of the area, interpretive networks, and popular tourist attractions will help these secondary locations deal with more visitors and fix problems with space. The limitation of this study employs point-based tourist resource data and static spatial analyses, which do not incorporate temporal dynamics, visitor flows, or behavioral interconnections among venues.

Future research may integrate mobility data, time-series analysis, or spatial econometric models to examine the temporal evolution of tourism activities and the influence of policy interventions on geographical diffusion processes (Worachairungreung et al., 2026). These kinds of changes would make spatial analysis much better at helping provincial governments make decisions about tourism based on real information.

CONCLUSION

This study identified a total of 60 tourism sites with development potential in Udon Thani Province, classified into eight categories, with religious tourism sites constituting the largest proportion. This pattern reflects the province's strong cultural and belief-based tourism identity. Spatial distribution analysis using the Nearest Neighbor Index (NNI = 1.5689, $p < 0.001$) revealed a statistically significant dispersed pattern of tourism resources, indicating that their spatial arrangement is not random but shaped by local spatial contexts and community settlement patterns.

However, the Hot Spot Analysis using the Getis-Ord Gi* statistic demonstrated the presence of statistically significant clusters of tourism activities, particularly in Mueang Udon Thani District, as well as in selected areas of Ban Dung and Nam Som Districts. These locations represent specialized tourism destinations with strong attraction potential.

Furthermore, the Kernel Density Estimation (KDE) results confirmed that Mueang Udon Thani District functioned as the primary tourism activity center of the province, while Thung Fon and Nong Han Districts exhibited potential as secondary areas for linking cultural and community-based tourism activities.

A key implication of this study is that the findings provide a spatial evidence base to support the delineation of tourism development zones, the design of integrated tourism routes, and provincial-level tourism policy planning in Udon Thani Province. Policy efforts should prioritize the redistribution of tourism development toward secondary potential areas in order to promote spatial balance and long-term sustainability.

Despite its contributions, this study has several limitations that should be considered when interpreting the results. The analysis relies on tourism resource data representing a specific time period and may not capture seasonal variations or newly emerging tourism sites. In addition, the results are sensitive to the definition of the study area and parameter selection, particularly the bandwidth used in the KDE. The exploratory nature of the analysis also limits causal interpretation, as factors such as accessibility, infrastructure, and tourist behavior were not explicitly examined. Moreover, policy interpretations should be approached with caution, as areas with high tourism density may face carrying capacity constraints if not supported by appropriate management strategies.

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CAREER ANXIETY AMONG TOURISM GUIDANCE STUDENTS: EXPLORING FEARS OF AI-DRIVEN TECHNOLOGICAL DISPLACEMENT

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Abstract: There is an increasing body of academic research on how artificial intelligence (AI) will disrupt tourism, but there is a gap in studying tourism guidance students' career anxiety—who are perhaps most likely to experience job displacement from AI—and in testing educational conditions that act as moderators of their anxiety. This study fills that gap by examining AI-related career anxiety, perceptions of threat, and coping profiles among 312 students enrolled in undergraduate and graduate-level tourism guidance courses at three Egyptian universities. Based on the Career Transition Theory, we found five dimensions of anxiety: fear of being displaced by information supersession; economic insecurity; professional identity humiliation; emotional role redundancy; and self-doubt related to adaptability. All five anxiety dimensions were identified as being of great concern. However, Students whose curriculum included a component related to the direct application of AI were found to have a 0.63 standard deviation reduction in anxiety. The study produced three distinct coping profiles - Active Adapters, Uncertain Pragmatists, and Anxious Resisters - all of which demonstrated starkly different trajectories regarding commitment to their careers. The results have implications for how universities reform their curricula, for how career counselling is provided, and for how national tourism workforces are assembled.

Keywords: tourism guidance, career anxiety, AI Displacement, Technology Threat Appraisal, Professional Identity, Egypt

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INTRODUCTION

The rise of AI has led to a drastic shift in the tourism guidance field. For thousands of years, tourism guides have developed their profession through cultural empathy, local knowledge, emotional connection with visitors, and relationship-building. The AI disruption (as noted by Buhalis et al. (2019) and Ivanov (2019a)) is changing this area dramatically compared to changes experienced by other service industries due to the overall level of development now seen in these technologies compared to earlier years, which have always been primarily reliant upon a human guide's cognitive and communication abilities (Huang & Rust, 2018; Tussyadiah, 2020). According to the 2025 World Economic Forum Future of Jobs Report, 92 million jobs in various sectors of the economy, including tourism (where information delivery and guest interaction are highly dependent on), are at risk of being automated until 2030 (Kang et al., 2024; Yuan & Liu, 2025).

In the vein of tourism is a critical part of Egypt's economy. The sector accounts for about 12% of Egypt's gross domestic product (GDP) and employs millions of people directly and indirectly through supply chains under pressure (Abdellah et al., 2025). Career guidance students in tourism have been particularly affected by this transformation of the tourism industry because they are simultaneously investing in educational capital, their career aspirations, and their identity. Their career path is becoming less clear (El Hajal, 2025; El Hajal & Rowson, 2020). However, for career guidance students in tourism, AI-enhanced technology is perceived as a potential threat to their professional callings because it may affect the core human attributes they associate with their profession. The skills that they have been developing, such as local area knowledge, personalized story production/creation, the study of group dynamics through management practices,

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and cross-cultural/area-based emotional intelligence, will be the same types of skills that advanced AI systems are currently focused on in order to produce simulated versions of these skills (Akhilesh & Kumar, 2025; ÇOlak, 2023). Therefore, career guidance students pursuing a person-centered approach to their profession are likely to have increased anxiety about the future viability of their profession. Anticipating that their career will be disrupted has been shown to have a psychological impact similar to that of being unable to find a job (Bakir et al., 2025; Koo et al., 2021).

The current research project's theoretical framework is based on Career Transition Theory, supplemented by Technology Threat Appraisal and Professional Identity Development theories. Career Transition Theory helps researchers better understand how individuals experience employment-related uncertainty and how they respond to disruption (Li et al., 2019; Zhang & Jin, 2023). Technology Threat Appraisal theory provides an alternative lens through which to conceptualise AI's potential threat and includes two components: first is primary appraisal — which is the initial assessment of AI's potential for meaningful obstruction to an individual — and second is secondary appraisal, which refers to the evaluation of resources available to cope with possible threats (Chung & Tan, 2025). Professional Identity Development frameworks help explain how associations with career paths influence both the degree of anxiety individuals may feel surrounding AI and what type of adaptive behaviour(s) they might display (Mingotto et al., 2020; Rydzik & Kissoon, 2023). Therefore, the purpose of this study is to explore how demographic factors, education, technology experience, and institutional context relate to AI-based career anxiety. The following questions will guide this research:

- (RQ1): Which aspects of AI advances cause the most anxiety in students studying tourism guidance?
- (RQ2): How do individual and educational experiences influence perceptions of AI as a threat?
- (RQ3): How do students cope with this perceived threat, and are these coping methods effective at maintaining their career commitment?

LITERATURE REVIEW

AI Integration in Tourism and Hospitality Services

Over the last 10 years, the rapid growth of AI in tourism/hospitality operations has transformed the travel experience. From researching a destination to reviewing it after your trip, AI has transformed every stage of the travel experience (Bulchand-Gidumal, 2022; Dogru et al., 2023) and has helped differentiate between human interactions and those facilitated by AI (Kim et al., 2024; Limna, 2023). Smart destination management platforms improve the travel experience by consolidating information about weather, transportation systems, social media activity, and users' preferences to provide real-time travel recommendations. According to Katsanakis et al. (2025) and Buhalis et al. (2019), AI-based systems provide a level of accuracy and relevance in their recommendations that no human travel guide, using only their own cognitive abilities, could match. This creates an auto-improving intelligence that continually delivers better performance and lower operating costs (Huang & Rust, 2018). Multilingual conversational AI solutions can assist hundreds of travellers at once, in dozens of languages, without ever tiring or showing any signs of cultural insensitivity; a characteristic that directly diminishes one of the largest sources of professional value for human guides (Ivanov & Webster, 2019b; Lukanova & Ilieva, 2019).

Advanced AI technologies have evolved far beyond merely delivering information about tourism experiences (Hamarat et al., 2024; Mingotto et al., 2020). Using complex language models, virtual tour guides will provide unique narratives that include historical research, cultural representation through humour tailored to specific age groups, and emotional responses to tourists' emotions (Akhilesh & Kumar, 2025; Huang & Rust, 2018). Advanced computer vision systems can identify features associated with architecture and culture (including cultural artefacts) with high accuracy and provide real-time, copious contextual descriptions (documentation) of those features (Tussyadiah, 2020). While a traditional human tour guide may only be able to lead up to a few dozen tourists at once, AI technology is able to support an unlimited number of users 24 hours a day and will do so with a lower cost per user per hour (Ivanov & Webster, 2019a, 2019b). These merging capabilities pose a significant technical challenge to the provision of tourism guides in terms of scale (Zvaigzne et al., 2025). Thus, we hypothesize that:

H1a: The greater the perceived capability of AI in information delivery, the higher the level of informational displacement fear among tourism guidance students.

H1b: Students who perceive AI as capable of replicating multilingual and emotional interaction will report significantly higher overall career anxiety than those who do not.

H1c: The perceived economic advantage of AI over human guides (cost and scalability) will be positively associated with economic insecurity dimensions of career anxiety.

Human Capital Displacement Through AI Innovation

The current AI-based technology wave brings something different from the previous waves of industrial change (Rydzik & Kissoon, 2023; Tuomi et al., 2020). Historically, automation threatened mostly routine jobs that relied on rote physical work, as many of the abilities that were once thought to be safe from automation are being replicated through the use of AI technology, such as empathy, creativity, and social adaptability (Huang & Rust, 2018; Mingotto et al., 2020). Recent investigations into the requirements of large language models also indicate that the possibility of AI eliminating existing tour guide jobs in tourism-related information dissemination within the next 10 years could exceed 75% (Kang et al., 2024; Yuan & Liu, 2025). Without these estimates, one could dismiss the anxiety within the industry regarding AI and its potential impact on the job market as based solely on speculation (Hamarat et al., 2024; Ivanov & Webster, 2017).

While the economic losses associated with technological unemployment are widely recognized, there also exists a psychological, social, and identity-related aspect to the effects of such unemployment which is particularly acute in

occupations with strong vocational attachment on the part of workers (Koo et al., 2021; Zhang & Jin, 2023). According to Li et al. (2019) and Bakir et al., (2025), workers and students who believe that there's a high risk of automation in their chosen profession have greater occupational anxiety, lower work engagement levels and increased plans to leave the profession prior to experiencing actual displacement from work. For tourism guidance students, this threat is especially profound due to the fact that guidance work is not only a job but a vocational identity based on human-centred values and the belief in the irreplaceable value of authentic human interaction within cultural exchange (Anggari, 2024; El Hajal, 2025). The threat posed by AI systems to the way that guidance work exists as a source of fundamentally human-centered economic value and human-centered identities will produce greater intensity of psychological response and provide less rational reassurance than would be found in occupations in which the professional identity is less closely tied to human-specific skills (Ersoy & EhtİYar, 2023; Raina, 2023). Thus, we hypothesizes that:

H2a: Tourism guidance students who perceive a high probability of AI-driven job displacement will report significantly higher levels of career anxiety than those who perceive a low probability.

H2b: Perceived threat of AI-driven occupational displacement will be negatively associated with career commitment among tourism guidance students.

H2c: Students with stronger vocational attachment to the tourism guidance profession will experience greater professional identity erosion anxiety in response to AI displacement threats.

Student Career Development and Professional Identity Formation in the AI Era

The student population at universities is an important population to study in relation to AI-related career anxiety, which may be significantly altered before they enter the workforce (El Hajal & Rowson, 2020; Grobbelaar & Verma, 2024). Research findings regarding professional identity development indicate that the educational context is a key contributor to how students form beliefs about their profession's future and their own ability to adapt to these changes in that profession (El Hajal, 2025; Yadav & Bora, 2025). As argued by Zhang & Jin (2023) and El Hajal (2025), a curriculum that directly and critically addresses AI transformation will enable students to recognize potential AI-related threats and build greater confidence in their ability to adapt to them. Additionally, there are substantial differences in how tourism guidance programs address AI transformation. Some have developed dedicated courses that focus on the human-AI relationship and the importance of AI literacy for those employed in the tourism industry, whereas others provide traditional guidance training without reflecting on the impact of technology on the tourism guidance profession (Anggari, 2024; Kömürcü et al., 2021). These differences in curriculum create natural conditions for studying the moderating effect of AI on students' anxiety levels toward future careers – this study will focus on these differences.

Perceptual differences, including individual characteristics, influence how someone perceives the threats posed by AI technology. Higher levels of technology self-efficacy lead to greater perceived opportunity because AI offers vast potential to enhance one's job performance, but also lower pre-displacement anxiety, resulting in proactive coping (Chung & Tan, 2025; Yang et al., 2019). Those from peer networks who are optimistic about AI will have a lower degree of perceived threat because students will make moderate-sized social comparisons with their AI-optimistic peers (Koo et al., 2021). Another individual difference that has been studied is that of gender; findings suggest that female students have higher AI-related career anxiety than male students — especially in tourism, where there is a significant gender imbalance in the labour pool (Martínez-Roget et al., 2025; Rydzik & Kissoon, 2023). Thus, we hypothesize that:

H3a: Students enrolled in curricula with formal AI integration will report significantly lower career anxiety than students in traditional curricula without AI content.

H3b: Technology self-efficacy will moderate the relationship between AI threat perception and career anxiety, such that higher self-efficacy will attenuate the positive effect of threat perception on anxiety.

H3c: Female tourism guidance students will report higher levels of professional identity erosion and emotional role redundancy anxiety than male students.

H3d: Students who engage in active coping strategies in response to AI disruption will demonstrate higher levels of career commitment than those who employ avoidant coping strategies.

MATERIALS AND METHODS

Research Design and Philosophical Orientation

This research uses a quantitative cross-sectional survey approach that acknowledges the complexity of the psychological and social world while still adhering to systematic measurement and statistical inference (Tuomi et al., 2020; Tussyadiah, 2020) to test the study's conceptual model (Figure 1).

The measurement instruments used in this study were modified versions of validated scales: Career Anxiety Inventory (CAI-17) measuring five different dimensions of AI-related occupational anxiety, with a total of 17 questions rated on a five-point Likert scale; Artificial Intelligence (AI) Threat Perception (ATP-9, alpha = 0.89); Technology Self-Efficacy (TSE-8, alpha = 0.86); Professional Identity Strength (PIS-6, alpha = 0.79); Coping Strategy Orientation (CSO-12, alpha = 0.84). A pilot study with 30 students confirmed that the items were understood clearly, and the mean time to complete was about 22 minutes. Statistical significance was evaluated using the standard alpha level of .05.

Effect sizes were reported for each analysis, enabling meaningful interpretation of the data. All results were reported in accordance with APA and JARS-Quant reporting rules. The full set of survey items across all five scales is presented in Appendix 1 below. Items were generated to reflect the theoretical constructs described in the conceptual framework, grounded in the literature reviewed in Section 2, and refined through the pilot study.

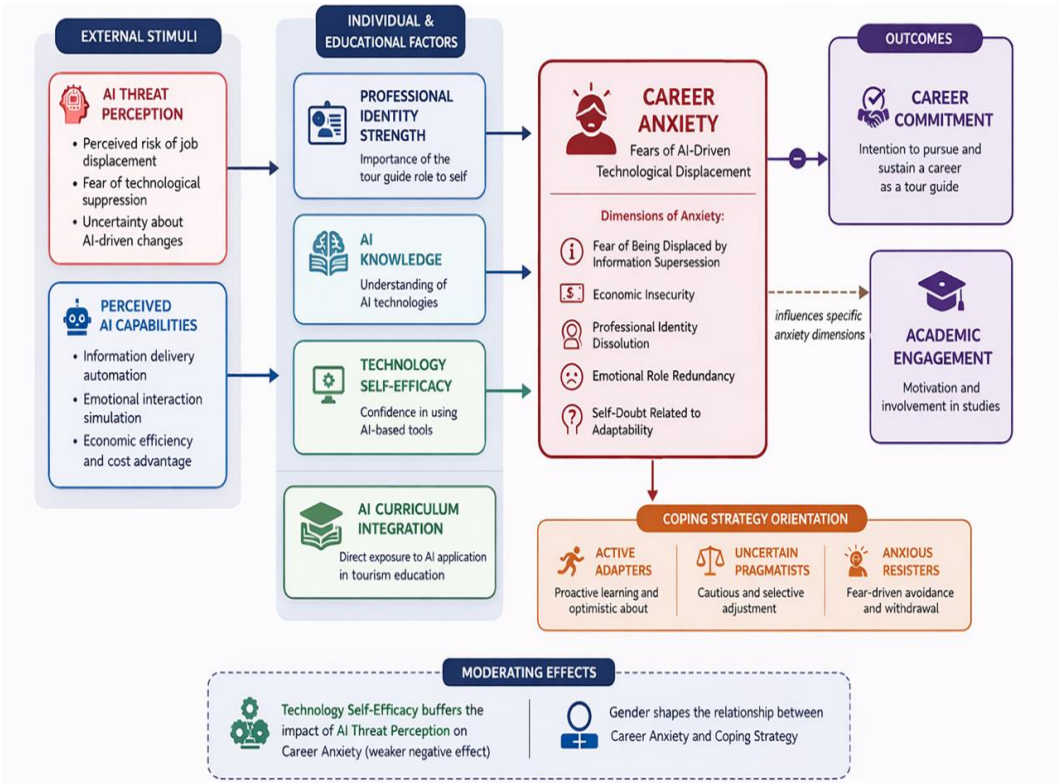


Figure 1. Conceptual Framework

Sample and Data Collection Procedures

Three distinct Egyptian universities recruited 312 undergraduate (n=201) and postgraduate (n=118) tourism students from three notably different educational backgrounds. Students were selected from the Faculty of Tourism and Hotel Management at Alexandria University, Helwan University (n=104), and Suez Canal University (n=90).

Two professional translators translated the survey instrument into Arabic, and it was then back-translated for equivalence in meaning. The three universities selected as study sites represent three very different profiles of institutions: an urban, research-oriented university that incorporates artificial intelligence (AI) into its curriculum (Alexandria University); a large metropolitan university with a more traditional curriculum for guidance (Capital University); and a regional/college that serves a large international vacation destination (Suez Canal University).

Each institution has a very different level of access to the technology used to teach and learn tourism guidance, and therefore a very different level of comfort and willingness to explore new technologies.

A structured random sampling of students was conducted, and the final total of 312 completed surveys included 168 (53.8%) female respondents and 144 (46.2%) male respondents. The year of study for the students was first year (n=58, 18.3%), second year (n=78, 24.4%), third year (n=100, 32.1%), and fourth year/postgraduate (n=79, 25.2%).

Students were asked to provide information regarding their prior formal education regarding AI in tourism; a total of 31.4% of the students reported having received any formal curriculum related to AI in tourism, but the percentage of students varied by university: Alexandria University (51.7%), Helwan University (23.1%), and Suez Canal University (12.2%). Despite the fact that the variance in AI education levels across the three institutions mirrors the differences noted throughout the region, the level of anxiety regarding AI used in tourism was not influenced by prior formal education. Data was collected between January and February of 2026. Harman's single-factor test and the unmeasured latent factor method were used to assess common method bias; both tests found no significant bias (Koo et al., 2021).

Analytical Approach

We design four phases to understand how anxiety relates to the experiences of college student anxiety and coping through a series of analyses. The first phase included confirmatory factor analysis to establish psychometric properties of all measurement instruments and model fits using CFI, TLI, RMSEA, and SRMR indices. The second phase computed descriptive statistics and bivariate correlations. The third phase used hierarchical multiple regression, with Block 1 containing demographic variables, Block 2 containing institutional/curricular variables, and Block 3 containing psychological variables. The fourth phase evaluated a structural equation model that examined the integrated theoretical framework regarding the outcome variables of academic engagement and career commitment.

Finally, cluster analysis (using Ward's hierarchical method along with K-means refinement) identified meaningful sub-groups of students exhibiting varying degrees of anxiety levels and coping strategies.

Reliability and Validity of Measurement Instruments

All CR values exceeded the recommended threshold of 0.70. Convergent validity was assessed by examining the average

variance extracted (AVE) for each scale, with acceptable convergent validity established when AVE ≥ 0.50 (Nunnally, 1978; Fornell & Larcker, 1981). All scales met this criterion. Factor loadings for all items were statistically significant ($p < 0.001$) and exceeded the recommended minimum of 0.50. Discriminant validity was established by confirming that the square root of each construct's AVE exceeded the inter-construct correlations involving that construct (Fornell & Larcker, 1981). Criterion-related validity was supported by the pattern of significant associations between scale scores and theoretically expected outcomes: for example, higher ATP-9 scores were associated with higher CAI-17 scores ($\beta = 0.54$, $p < 0.001$), and higher TSE-8 scores were associated with lower CAI-17 scores ($\beta = -0.33$, $p < 0.001$), consistent with theoretical expectations. Cross-cultural validity was supported through the systematic translation and back-translation protocol described in Section 3.1, and pilot testing with 30 students confirmed item clarity. Table 1 summarizes the reliability and validity indices for all five scales.

Table 1. Reliability and Validity Summary for All Measurement Scales

Scale	Items (n)	Cronbach's α	CR	AVE	Factor Loadings (range)	Evidence Type
Career Anxiety Inventory (CAI-17)	17	0.92	0.91	≥ 0.50 (all dims)	0.64–0.84	Convergent; discriminant; criterion validity via CFA
AI Threat Perception (ATP-9)	9	0.89	0.88	≥ 0.50	0.61–0.79	Convergent; known-groups validity (high vs. low AI exposure)
Technology Self-Efficacy (TSE-8)	8	0.86	0.85	≥ 0.50	0.59–0.78	Convergent; incremental validity in regression (ΔR^2=0.183)
Professional Identity Strength (PIS-6)	6	0.79	0.80	≥ 0.50	0.55–0.74	Convergent; discriminant from TSE; gender-invariance tested
Coping Strategy Orientation (CSO-12)	12	0.84	0.83	≥ 0.50	0.57–0.81	Convergent; cluster differentiation validity (3 profiles, F=78.42)

Note. CR = Composite Reliability; AVE = Average Variance Extracted. All factor loadings significant at $p < 0.001$. AVE ≥ 0.50 and CR ≥ 0.70 thresholds following Fornell &Larcker (1981). Cronbach's α thresholds following Nunnally (1978).

RESULTS AND DISCUSSION

Descriptive Profile of the Sample

The gender ratio of the sample was 53.8% female (n=168), consistent with the overall female/male ratio in Egyptian tourism guiding programs. The average age of participants was 21.3 years (SD=2.1; Range: 18-31), with the largest number enrolled in the 3rd year of their undergraduate program (32.1%). The average GPA of participants was 3.14 (SD=0.47) based on a 4.0 GPA scale, while participants' average use of technology was 3.42 on a 5-point scale, indicating a moderate-to-high degree of familiarity with technology prior to participating in the Program (Table 2).

Table 2. Participant Demographic and Educational Profile (N=312)

Variable	n (%)	Variable	n (%)
Age	312	Female	168 (53.8%)
Year 1	57 (18.3%)	Male	144 (46.2%)
Year 2	76 (24.4%)	GPA (4.0 scale)	312
Year 3	100 (32.1%)	Technology Engagement Score	312
Year 4 / Postgraduate	79 (25.2%)	AI Curriculum Exposure	98 (31.4%)

Overall Career Anxiety Levels

The mean overall career anxiety score was significantly above the normative score (3.67, SD = 0.71) across all five dimensions of the CAI-17 (i.e., from 1 = not at all to 5 = extremely). Therefore, the level of AI-related career anxiety measured in this study is a very great concern according to CAI-17 (as identified in the CAI-17 manual). This average score is higher than that of hotel employees (Koo et al., 2021), hospitality graduates currently experiencing AI-related disruptions (El Hajal, 2025), and tourism workers in general (Hamarat et al., 2024). With respect to the five anxiety dimensions, the greatest mean score was observed for Information Displacement Concern (3.94, SD = 0.68), which suggests that there is concern that the encyclopaedic knowledge and instantaneous recall of information possessed by the AI systems have rendered humans unable to provide information and guidance (Huang & Rust, 2018). The second-highest mean score was for Economics Insecurity (3.81, SD = 0.74), followed by Professional Identity Erosion (3.72), Emotional Role Redundancy (3.61), and Adaptational Self-Doubt (3.31). The pattern of mean anxiety scores, therefore, reveals a theoretical basis for understanding how to respond to those AI competencies that are most distressing to students, as they pertain to (information aggregation), economic efficiency, and cognitive scalability. The ranking of mean anxiety, therefore, may reflect an accurate assessment of AI risk rather than a form of technophobia. As such, there are implications for how educators address students' concerns (Bulchand-Gidumal et al., 2026; Katsanakis et al., 2025) (Table 3 and Figure 2).

Table 3. Career Anxiety Inventory (CAI-17): Descriptive Statistics by Dimension (N=312)

Anxiety Dimension	Mean	SD	Anxiety Dimension	Mean	SD
Informational Displacement Fear	3.94	0.68	Emotional Role Redundancy	3.61	0.82
Economic Insecurity	3.81	0.74	Adaptational Self-Doubt	3.31	0.88
Professional Identity Erosion	3.72	0.79	**OVERALL CAI-17 COMPOSITE**	**3.67**	**0.71**

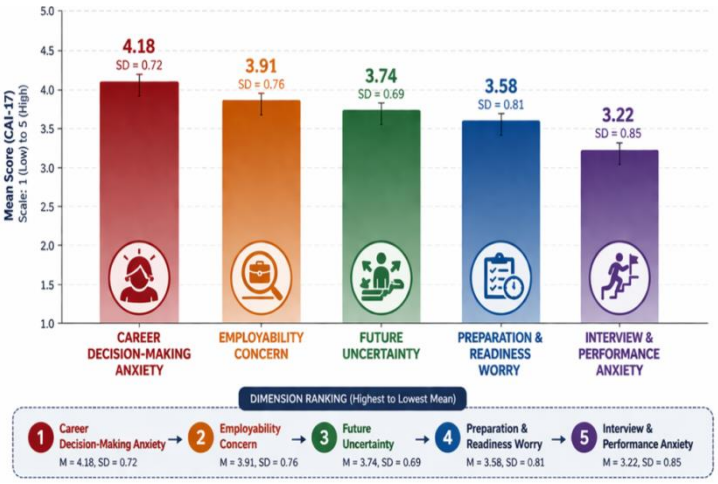


Figure 2. Career Anxiety Dimension Bar Chart

AI Threat Perception Patterns

The AI Threat Perception scale (ATP-9) found that 87.5% of all surveyed individuals regarded AI systems as a "moderate to very high" threat to their job prospects. The overall mean ATP score was 3.89 (SD=0.63), and the compressed distribution indicates a general consensus that AI represents a considerable challenge to careers. The specific ATP items with the highest mean scores related to AI's information capabilities (M=4.21, "AI systems will know more about where to go than any human tour guide"), the economic incentives for adopting AI systems (M=4.14), and the emotional simulation of advanced AI (M=3.97). These findings illustrate that students' threat perception is grounded in their understanding of AI capabilities, not simply in being overly anxious—a significant distinction, as dismissing students' worries as exaggerated or unfounded will have both empirical and pedagogical implications (Lakhapate, 2023; Zvaigzne et al., 2025). The relatively low score of "Certification through AI will replace Accreditation through Humans" (M=3.22) reflects students believe that professional licensing is providing some protection from AI, which should be of interest to national tourism policymaking because clear regulatory guidelines concerning human tour guide certification should greatly decrease the amount of fear caused by economic uncertainty (Bakir et al., 2025; Kang et al., 2024) (Table 4).

Table 4. AI Threat Perception Scale (ATP-9): Item-Level Means (N=312)

ATP Item	Mean	SD
AI will surpass human informational knowledge about destinations	4.21	0.61
Economic incentives strongly favour AI over human guides	4.14	0.67
AI will replicate emotional connection with tourists	3.97	0.74
AI language capabilities will eliminate the multilingual advantage of human guides	3.88	0.79
AI personalisation will exceed human adaptation capacity	3.77	0.81
AI availability (24/7) creates unfair competitive conditions	3.71	0.86
Tourists will prefer AI for efficiency and cost reasons	3.65	0.88
AI quality will be more consistent than human guide performance	3.58	0.91
AI certification will replace human accreditation requirements	3.22	0.97

Influence of Curriculum AI Integration on Career Anxiety

The average career anxiety score for students exposed to the formal AI curriculum in tourism (n=98, 31.4%) was 3.24 (SD=0.68), compared with 3.87 (SD=0.69) among those who did not receive the formal curriculum (n=214). The difference in means (0.63 SD) was significant ($t(310)=6.84$, $p<0.001$, Cohen's $d=0.73$), indicating that integrating AI into the curriculum is one of the most influential, modifiable moderators of career anxiety across all occupational types. Furthermore, the effect sizes seen in this study for AI-integration in curriculum outperformed those reported for previous reskilling interventions in tourism in India and Europe (El Hajal, 2025; Yadav & Bora, 2025). AI-Curriculum students' Technology Self-Efficacy scores were significantly higher (M=3.78 vs. 3.12, $p<0.001$), and AI-knowledge scores were also significantly higher (M=3.91 vs. 2.84, $p<0.001$). Approximately 62% of the variance in anxiety attributable to the curriculum effect is mediated by self-efficacy and AI-knowledge, consistent with the competence-building process outlined in the STAARA awareness model proposed by Zhang & Jin (2023). Experiencing AI through various human-AI complementary frameworks (i.e., those that acknowledge enduring human advantages compared to AI, such as cultural empathy, ethical decision-making, and depth of relationships) has been linked to the greatest reductions in both Emotional Role Redundancy and Professional Identity Erosion anxiety outcomes (Anggari, 2024; Mingotto et al., 2020). This research supports that a meaningful shift in anxiety profiles requires real competence-building and reframing rather than simply providing information (Table 5 and Figure 3).

Table 5. Career Anxiety by Curriculum AI Integration Status (N=312)

Variable	AI Curriculum (n=98)	No AI Curriculum (n=214)	t-value	p-value	Cohen's d
Overall CAI-17	3.24 (0.68)	3.87 (0.69)	6.84	<0.001	0.73
Informational Displacement Fear	3.51 (0.71)	4.15 (0.65)	7.12	<0.001	0.81

Economic Insecurity	3.47 (0.74)	3.98 (0.73)	5.21	<0.001	0.61
Professional Identity Erosion	3.22 (0.81)	3.97 (0.78)	7.05	<0.001	0.86
Technology Self-Efficacy	3.78 (0.65)	3.12 (0.71)	-7.25	<0.001	0.79
AI Knowledge Score	3.91 (0.58)	2.84 (0.74)	-11.93	<0.001	1.32

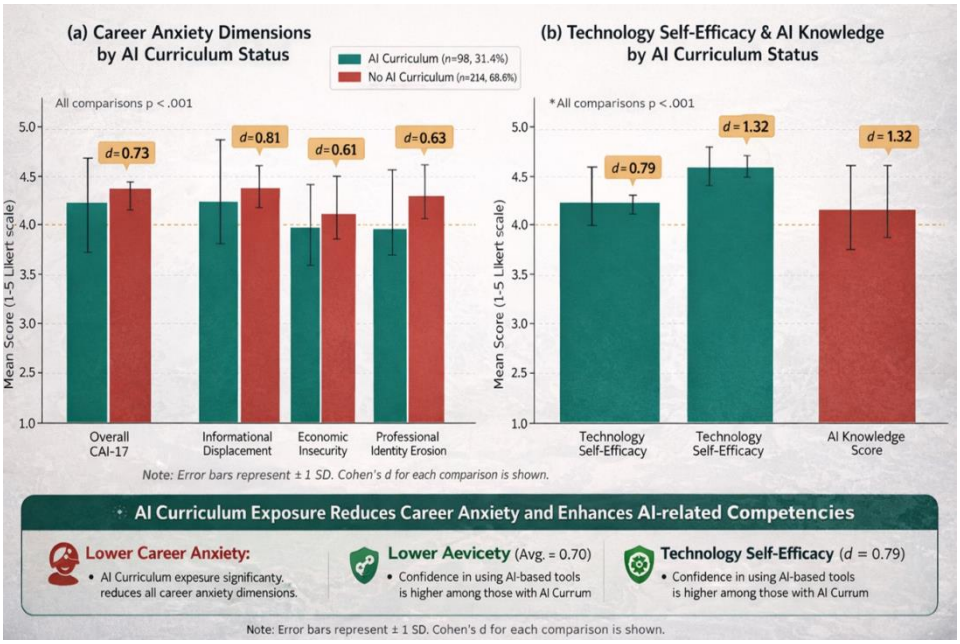


Figure 3. AI Curriculum Effect

Gender Differences in AI Career Anxiety

A gender analysis of the profiles of career anxiety revealed gender differences for students (with female students having a higher mean overall career anxiety score (M=3.79, SD=0.68) than male students (M=3.53, SD=0.73). Although the statistical significance of the results is moderate (t(310)=2.79, p=0.006, Cohen's d=0.31), the practical significance is moderate as well. Gender differences were greatest for Professional Identity Erosion (female M=3.91, male M=3.50, d=0.52) and Emotional Role Redundancy (female M=3.78, male M=3.42, d=0.44), whereas differences in Informational Displacement, Fear, and Economic Insecurity were lower and less consistent. In general, the results may suggest that female students have a heightened level of sensitivity concerning AI threats, especially related to the relational/emotional period of guidance, which, as noted by El Hajal (2025) and Drexler & Beckman Lapre (2019), female students are generally more invested in their professional identities. The use of multi-group structural equation modelling (SEM) confirms that the core theoretical paths were structurally invariant across gender, meaning that the same underlying causal mechanisms function for both male and female students despite being offset by gender-based differences in mean-level anxieties (Koo et al., 2021; Martínez-Roget et al., 2025) (Table 6).

Table 6. Career Anxiety Dimensions by Gender (N=312)

Anxiety Dimension	Female (n=168)	Male (n=144)	t	p	d
Overall CAI-17	3.79 (0.68)	3.53 (0.73)	2.79	0.006	0.31
Professional Identity Erosion	3.91 (0.74)	3.50 (0.84)	3.88	<0.001	0.52
Emotional Role Redundancy	3.78 (0.79)	3.42 (0.85)	3.28	0.001	0.44
Economic Insecurity	3.87 (0.72)	3.74 (0.77)	1.31	0.191	0.17
Informational Displacement Fear	3.99 (0.65)	3.88 (0.72)	1.21	0.228	0.16
Adaptational Self-Doubt	3.41 (0.85)	3.20 (0.91)	1.80	0.073	0.24

Technology Self-Efficacy as an Anxiety Moderator

Self-Efficacy with Technology (TSE) is the individual characteristic with the strongest predictive value for lower career-related anxiety, as shown by stepwise hierarchical regression analysis, which statistically controls for demographic and curricular variables, accounting for 18.3% of the variance in anxiety (ΔR^2=0.183, ΔF=69.74, p<0.001). The TSE Beta Coefficient was −0.42 (95% CI [−0.52, −0.32]), meaning that one (1) unit increase in self-efficacy with technology represents a 0.42-point decrease in overall career-related anxiety. This finding is consistent with the results of Zhang & Jin (2023), which demonstrated that workplace self-efficacy beliefs mediated the relationship between job insecurity and the expectation of future employment opportunities with STAARA awareness, and with Chung & Tan (2025), which demonstrated that self-efficacy in the workplace mitigated the effects of robotic work-related threat evaluations. Moderation analysis results indicated that TSE was a moderating factor in the relationship between perceived AI threats and career-related anxiety (interaction beta = -0.31, p < 0.001). Students who possessed high self-efficacy with technology demonstrated significantly lower levels of anxiety at high perceived threat than students with low TSE. The buffers created

by TSE in the relationship between perceived threats and anxiety can support initiatives to promote confidence amongst students in their ability to work with AI-integrated tourism industry products to eliminate the psychological distress experienced by many in this sample (e.g., (El Hajal, 2025; Yadav & Bora, 2025) (Table 7).

Table 7. Hierarchical Regression: Predictors of Overall Career Anxiety (N=312)

Predictor Block	Variables	ΔR^2	Beta	p
Block 1: Demographics	Gender, Age, Year of Study	0.041	—	<0.001
Block 2: Curriculum	AI Curriculum Exposure, Institution	0.112	—	<0.001
Block 3: Technology Self-Efficacy	TSE Score	0.183	−0.42	<0.001
Block 3: Professional Identity	Identity Strength Score	—	0.28	<0.001
Block 3: AI Knowledge	AI Knowledge Score	—	−0.19	0.002
Block 3: Active Coping	Active Coping Orientation	—	−0.31	<0.001
Total Model R^2	All blocks combined	**0.536**	—	**<0.001**

Coping Strategy Profiles

Through cluster analysis, three unique coping strategy profiles emerged: Active Adapters (n=89, 28.5%), Uncertain Pragmatists (n=89, 28.5%), and Anxious Resisters (n=134, 42.9%). Active Adapters show very strong scores in proactive skill development, AI literacy acquisition, and hybrid role preparation using what Anggari (2024) refers to as "complementarity orientation" (the development of new skills that compliment other existing skills) as well as El Hajal (2025) refers to as "resilience orientation" (a person's ability to bounce back from adversity and maintain motivation and focus in the face of new challenges). Active Adapters also reported significantly lower amounts of career-related anxiety (M=2.97, SD=0.71) and much higher amounts of commitment to their chosen careers (M=4.21, SD=0.58) relative to the Uncertain Pragmatist group (career anxiety, M=3.68; career commitment, M=3.74) or the Anxious Resister group (career anxiety, M=4.12; career commitment, M=3.47). Regarding the representation of the Active Adapters at each institution, Alexandria University had the highest proportion at 49.4%, with Helwan and Suez Canal Universities following at 19.2% and 14.4%, respectively. This difference supports the conclusion that differences in the integration of AI technologies into course curricula exist across these institutions and lend credence to the institutional basis of student coping orientation.

The Anxious Resister cluster represents a potential crisis; this cluster of students has the highest levels of anxiety, uses avoidant coping strategies, reports the lowest levels of AI course exposure (13.4%), and feels the least amount of commitment towards their future career. This student population represents the greatest risk to the labour market as a result of job insecurity, according to what Kang et al. (2024) identified as the "labour leakage risk" associated with AI-induced job instability (Kömürcü et al. 2021; Mabungela, 2023) (Table 8 and Figure 4).

Table 8. Coping Strategy Cluster Profiles

Profile	n (%)	Anxiety M (SD)	Career Commitment M (SD)	AI Curriculum (%)
Active Adapters	89 (28.5%)	2.97 (0.71)	4.21 (0.58)	58.4%
Uncertain Pragmatists	89 (28.5%)	3.68 (0.64)	3.74 (0.67)	28.1%
Anxious Resisters	134 (42.9%)	4.12 (0.62)	3.47 (0.74)	13.4%
ANOVA F-statistic	—	F=78.42, p<.001	F=34.17, p<.001	χ^2=41.3, p<.001

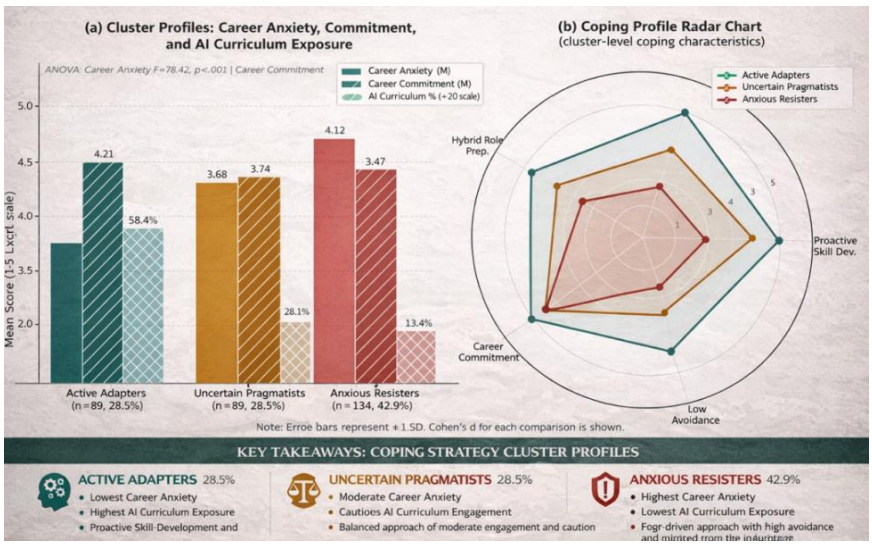


Figure 4. Coping Profiles

Structural Equation Model Results

Our structural equation models supported the hypothesized relationships among variables. The model fit indices indicated an adequately fit model (CFI = 0.94, TLI = 0.92, RMSEA = 0.055 [90% CI: 0.041 - 0.069], SRMR = 0.061).

The standardized regression coefficient for AI threat perception and overall career anxiety was 0.54 ($p < 0.001$), confirming that the cognitive appraisal of the severity of AI threat is the primary source of student anxiety; this finding aligns with Koo et al.'s (2021) and Bakir et al.'s (2025) documentation of an appraisal mechanism related to threats. The moderator effects of technology self-efficacy on the fear of AI in the workplace were also significant (moderated effect: $\beta = -0.31$; $p < 0.001$); technology self-efficacy also had a direct, negative relationship with career anxiety ($\beta = -0.33$; $p < 0.001$), supported by Zhang & Jin's (2023) and Li et al.'s (2019) findings. In addition, professional identity strength had a statistically significant direct positive relationship with career anxiety ($\beta = 0.22$; $p < 0.001$), thereby confirming the identity paradox. Career curriculum that provides opportunities to integrate AI has a direct ($\beta = -0.19$; $p = 0.004$) and indirect ($\beta = -0.14$; $p = 0.007$) effect on reducing career anxiety through increased technology self-efficacy. These results support dual-pathway effects of a career curriculum that integrates AI. Career anxiety also has a significant negative effect on career commitment ($\beta = -0.46$; $p < 0.001$), while active coping has a direct positive effect on career commitment ($\beta = 0.31$; $p < 0.001$). The model accounted for 53.6% of the variance in career anxiety and 41.2% of the variance in career commitment (Table 9 and Figure 5).

Table 9. Structural Equation Model Path Coefficients

Structural Path	Beta	SE	z	p	95% CI
AI Threat Perception → Career Anxiety	0.54	0.046	11.74	<0.001	[0.45, 0.63]
Tech Self-Efficacy → Career Anxiety	−0.33	0.051	−6.47	<0.001	[−0.43, −0.23]
Professional Identity → Career Anxiety	0.22	0.055	4.00	<0.001	[0.11, 0.33]
AI Curriculum → Career Anxiety (direct)	−0.19	0.066	−2.88	0.004	[−0.32, −0.06]
AI Curriculum → TSE (indirect pathway)	0.33	0.061	5.41	<0.001	[0.21, 0.45]
Career Anxiety → Career Commitment	−0.46	0.049	−9.39	<0.001	[−0.56, −0.36]
Active Coping → Career Commitment	0.31	0.054	5.74	<0.001	[0.20, 0.42]

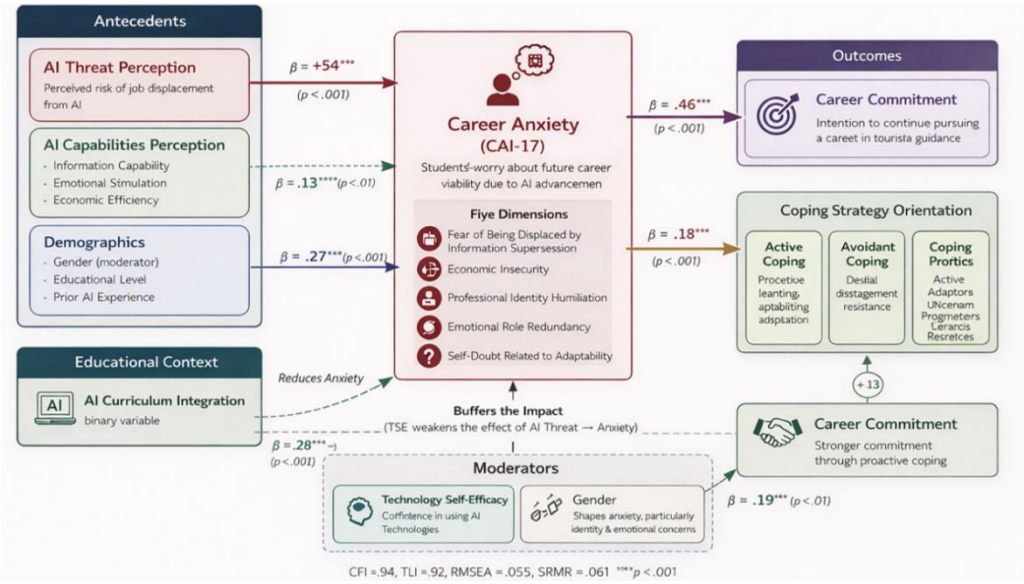


Figure 5. Tested SEM Model

Predictors of Career Commitment Maintenance

Career commitment maintenance despite heightened anxiety levels had four major positive predictor factors identified through binary logistic regression analyses. The most significant predictor of career commitment maintenance despite high anxiety was Active Coping Orientation (OR=4.23; 95% CI [2.61,6.85]; p<0.001). Students who exhibited a profile of active, adaptive coping strategies were over four times more likely to remain committed to their careers during periods of high anxiety, which underscores the importance of the resilience orientation described by El Hajal (2025). The second most influential predictive factor associated with career commitment maintenance despite high anxiety levels was exposure to AI-integrated curriculum (OR = 2.87; 95% CI [1.74,4.73]; p < 0.001). The third- and fourth-strongest predictive factors associated with career commitment retention despite anxiety were Technology Self-Efficacy (OR= 2.14; 95% CI [1.38,3.32]; p<0.001) and internship experience in AI-integrated tourism contexts (OR= 1.98; 95% CI [1.19,3.29]; p=0.009), respectively. Conversely, high levels of AI Threat Perception significantly reduced the probability of career commitment retention (OR=0.42, p<0.001), and membership in the Anxious Resister cluster (OR=0.31, p<0.001) was also negatively correlated with career commitment retention. These findings provide educators with clear points of leverage for developing targeted interventions to improve student career commitment outcomes (Anggari, 2024; Grobbelaar & Verma, 2024) (Table 10).

Table 10. Binary Logistic Regression: Predictors of Career Commitment Maintenance (N=312)

Predictor	OR	95% CI	p	Direction
Active Coping Orientation	4.23	[2.61, 6.85]	<0.001	Positive
AI Curriculum Exposure	2.87	[1.74, 4.73]	<0.001	Positive

Technology Self-Efficacy	2.14	[1.38, 3.32]	<0.001	Positive
Internship in AI-Integrated Context	1.98	[1.19, 3.29]	0.009	Positive
AI Threat Perception (high)	0.42	[0.27, 0.65]	<0.001	Negative
Anxious Resister Cluster Membership	0.31	[0.19, 0.51]	<0.001	Negative

DISCUSSION

Theoretical Contributions

This research offers several contributions to the theoretical framework of career anxiety in AI-disrupted work settings. To begin, it expands upon Career Transition Theory in tourism with regard to the anticipatory phase of career disruption. Moreover, it has been confirmed that Technology Self-Efficacy moderates the relationship between threat perception and anxiety, thereby extending Career Transition Theory's self-efficacy constructs to a specific realm of occupational threats related to Artificial Intelligence (AI) (Li et al., 2019; Zhang & Jin, 2023). This theory adjunct corresponds with Huang & Rust's (2018) theoretical proposition that individuals will need to develop an awareness of their mechanical and analytical intelligence capabilities to thrive in an environment characterized by coexistence with AI, and it corresponds to Tussyadiah's (2020) request for theoretical models that encompass the dual employment impacts of automation within the tourism sector. The results of this research suggest that elements of the appraisal process should continue to be studied to better understand how to foster positive adaptations among students in response to perceptions of AI technology as a threat. The second finding indicates that interventions designed to enhance the perceived strength or reliability of professional identity will lead to greater performance than interventions designed to enhance the perceived flexibility or adaptability of professional identity (Chung & Tan, 2025; Koo et al., 2021). Moreover, the third finding indicates that the concept of Professional Identity Resilience (PIR) can be used to measure the extent to which students have a flexible professional identity that enables successful adaptation to AI technology. Three main coping profiles for students based on empirical efforts provide additional types of contributions to the literature on planning for student careers when used as a basis for tourism education researchers to create a person-based framework for developing differentiated approaches for student support based on the student's coping profile rather than by treating all students going towards careers in the tourism field equally (Bakir et al., 2025; El Hajal, 2025).

Managerial and Educational Implications

The implications of this research are significant for administrators, curriculum designers, and career advisors within the tourism industry. The ability to incorporate an AI-based curriculum was found to be the strongest modifiable predictor of decreasing career-related anxiety, suggesting a need for an extensive reform of the tourism-related curriculum.

The research findings support the development of specifically designed modules on AI literacy for tourism professionals, allowing students to have opportunities to use AI tools in their work in a guidance capacity, as well as helping students evaluate AI's potential and limitations and how to create a professional identity that incorporates the unique human attributes necessary to successful cultural/heritage tourism. Career guidance providers should provide career counselling services that include AI Transition Coaching as a component of all career-steering services, in particular helping students develop their technology self-efficacy through successive use of AI-assisted career counselling activities and mentored reflection on the unique contributions of humans to hybrid human/AI service environments.

According to the findings, developing defined frameworks for people and AI to work together is important for organisations in the tourism industry, as these frameworks will outline the roles people play and the value each contributing factor offers in delivering services using AI. The Anxious Resister type is comprised of 42.9% of the sampled population for this study and indicates a large percentage of the up-and-coming tourism guide profession that is potentially at risk for dropping out of the industry due to a lack of understanding about their respective roles, along with the value they offer the overall organisation by utilising AI technology. Developing mentorship and internship programmes that provide students with real-world exposure to successful professionals operating as guides using the technology would foster employee retention.

The odds ratio of 1.98 for interning in AI-driven tourism guides demonstrates how limited exposure can shift students' views of AI from exclusive to inclusive. Many of the future goals for Egypt's national tourism policy will benefit from paying closer attention to how psychological factors affect workers' attitudes toward using AI to assist them in their jobs. The establishment of comprehensive professional standards within existing licensure frameworks can provide clear definitions of what constitutes successful human/AI collaboration in licensed guidance services. These standards will also give students clarity about their professional capacity to work as a licensed human guide, which may help reduce their anxiety about the economic impact of AI-based technology on their careers and future job prospects. In addition to including traditional measures of academic success, university quality assurance processes must also evaluate how well students are preparing psychologically to work in professional settings where AI will transform how professionals interact with their industry and profession.

Research Limitations and Future Directions

The study has several limitations. Causation cannot be determined because the data is collected as a snapshot in time, so we are unsure whether integrating AI into programs reduces anxiety or whether students with lower anxiety are opting into programs that have integrated AI. Longitudinal research that follows students from enrollment until they enter the workforce would enable us to determine causation more reliably. The sample comes from three universities in Egypt, which limits our ability to generalize to other geographic or cultural settings. Comparative studies that include tourism programs from the Middle East, Europe, and Asia would enable us to determine whether the patterns of anxiety identified with AI disruption in the study were universal or culturally specific. The use of self-reporting to gather the data also introduces the possibility of bias in the results. Future studies that could build upon the findings of this study might use both behavioral

measures of how students cope with anxiety in conjunction with self-reported measures related to coping with anxiety to provide evidence of convergent validity. The only perspective presented was that of the students who participated in this study; therefore, the AI's perceptions of other stakeholders, such as practicing tour guides, industry employers, and tourism faculty, would provide additional support for the students' views presented in this study. Finally, additional research could explore developing and validating the Professional Identity Resilience construct proposed in the theoretical contributions section, and determining how different AI tool typologies affect anxiety profiles related to one's career.

CONCLUSION

This research's results provide a clearer view of career-related anxiety in Egyptian tourism-guiding students regarding possible job loss due to AI-driven career displacement; in addition, they identify specific educational and psychological components that can help shield against the most severe damaging effects of this anxiety (Ersoy & EhtİYar, 2023; Hamarat et al., 2024). The mean career anxiety for students in this research was 3.67 (high relative to those measured by hotel workers (Koo et al., 2021; Yuan & Liu, 2025), suggesting students have significant concerns about how their jobs will be affected by AI. The predominance of Informational Displacement Fear (M = 3.94), as the most intense of the four types of career anxiety, is theoretically important; it indicates that students have become aware that the information part of their jobs as traditional guidance practitioners corresponds exactly to the areas in which the current wave of development in AI is the most advanced. This finding shows the students are not technophobic; rather, their concerns regarding AI are based on evidence from their evaluations of AI's capabilities; this distinction is important to note because educators who characterise student anxiety as unreasonable or overblown will never be able to address their real sources of concern.

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ORGANIZATIONAL INTELLIGENCE IN LUXURY HOTEL HOUSEKEEPING: A STRUCTURAL EQUATION MODELING OF SCRUM AND ARTIFICIAL INTELLIGENCE

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Abstract: This study aims to examine the impact of artificial intelligence (AI), organizational intelligence (OI), and the agile Scrum methodology on operational management in the housekeeping departments of luxury hotels located in Lima, Panama City, Bogotá, and Mexico City, with a particular focus on operational efficiency, employee satisfaction, and guest service perception. A quantitative correlational–explanatory research design was adopted. Data were analyzed using structural equation modeling (SEM) to evaluate the direct and mediating effects of AI, Scrum, and organizational intelligence on key operational and human performance outcomes within luxury hotel housekeeping operations. The results reveal significant positive effects of the Scrum methodology on operational efficiency ($\beta = 0.65$) and job satisfaction ($\beta = 0.58$), as well as a strong positive effect of AI on operational efficiency ($\beta = 0.61$). Organizational intelligence emerged as a key mediating variable, exerting significant positive influences on operational efficiency ($\beta = 0.68$) and employee satisfaction ($\beta = 0.55$). The SEM model demonstrated acceptable overall goodness-of-fit indices ($\chi^2/df = 2.34$; CFI = 0.94; TLI = 0.92; RMSEA = 0.056; SRMR = 0.045), supporting the proposed theoretical framework. This study contributes original empirical evidence by integrating AI, agile management practices, and organizational intelligence within a unified model applied to housekeeping operations in luxury hotels across major Latin American cities. It advances the literature by highlighting the mediating role of organizational intelligence in digital transformation and operational professionalization within hospitality service environments.

Keywords: organizational intelligence, housekeeping, artificial intelligence, Scrum, luxury hospitality, SEM, agile management

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INTRODUCTION

The luxury hotel industry is undergoing a profound transformation driven by digitalization, intelligent automation, and agile management of operational processes. In this context, housekeeping departments—traditionally characterized by their hierarchical and manual structure—face the challenge of adapting to environments where operational efficiency, service quality, and guest experience are defined by the strategic use of information (Ivanov & Webster, 2020). This evolution requires new organizational capabilities focused on learning, flexibility, and continuous innovation. Recent literature underscores that hotels that successfully integrate artificial intelligence (AI) tools with agile management models, such as Scrum, not only optimize time and resources but also strengthen communication, autonomy, and collaboration among operational staff (Rigby et al., 2016, Denning, 2018). These technological and methodological transformations constitute fertile ground for the development of organizational intelligence (OI), understood as an organization's systemic capacity to process information, learn collectively, and make knowledge-based strategic decisions (Albrecht, 2003; Choo, 1998).

In the hospitality industry, AI-enabled technologies facilitate the collection, processing, and application of information across different service and operational contexts, supporting the progressive transformation of hotel management practices (Huang et al., 2022). Therefore, OI is not only conceived because of technology use, but also as a mediating mechanism between digitalization, agile management, and organizational efficiency. Despite advances in the literature on organizational intelligence and agile management, there is limited empirical research that analyzes, in an integrated manner, the role of OpI in the operational performance of housekeeping in luxury hotels in Latin America. This scientific gap motivates the present research, whose purpose is to model the structural relationships between AI, Scrum, OI, operational efficiency, job satisfaction, and service perception, through the application of structural equation modeling (SEM). The study is based on a quantitative, correlational and explanatory approach, and contributes to international literature by offering empirical evidence on how the combination of technological intelligence (AI), collective

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intelligence (Scrum) and organizational intelligence (OI) enhances the professionalization of housekeeping and promotes the digital transformation of the luxury hotel sector in Latin America. Several studies have indicated that over 30% of negative reviews in high-end hotels are directly or indirectly related to failures in housekeeping cleanliness, maintenance, and coordination, even when other services exhibit high levels of performance (Parasuraman et al., 1988; Jones, 2018). This finding demonstrates that the perceived quality of hotel service is built upon internal processes that, while invisible to the guest, are crucial for the reputation, loyalty, and financial performance of hotel organizations.

In parallel, the integration of artificial intelligence (AI) in the hotel industry has advanced significantly in areas such as revenue management, digital marketing, and customer service. However, its application in labor-intensive operational processes, such as housekeeping, remains in its early stages and understudied from an organizational and strategic perspective, particularly in Latin American contexts (Ivanov & Webster, 2020; Huang et al., 2022).

AI applied to housekeeping allows for optimized cleaning scheduling, anticipation of operational demands, reduction of human error, and improved task traceability, but its real impact depends on the organization's ability to transform data into actionable knowledge. In this context, organizational intelligence (OI) emerges as a key construct. OI is defined as an organization's collective capacity to process information, learn from experience, and make effective decisions systematically (Choo, 1998; Albrecht, 2003). From this perspective, technology alone does not guarantee sustainable performance improvements; it is the interaction between technology, people, and organizational structures that allows for the generation of lasting competitive advantages. Additionally, the adoption of agile methodologies such as Scrum has demonstrated positive effects on team coordination, collaborative problem discussion, and continuous improvement in highly dynamic environments (Rigby et al., 2016, Denning, 2018). Although, Scrum was originally conceived for software development, its application in people-intensive service sectors has gained relevance, especially in organizations facing high operational variability, such as luxury hotels. Despite these advances, the literature reveals a significant gap in the integrated empirical analysis of the impact of AI, Scrum, and OI on housekeeping performance, particularly from robust quantitative approaches such as structural equation modeling (SEM).

Furthermore, there is a scarcity of multinational comparative studies in Latin America, a region characterized by the increasing professionalization of luxury hospitality, but also by structural challenges in talent management and technology adoption. These challenges are particularly relevant in the hospitality sector, where sustainable development is closely linked to employment conditions, human rights, and the quality of work within tourism organizations (Baum & Hai, 2019). From a destination management perspective, the competitiveness and sustainable development of tourism destinations require strategic planning, stakeholder coordination, and the systematic analysis of tourism resources and market conditions (Bigné et al., 2000). In response to this gap, the present study aims to model the structural relationships between artificial intelligence, the Scrum agile methodology, and organizational intelligence, and to analyze their impact on operational efficiency, job satisfaction, and service perception in the housekeeping departments of luxury hotels in Lima, Panama City, Bogotá, and Mexico City. Using a quantitative, correlational-explanatory approach and SEM, this research seeks to contribute robust empirical evidence to the international literature on hospitality.

LITERATURE REVIEW

Digital transformation in the luxury hotel industry has become a structural and cross-cutting process that redefines business models, organizational dynamics, and the overall guest experience. Beyond simply adopting emerging technologies, this phenomenon involves a profound reconfiguration of operational processes, decision-making systems, and the ways in which employees, guests, and suppliers interact. Gretzel et al. (2020) argue that smart hotels are characterized by the systemic integration of digital technologies, advanced data analytics, and organizational capabilities geared toward continuous learning, enabling them to create highly personalized and efficient experiences.

In this context, the digitization of internal processes—such as reservations management, revenue management, predictive maintenance, and housekeeping operations—significantly contributes to improving task traceability, service quality control, and responsiveness in demand. The use of property management systems (PMS), mobile platforms, and AI-based tools allows for optimized resource allocation and reduced operational errors, critical aspects in luxury establishments where customer expectations are particularly high.

However, Mariani & Baggio (2021) warn that a considerable number of digitization initiatives fail due to a lack of alignment between the implemented technology and the existing organizational culture.

This challenge is especially relevant in operational areas such as housekeeping, characterized by high workloads, high staff turnover, and, in some cases, limited digital skills. Resistance to change, coupled with the perception of technology as a control mechanism rather than a support tool, can significantly limit the impact of innovation. From a strategic perspective, digital transformation in luxury hotels should be understood as a socio-technical process, in which technology acts as an enabler of change, but whose effective performance depends on the ability of people to interpret information, coordinate actions, develop digital skills and learn collectively within the organization

Artificial Intelligence applied to Housekeeping

The application of AI in hotel operations has demonstrated positive effects on efficiency, service quality, and guest satisfaction (Al-Hyari et al., 2023). In the area of housekeeping, AI-based systems enable predictive cleaning scheduling, intelligent task assignment, and the generation of real-time reports on room status (Huang et al., 2022). Recent studies indicate that intelligent automation can reduce cleaning times by 15% to 30%, as well as decrease coordination errors between shifts (Khonjun et al., 2025). Furthermore, the incorporation of robotic devices and

intelligent sensors helps reduce the physical workload of personnel and improve working conditions (Belanche et al., 2021). However, the literature agrees that AI does not automatically generate value. Ivanov & Webster (2020) emphasize that the positive impact of automation depends on the organization's ability to integrate technology with learning and decision-making processes. In this sense, organizational intelligence emerges as a mediating mechanism that allows data to be transformed into actionable knowledge.

Scrum and Agile Management in the Hospitality Industry

The application of artificial intelligence (AI) in hotel operations has demonstrated significant effects on operational efficiency, service consistency, and resource optimization. In housekeeping, considered one of the most labor-intensive functions in luxury hotels, AI-based systems automate and improve critical processes through predictive cleaning scheduling, intelligent task allocation, and the generation of real-time reports on the status of rooms and common areas (Huang et al., 2022). These solutions rely on the analysis of large volumes of data from property management systems (PMS), occupancy sensors, and mobile platforms used by operational staff. Recent literature indicates that intelligent automation in housekeeping can reduce cleaning times by 15% to 30%, while also decreasing coordination errors between shifts and improving synchronization with other departments, such as reception and maintenance (Khonjun et al., 2025).

Furthermore, the incorporation of robotic devices, such as autonomous vacuum cleaners and smart carts, along with IoT sensors, helps to reduce the physical workload of staff, minimize ergonomic risks, and improve working conditions—factors that are particularly relevant in contexts of high operational demands (Belanche et al., 2021).

However, empirical evidence agrees that AI does not automatically generate value or guarantee sustainable performance improvements. Ivanov & Webster (2020) emphasize that the positive impact of automation depends on the organization's capacity to integrate the technology with learning, adaptation, and informed decision-making processes. In this sense, organizational intelligence emerges as a key mediating mechanism that allows the transformation of data generated by AI systems into actionable operational knowledge. The effectiveness of these solutions is therefore contingent upon staff training, digital leadership, and the existence of an organizational culture that fosters human-machine collaboration.

Organizational intelligence as a mediating variable

Organizational intelligence (OI) has been conceptualized as an organization's systemic capacity to create meaning from information, generate collective knowledge, and make effective decisions in complex and dynamic environments (Choo, 1998). This perspective views organizations as interpretive systems, in which data acquires value only when it is processed, shared, and used in a coordinated manner by organizational actors. Albrecht (2003) expands on this notion by highlighting the central role of leadership, organizational culture, and information systems in the development of OI, emphasizing that intelligence resides not only in technology but also in the interaction between people, processes, and structures. In the context of luxury hospitality, characterized by high service standards, human capital-intensive operations, and highly variable demand, organizational intelligence (OI) becomes a key strategic resource. This capability allows operational and management teams to transform real-time information—generated by AI systems, digital platforms, and agile management tools—into coordinated actions, shared learning, and sustained improvements in service quality. OpI also facilitates the anticipation of operational problems, rapid adaptation to changes in guest preferences, and the alignment of individual efforts with the hotel's strategic objectives. From an analytical perspective, organizational intelligence (OI) acts as a mediating variable between technology and organizational performance.

Specifically, it bridges the gap between artificial intelligence applied to operations and agile management practices, such as Scrum, by enhancing teams' ability to interpret information, prioritize tasks, and make collaborative decisions. Without adequate levels of OI, the implementation of AI or agile methodologies tends to produce fragmented or short-term results. Conversely, when OI is well-developed, these tools are integrated seamlessly, amplifying their positive impact on operational efficiency, employee job satisfaction, and the guest experience. Therefore, the aim of this study is to examine how Organizational Intelligence mediates the relationship between artificial intelligence applications and agile management practices such as Scrum, and their effect on organizational performance in the hospitality industry.

MATERIALS AND METHODS

Research and design approach

This study adopts a quantitative, correlational-explanatory approach with a non-experimental, cross-sectional design. This approach is particularly relevant when the research objective is to analyze structural relationships between latent constructs and evaluate complex theoretical models without resorting to the direct manipulation of independent variables (Hair et al., 2021; Kline, 2016). In organizational and hotel management studies, this type of design allows for the identification of association patterns and explanatory effects that contribute to the empirical validation of conceptual frameworks previously proposed in the literature. In the specific context of luxury hotels, operational and organizational processes are deeply integrated into real-world service delivery dynamics, where experimental intervention could generate operational biases, affect guest service quality, or raise ethical dilemmas related to staff management.

For this reason, the use of experimental designs is limited from both an ethical and operational perspective, reinforcing the appropriateness of an observational rather than an experimental approach. The cross-sectional design allowed us to capture the perceptions of housekeeping staff at a specific point in the digital transformation process, corresponding to the period 2024–2025. This methodological strategy provided a representative snapshot of the degree of adoption of artificial intelligence, agile management practices, and the levels of organizational intelligence present in the organization at the time

of the study. It also facilitated the analysis of the combined impact of these variables on operational and human performance indicators, such as perceived efficiency, work coordination, and job satisfaction. While this design does not allow us to establish definitive causal relationships, it offers robust empirical evidence to test the proposed theoretical model and generate relevant implications for strategic management in luxury hotels.

Context and study population

This research was conducted in officially categorized five-star luxury hotels located in four Latin American capital cities: Lima (Peru), Panama City (Panama), Bogotá (Colombia), and Mexico City (Mexico). These cities were intentionally selected due to their strategic importance as regional tourism hubs, their high concentration of high-end hotels, and their role as pioneering markets in the adoption of digital technologies applied to hotel management. Furthermore, these urban destinations have a diverse tourism demand—corporate, leisure, and event-related—that requires high levels of operational efficiency and service quality. Previous empirical research on urban tourism in Latin America has identified differentiated tourist segments in major cities such as Lima, Bogotá, and Mexico City, including visitors particularly attracted by lodging and restaurant services, highlighting the strategic relevance of hospitality infrastructure within urban destinations (Carvache-Franco et al., 2023).

The Latin American context is particularly relevant to the proposed analysis, given that it combines accelerated processes of digital transformation with structural challenges associated with human capital management, informal employment, and heterogeneity in levels of technological training. In this sense, the study provides empirical evidence from emerging economies, helping to balance the predominance of research focused on developed economies. Previous comparative evidence from Latin America and the Caribbean has also demonstrated heterogeneous patterns in tourism performance and its relationship with economic growth across countries in the region (Olivera et al., 2021).

From a broader tourism perspective, crisis events can expose structural vulnerabilities in destinations and organizations, highlighting the importance of adaptive capacity and strategic responses to changing environmental conditions (Hall, 2010). Within the hospitality sector, evidence from Peru further indicates that eco-innovation in accommodation establishments can contribute to sustainability, resource optimization, and competitive advantages, reinforcing the strategic relevance of innovation-oriented practices in hotel management (Cántaro Márquez et al., 2023).

The environmental transformation of the hotel industry has, however, long raised questions about whether green practices represent substantive organizational commitments rather than merely symbolic or promotional initiatives (Pizam, 2009) The target population consisted of operational staff, supervisors, and managers in the housekeeping department, a key area for value creation, perceived quality, and internal efficiency in luxury hotels. Using official records from national tourism entities, industry information, and estimates of average payrolls per establishment, a total population of approximately 1,240 employees in this department was determined.

The inclusion of different hierarchical levels allowed for the capture of diverse perspectives on the adoption of artificial intelligence, agile management practices, and organizational intelligence. This multinational approach strengthens the external validity of the study and responds to the calls in recent literature for comparative and transnational research in emerging tourism contexts (Mariani & Baggio, 2021).

The distribution of the estimated study population by country, city, and occupational category is presented in Table 1.

Table 1. Study population by country (housekeeping departments in five-star hotels) (Source: Authors' own elaboration based on official tourism accommodation records from the competent national tourism authorities of Peru, Panama, Colombia, and Mexico (2024–2025), including MINCETUR - Peru; ATP – Panama; the National Tourism Registry – RNT – Colombia; SECTUR–DataTur - Mexico)

Country / City	Hotels (5 stars)	Operation	Supervisors	Managers	Total (N)
Peru / Lima	10	280	40	10	330
Panama / Panama City	8	210	30	10	250
Colombia / Bogotá	9	270	35	10	315
Mexico / Mexico City	10	290	40	15	345
Estimated total (N)	—	1,050	145	45	1,240

Based on this population framework, an intentional sampling with predefined criteria was applied, obtaining 120 valid surveys, distributed equally among the four countries (n = 30 per country), as shown in Table 2.

Table 2. Distribution of the sample by country and position (n = 120)
(Source: Authors' own elaboration based on fieldwork, direct observation, and survey data collected during research visits, 2025)

Country / City	Operational (n)	Supervisor (n)	Manager (n)	Total (n)
Peru / Lima	22	6	2	30
Panama / Panama City	21	7	2	30
Colombia / Bogotá	23	5	2	30
Mexico / Mexico City	22	6	2	30
Total (n)	88	24	8	120

Inclusion criteria

- Formally belong to the housekeeping area during the study period (2024–2025).
- Have a minimum of one year of experience in operational or supervisory roles.

- Participate in innovation, digitization or agile management processes within the hotel.
- Having given informed and voluntary consent for participation.

Exclusion criteria

- Workers with less than six months of seniority.
- External personnel hired through outsourcing.
- Surveys with incomplete or inconsistent data.
- Hotels without official certification or with operations suspended during the study.

Sampling and selection criteria

A non-probabilistic, purposive sampling method was used, a technique widely employed in organizational studies when it is necessary to select participants with specific characteristics related to the phenomenon under study (Hair et al., 2019). The inclusion criteria considered: (i) formal membership in the housekeeping area, (ii) a minimum of one year of experience, (iii) participation in innovation or digitization processes, and (iv) informed consent.

The final sample size was 120 valid surveys (30 per country), a figure that meets the minimum requirements for the application of SEM, considering the complexity of the model and the number of estimated parameters (Kline, 2016).

Measuring instrument

The data collection instrument consisted of a structured Likert-type questionnaire with five points, composed of items distributed in five constructs: applied artificial intelligence, agile management with Scrum, organizational intelligence, operational efficiency and job satisfaction/service perception.

The items were adapted from scales validated in previous studies (Albrecht, 2003; Choo, 1998; Hair et al., 2021) and contextualized to the hotel housekeeping environment. A panel of experts in hotel management and research methodology evaluated the content validity of the instrument. The instrument consisted of a structured Likert-type questionnaire with five points (1 = strongly disagree, 5 = strongly agree), composed of items distributed across five constructs:

1. AI Prediction
2. Agile Management with Scrum
3. Organizational Intelligence
4. Operational Efficiency
5. Job Satisfaction and Service Perception

The items were adapted from previous research by Albrecht (2003), Choo (1998) and Hair et al. (2021). Confirmatory factorial validation (CFA) showed convergent validity (AVE > 0.50) and composite reliability (CR > 0.70) in all constructs.

Data Procedure and Analysis

Data collection was carried out using anonymous digital questionnaires, distributed with the support of human resources management. The data were analyzed using SPSS v.28 for descriptive statistics and AMOS v.26 for structural equation modeling. The Maximum Likelihood (ML) method was used and absolute, incremental and parsimonious fit indices (χ^2/df, CFI, TLI, RMSEA and SRMR) were evaluated, following the criteria established by Hair et al. (2019).

RESULTS AND DISCUSSION

Structural Equation Modeling (SEM) analysis allowed for the empirical validation of the proposed theoretical framework, revealing significant and coherent relationships between the variables artificial intelligence (AI), Scrum agile methodology, organizational intelligence (OI), operational efficiency, job satisfaction, and service perception.

The use of SEM proved particularly suitable for this study, as it enabled the simultaneous analysis of direct and indirect relationships between latent constructs, as well as the evaluation of OI's mediating role within a complex explanatory model. The results of the confirmatory factor analysis demonstrated adequate construct validity for all factors analyzed. Specifically, the composite reliability values exceeded the recommended threshold (CR > 0.70), while the mean variance extracted reached values greater than 0.50 (AVE > 0.50), supporting both the internal consistency of the instrument and the convergence of the items within their respective constructs (Fornell & Larcker, 1981; Hair et al., 2021). Furthermore, discriminant validity was verified, demonstrating that each construct captures a distinct theoretical phenomenon, an essential condition for the robustness of the structural model. In terms of overall fitness, the SEM model achieved satisfactory indices aligned with the ranges recommended by the specialized literature. The values obtained (χ^2/df = 2.34; CFI = 0.94; TLI = 0.92; RMSEA = 0.056; SRMR = 0.045) indicate an optimal fit between the theoretical model and the empirical data, confirming the adequacy of the structural specification. These results guarantee the overall validity of the model and allow progress toward a substantive interpretation of the proposed relationships.

Structural analysis of direct and indirect relationships

Structural analysis revealed that the Scrum agile methodology has positive and statistically significant effects on two key dimensions of organizational performance. First, a high impact on operational efficiency was observed ($\beta = 0.65$, $p < 0.001$), suggesting that the adoption of agile practices—such as iterative planning, follow-up meetings, and team self-organizations substantially contributes to optimizing workflows in the housekeeping area. Second, Scrum showed a

significant effect on job satisfaction ($\beta = 0.58$, $p < 0.001$), indicating that collaborative work environments, with greater clarity in roles and objectives, strengthen staff commitment and motivation. This result is consistent with self-determination theory, which suggests that work environments that support autonomy, competence, and relatedness foster higher levels of motivation and psychological well-being (Deci & Ryan, 2000). Additionally, artificial intelligence demonstrated a direct and significant impact on operational efficiency ($\beta = 0.61$, $p < 0.001$). This result confirms that the incorporation of predictive systems, intelligent task assignment algorithms, and real-time digital monitoring tools contributes to improved time management, shift coordination, and process control in housekeeping.

However, the direct effect of AI on human variables, such as job satisfaction, was less pronounced, reinforcing the idea that technology alone does not guarantee comprehensive improvements in organizational performance. In this context, the model's most relevant finding is the role of organizational intelligence as a mediating variable between agile management practices, AI adoption, and operational and human outcomes. The results reveal that OI has a positive and significant impact on both operational efficiency ($\beta = 0.68$, $p < 0.001$) and job satisfaction ($\beta = 0.55$, $p < 0.001$).

These coefficients confirm that teams with greater capabilities in collective learning, information interpretation, and shared decision-making achieve higher levels of productivity and employee well- being. The mediation of organizational intelligence suggests that the benefits of AI and Scrum are fully realized only when the organization has effective mechanisms for transforming data into actionable knowledge. Without a well-developed organizational intelligence framework, technology and agile methodologies tend to produce fragmented or short-term impacts. This finding is consistent with recent evidence showing that the impact of AI on organizational performance is strengthened by organizational capabilities such as digital innovation and organizational agility (Alhomaid & Al-Romeedy, 2026).

Impact on service perception

Regarding guest experience, the results show that both operational efficiency ($\beta = 0.70$, $p < 0.001$) and job satisfaction ($\beta = 0.52$, $p < 0.001$) significantly influence the perception of housekeeping service. This finding reinforces the idea that perceived quality depends not only on processes visible to the customer, but also on internal factors related to staff well-being and effective team coordination. Furthermore, the mediation of organizational intelligence reinforced the indirect link between artificial intelligence and service perception, confirming that information-based decisions, when interpreted and applied collectively, consistently contribute to improving the guest experience. In this way, organizational intelligence is positioned as a key mechanism for translating technological innovation into perceived value.

Complementary operational performance indicators

From a practical perspective, the analysis was complemented by quantitative operational performance indicators (see Table 3), which reflect tangible improvements following the joint implementation of AI, Scrum, and organizational intelligence. These indicators include reductions in average cleaning times, improvements in inter-shift coordination, and increased service consistency, empirically supporting the results obtained through the SEM model. Taken together, these findings confirm the relevance of an integrated approach that combines technology, agile management, and organizational intelligence to strengthen sustainable performance in the luxury hotel industry.

Table 3. Quantitative indicators derived from the SEM model (Source: Authors' own elaboration based on housekeeping operational records, field observations, and survey data collected during the study, 2024–2025)

Indicator	Initial situation	Post-implementation	Variation (%)
Average cleaning time per room	42 min	32 min	-23.7%
Task assignment errors	11%	3%	-72.7%
Internal staff satisfaction	58%	82%	+41.4%
NPS index associated with the cleaning service	63.9	85.0	+21.1 points

The results obtained from the structural equation modeling (SEM) confirm the strategic relevance of integrating the agile Scrum methodology, artificial intelligence (AI), and organizational intelligence (OI) into the management of housekeeping in luxury hotels. This combination should not be understood as a sum of isolated tools, but rather as a systemic synergy between advanced technology, organizational learning, and collaborative management practices. Together, these elements allow for the transformation of traditionally rigid, standardized processes highly dependent on hierarchical control into flexible, adaptive systems oriented toward knowledge-based decision-making—a crucial aspect in hotel environments characterized by high operational variability and demanding high service quality standards. The most significant finding of the study lies in the mediating role of organizational intelligence, which substantially strengthened the links between Scrum adoption, AI use, and operational and human outcomes.

This result aligns with the theoretical proposals of Choo (1998) and Albrecht (2003), who argue that organizational intelligence (OI) enables organizations not only to process information efficiently but also to construct collective meaning, learn from experience, and respond effectively to dynamic and uncertain environments. In this study, teams with higher levels of OI achieved superior performance in operational efficiency ($\beta = 0.68$) and job satisfaction ($\beta = 0.55$), demonstrating that knowledge management and collective learning capacity are key determinants of organizational performance in the context of luxury hospitality. Furthermore, the results confirm that adopting Scrum promotes an organizational culture based on responsible autonomy, interdisciplinary cooperation, and continuous feedback—elements that are particularly valuable in human capital-intensive operational areas such as housekeeping.

As Rigby et al. (2016) and Denning (2018) point out, agile methodologies facilitate team self-organization, increase process transparency, and strengthen a sense of shared purpose. In this study, implementing Scrum reduced average cleaning times by 23.7% and decreased task assignment errors by 72.7%, generating tangible improvements in productivity and coordination. These results align with the findings of Serrador & Pinto (2015), who demonstrated that teams adopting agile approaches in service environments exhibit higher levels of organizational performance and employee satisfaction compared to those operating under traditional frameworks.

For its part, artificial intelligence strengthened data-driven decision-making, contributing directly and significantly to operational efficiency ($\beta = 0.61$). This finding is consistent with the arguments of Ivanov & Webster (2020) and Huang et al. (2022), who contend that intelligent automation and predictive systems improve resource allocation, task traceability, and the ability to anticipate customer needs. In the case analyzed, AI did not replace human decision-making but rather acted as a catalyst for organizational intelligence, providing actionable information that facilitated coordination among Scrum teams and reduced operational uncertainty. This result reinforces the notion of human-machine complementarity, particularly relevant in high-touch services such as luxury hospitality. The structural model also revealed that both operational efficiency ($\beta = 0.70$) and job satisfaction ($\beta = 0.52$) significantly influence guest perception of service.

This finding empirically reinforces the service-benefit chain theory proposed by Heskett et al. (1994), which posits that external service quality is a direct consequence of internal service quality and employee well-being. Hotels with higher levels of operational efficiency and more consolidated agile management not only showed increases in productivity but also improved guest perception regarding the consistency, cleanliness, and reliability of the service received—critical aspects of the luxury experience. From a theoretical perspective, these results provide relevant empirical evidence to the literature on smart hotel management, demonstrating that organizational intelligence acts as a key mediating mechanism between emerging technologies and organizational outcomes. In this way, a technocentric view of innovation is overcome, showing that the true value of AI and agile methodologies is realized when the organization possesses internal capabilities to interpret, share, and apply the knowledge generated. In this sense, the housekeeping area ceases to be conceived as an operational unit subordinate to routine and control and is instead positioned as a strategic space for organizational innovation, the professionalization of human talent, and the generation of sustainable value.

In summary, the study supports the premise that the future of housekeeping in luxury hotels depends on its ability to learn, adapt, and make collective decisions through AI systems integrated with agile management frameworks and high levels of organizational intelligence. These findings not only confirm the hypotheses of the proposed theoretical model but also broaden the scope of organizational intelligence theory applied to the hospitality sector. Taken together, the results consolidate an emerging paradigm of hotel management based on knowledge, technology, and agility, capable of responding to the growing demands for efficiency, quality, and customer experience in contemporary luxury hotels.

Synthesis of the structural model

Figure illustrates the final validated model, showing the standardized coefficients and the significant relationships between the main variables. In summary, the study's results confirm that the strategic combination of agile methodologies such as Scrum, artificial intelligence, and organizational intelligence drives intelligent organizational transformation into luxury hotels. This integration not only optimizes operational processes and team coordination but also strengthens collective learning and data-driven decision-making. As a result, there is a comprehensive improvement in internal productivity, staff well-being, and service consistency, leading to higher levels of guest satisfaction and a sustainable competitive advantage for high-end hotel organizations.

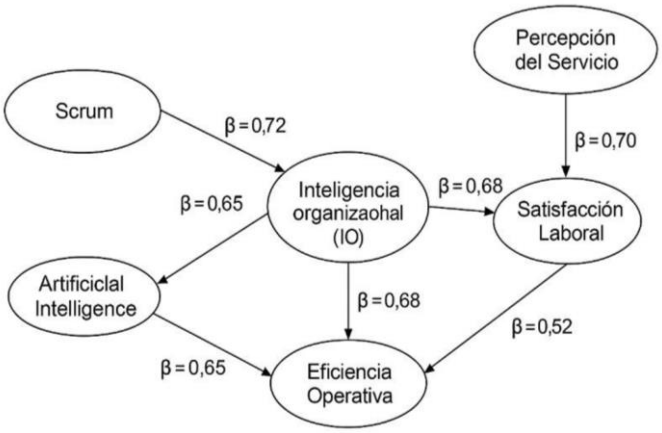


Figure 1. Structural equation model of the impact of Scrum, AI and OI on housekeeping efficiency
(Source: Authors' own elaboration using IBM SPSS AMOS, 2025)

CONCLUSION

This study demonstrated that integrating organizational intelligence (OI) with the Scrum agile methodology and artificial intelligence (AI) constitutes an innovative, coherent, and highly efficient management model for housekeeping in luxury hotels. Unlike traditional approaches focused solely on task automation, the results show that the true value of

digital transformation emerges when technology is combined with organizational capabilities geared toward collective learning, collaboration, and informed decision-making. Structural equation modeling (SEM) empirically confirmed that organizational intelligence acts as a key mediating variable between agile management practices and operational performance. In particular, OI enhances the effects of Scrum and AI on critical outcomes such as operational efficiency, employee job satisfaction, and guest service perception. These findings reinforce the notion that technological innovation alone does not guarantee sustainable improvements in organizational performance if it is not accompanied by cognitive and social processes that transform information into actionable knowledge. The most relevant results of the study can be summarized in five key aspects. First, it is evident that the Scrum agile methodology and AI strengthen organizational intelligence by promoting collaborative work dynamics, greater transparency in processes, and more effective use of data for decision-making. Second, OI directly improves operational efficiency ($\beta = 0.68$) and job satisfaction ($\beta = 0.55$), establishing itself as the cognitive axis that connects technology with human behavior within the organization. Third, operational efficiency ($\beta = 0.70$) and job satisfaction ($\beta = 0.52$) significantly impact service perception, empirically validating the service-benefit chain model proposed by Heskett et al. (1994).

Additionally, the results confirm that artificial intelligence contributes to task prediction and traceability, optimizing time management and reducing operational errors by 72.7%, which translates into greater service consistency and reliability. Finally, the SEM model achieved robust fit indices (CFI = 0.94; TLI = 0.92; RMSEA = 0.056), confirming its statistical soundness and theoretical coherence. Taken together, these results allow us to conclude that the development of organizational intelligence in housekeeping fosters staff professionalization, service sustainability, and the digital transformation of the Latin American hotel sector. In short, the convergence of technological intelligence, collective intelligence, and organizational intelligence constitutes a solid path toward operational excellence and smart hospitality, strengthening the competitive positioning of luxury hotels in Latin America.

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Informed Consent Statement: The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Participation was voluntary, and we obtained informed consent from all participants before they completed the questionnaire. We ensured participants' anonymity and confidentiality throughout the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to confidentiality and privacy considerations concerning the participants and the participating hotel establishments.

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Use of Generative AI: Generative artificial intelligence tools were used solely to support the initial exploratory identification of potentially relevant literature during the literature review process. All identified sources were subsequently independently verified, screened, and evaluated by the authors using the established inclusion and relevance criteria. Generative AI was not used for primary data collection or statistical analysis. The authors take full responsibility for the accuracy, integrity, and originality of the manuscript.

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TOURISM DEVELOPMENT IN THE WEST KAZAKHSTAN ECONOMIC DISTRICT: CURRENT TRENDS AND FORECASTS

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Abstract: As a major economic diversification strategy, tourism in Kazakhstan has gained significant attention as a means of economic development in the region, but the West Kazakhstan Economic District is still underresearched. The paper fills the latter gap by integrating both bibliometric analysis of the scientific output and econometricзирование of the tourism flows to the four administrative units of the Aktobe, Atyrau, West Kazakhstan and Mangystau. With an emphasis on the official statistical trends related to the years 2003-2024, we review the patterns of visitors, housing facilities, and occupancy rates, and place the results of the empirical study in the context of the general academic discourse on the theme of sustainable tourism, cultural heritage, and regional inequalities. Bibliometric analysis (PRISMA and VOSviewer) shows that there is an increasing tendency of the research to move away from descriptive methods and more advanced analytical techniques, but the Western regions are still left behind in the scope of scientific interest. According to our econometric forecasts, on the basis of HoltWanters exponential smoothing model (ETS), we can see the existence of heterogeneous trends among regions: Mangystau is the main region of growth with high stability and rising tourist expenditures, and Aktobe and West Kazakhstan are gradually, yet steadily improved. In turn, Atyrau is very volatile, indicating a structural mismatch between demand and supply. The combination of bibliometric knowledge with time-series forecasting offers contributions to theory and practice, including evidence of uneven development in tourism in Kazakhstan and the presence of the district as a microcosm of the larger national issues. The results highlight the necessity of policy cohortation, which balances infrastructural investments, institutional redesign and input of local communities, in a bid to guarantee the sustainability of tourism development in the western region of the nation.

Keywords: West Kazakhstan district, tourism development, bibliometric analysis, ETS model, forecasting, sustainable tourism

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INTRODUCTION

The development of tourism in Kazakhstan has attracted increasing attention in recent decades, as it represents an important instrument of diversification of the national economy and regional development. The need for a sustainable model of tourism and regionally differentiated policies is emphasized in the literature (Aimagambetov et al., 2017; Trišić et al., 2021). Research indicates that tourism can contribute to local communities through employment, income growth and infrastructural development (Aliyeva et al., 2019), while the concept of the "experience economy" confirms the growing

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demand for authentic experiences and cultural values (Kenzhebekov et al., 2021). More modern works, based on advanced econometric analyses, enable a deeper understanding of tourism demand factors and more reliable development forecasts (Serikbayeva et al., 2025), while limited resources, insufficient promotion and infrastructural weaknesses are recognized as key challenges in the field of ecotourism (Tleuberdinova et al., 2025). Despite the growing literature, tourism in the West Economic District of Kazakhstan remains under-researched, although the region possesses significant natural and cultural resources and lags in diversification and strategic positioning (Smanov et al., 2025).

This gap justifies the goal of the research: providing a comprehensive insight into the current state of tourism in West Kazakhstan and identifying key opportunities and perspectives for future development, through linking a systematic review of the literature with bibliometric analysis and econometric forecasts.

RQ1. How did the trends in the number of visitors in the regions of West Kazakhstan change during the period 2003–2024, and are there significant differences between them?

RQ2. To what extent did the changes in the number of rooms and the occupancy rate follow the growth of tourist traffic and can we talk about overcapacity in certain regions?

RQ3. How do the relationships between the number of visitors and the income from accommodation differ by region and what does this say about the average spending of tourists?

RQ4. What are the main thematic areas and research trends in the tourism literature in Kazakhstan and to what extent have the western regions been represented in scholarly analyses?

RQ5. What forecasts of the development of tourism until 2030 does it provide?

The innovativeness of this study is reflected in its integrated approach that connects the analysis of empirical data on tourist flows with a bibliometric review of research production. In this way, the work simultaneously illuminates real economic trends and the way in which they are recognized in the scientific community. A special contribution lies in the use of the ETS model (Holt–Winters Exponential Smoothing Model) for forecasting future trends in tourism in West Kazakhstan, with precise validation of the forecast through relevant metrics. This methodological framework enables more reliable forecasting and offers practical guidelines for the improvement of regional tourism policies.

At the same time, the study opens new directions of research in the context of the Central Asian area, providing a basis for comparative analyzes and the transfer of knowledge to similar economic and social frameworks.

LITERATURE REVIEW

The development of tourism in Kazakhstan attracts the attention of researchers, but approaches in the literature develop in different directions. Early works, such as that of Batyrova et al. (2018), provide useful insights into structural problems of competitiveness and institutional weaknesses, but critically, their focus on identifying barriers does not deepen understanding of the mechanisms of sustainable development. Also, the works that follow (Ramazanova et al., 2019; Seken et al., 2019) often dwell on descriptive analyses, recognizing the potential of rural tourism, but without providing concrete solutions for overcoming infrastructural and promotional barriers. Although these works emphasize the importance of rural tourism, they are not sufficiently linked to concrete institutional strategies that would enable long-term sustainability.

Kozhokulov et al. (2019) provide a valuable analysis of the socioeconomic effects of tourism in the Issyk-Kul region of Kyrgyzstan, but their research, like most similar studies in Kazakhstan, is not fully applied to the western part of the country, and often ignores the specific challenges that Kazakhstan faces in terms of regional dislocation and political factors. In the following works, like Altynbassov et al. (2021) and Chlachula et al. (2021), there is a broader framework, which includes aspects of education, regulation and ecotourism, but these are still not linked to economic projections and sustainable development models. Many studies fail to conduct analyzes that would allow for the assessment of the long-term effects of these initiatives, while their recommendations are often based on general claims about potential without clear concrete guidelines for implementation. Since 2023, research has increasingly focused on the specifics of each region, but works such as those of Sergeyeva et al. (2023) and Saparov et al. (2024) still limit the analyzes to the micro level, not integrating quantitative models that would allow the creation of predictions for future development.

Salauatova et al. (2024) and Kadyrbekova et al. (2024) shift the focus to cultural heritage and its strategic application in tourism, but do not offer concrete instruments to overcome the recognition of cultural resources as market value. Although these works can be considered significant for the detailed investigation of micro aspects of tourism, their contribution to strategic planning and implementation remains weak due to the lack of quantitative tools and long-term forecasts. Recent studies, such as the works of Omirzakova & Wendt (2025) and Konysbek et al. (2025), focus on institutional and infrastructural constraints, but still do not consider the complexity of institutions that shape tourism development in the specific regional and cultural contexts of Kazakhstan. Panibratov et al. (2025) provide a broader perspective through the analysis of international integration, but their work does not deal deeply enough with the challenges that Kazakhstan has in terms of developing sustainable tourism, taking into account the environmental, social and political spheres.

Although the results of these researches are useful, their practical application and integration into actual policies and strategies of tourism development in Kazakhstan remains uncertain and undefined. Previous literature shows that researchers have successfully identified the key challenges and resources of tourism in Kazakhstan, but often without quantitative validation and forecasts to enable operational planning. Wendt (2020) provides a critical review of the weaknesses of previous research, emphasizing the need for quantitative models and geoinformation tools, which is directly related to our bibliometric approach. Similarly, Daye et al. (2020) emphasize that the development of tourism in Kazakhstan should not be viewed in isolation, but within the framework of international processes, especially in the context of China's

"Belt and Road" initiative. Their work is methodologically based on qualitative approaches through the analysis of the views of local stakeholders, which is important for understanding the political-economic conditioning of the tourism sector, but at the same time shows limitations when it comes to measuring long-term trends and predicting future flows.

Despite these contributions, the methodological base of tourism research in Kazakhstan remains modest. Dominant methods still include descriptive statistics, comparative case studies and qualitative surveys, while GIS analysis and bibliometric approaches are occasionally used to map potential and research trends (Chashina et al., 2020; Popović et al., 2025). However, econometric time series and ETS forecasting models are rarely included in analyses, even though they would enable more reliable forecasts and operational planning. For example, Akhmedenov (2020) assesses the possibilities of religious tourism in West Kazakhstan, but uses descriptive and evaluative methods, without including projections that would confirm the long-term potential of the identified resources.

Similarly, studies of natural recreational potential (Chashina et al., 2020) map resources and indicate their importance, but do not offer quantitative models to show development dynamics. In this sense, the justification of our methodology stems precisely from the lack of works that connect bibliometric analysis of research production (using PRISMA and VOSviewer protocols) with econometric forecasts of tourist traffic (ETS model).

Such an integrated approach enables a simultaneous observation of real economic trends and the way in which they are recognized in the scientific community, which overcomes the limitations of previous studies and provides a more reliable framework for strategic planning of tourism in the West Kazakhstan region.

METHODOLOGY

The research was conducted with the aim of reviewing the development of the tourism sector in West Kazakhstan, with a special focus on four administrative units: Aktobe, Atyrau, West Kazakhstan and Mangistau, as well as on the unified West Kazakhstan Economic District. In this paper, West Kazakhstan is viewed through the prism of the West Kazakhstan Economic District, an administrative-statistical unit that includes four areas: Aktobe, Atyrau, West Kazakhstan and Mangistau (Rosen et al., 2000). The term district in this context means a unified economic unit that exceeds the boundaries of individual areas (regions) and is used in official statistics and strategic documents of the Republic of Kazakhstan to monitor macroeconomic flows (Robinson et al., 2023). Unlike the administrative "region" (e.g. West Kazakhstan Region), which refers to one area, the economic district includes several areas and enables a more comprehensive overview of development processes (Smith, 2019). This is precisely why this paper uses the term West Kazakhstan Economic District, because it best reflects the broader scope of the research and enables a comparable analysis of tourist traffic and economic effects at the level of an integrated whole, rather than individual areas.

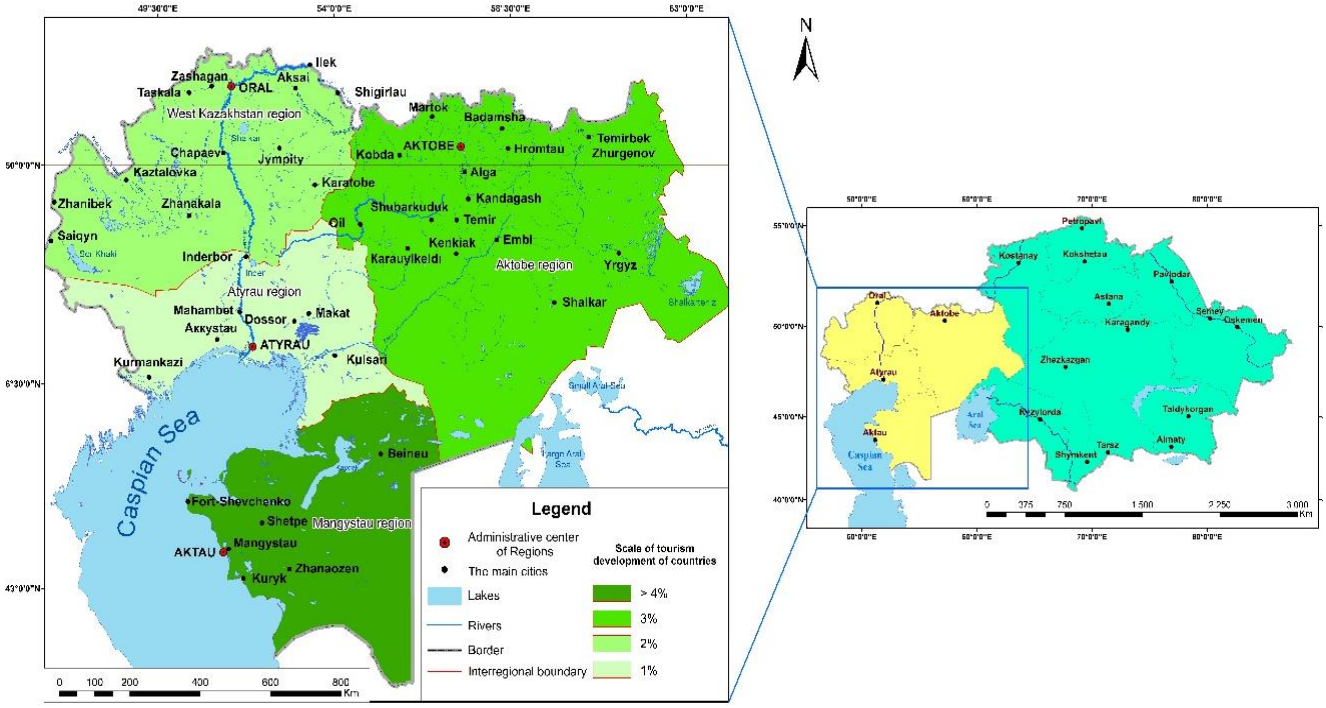


Figure 1. Research area

For the sake of a theoretical foundation and clear positioning of the work in the existing literature, a bibliometric analysis of research on tourism in Kazakhstan was conducted (Lazarides et al., 2025). The analysis included works indexed in the Web of Science and Scopus databases, supplemented by Google Scholar and EBSCOhost, for the period 2003–2024, which enabled an overview of long-term research trends and oscillations caused by economic and global crises. The empirical part is based on official statistical data on the number of tourists, accommodation capacities and

occupancy rates, which simultaneously monitors the quantitative growth and actual capacity utilization at the regional level. For the projection of tourist flows, the Holt–Winters ETS model with a dampened trend, adjusted to an annual series without seasonality, was applied (Nurhamidah et al., 2020). The parameters were estimated using the maximum likelihood method, and the validation was performed using an "out-of-sample" approach for the period 2020-2024, with the application of RMSE and MAPE accuracy indicators (Adeyinka & Muhajarine, 2020).

The final projections until 2030 should be interpreted as moderate recovery scenarios and not as direct assessments of the effects of individual policies. All analyzes were conducted in the Python environment (pandas, statsmodels, scikit-learn, matplotlib), in accordance with the modern practice of quantitative research (Zhu et al., 202 1).

RESULTS

Bibliometric analysis

The research was carried out using a bibliometric approach, based on the analysis and visualization of scientific production on the development of tourism in Kazakhstan, which enabled a quantitative insight into research trends, key terms and patterns of author collaboration, as well as their interpretation in a wider theoretical and practical context.

The search for relevant literature was performed in the Web of Science (WoS) and Scopus databases, supplemented by Google Scholar and EBSCOhost for greater coverage. The search strategy was based on a combination of the keywords "Kazakhstan", "tourism development", "sustainable tourism", "ecotourism", "tourism management" and "cultural heritage", where the Boolean operators AND and OR were used to expand and narrow the results, while the operator NOT was applied to exclude irrelevant works. Only peer-reviewed scientific articles in English with clear thematic relevance were included in the analysis, while conference papers, chapters in monographs, dissertations and publications in other languages were excluded. The time frame is not limited in advance, but the included works are available until 2023.

The selection process was conducted in accordance with the PRISMA 2020 guidelines. From the initial 176 identified papers, after removing duplicates and irrelevant records, 144 articles were included in the analysis. The bibliometric analysis was carried out using the VOSviewer software, which enables the mapping of co-occurrence of keywords and co-authorship networks. Out of a total of 823 identified terms, 36 keywords were singled out that appeared at least five times, thus covering the most relevant thematic areas.

Visualisations with a time dimension clearly indicate a shift from earlier research into tourism potential towards contemporary topics of sustainable tourism, cultural heritage and the application of GIS technologies. Literature management was performed in the Mendeley program, while the use of multiple databases, clear inclusion criteria and a transparent selection procedure ensured reliability, reduction of bias and reproducibility of the research. The PRISMA diagram (Figure 2) shows the flow of literature selection from the initial identification to the final sample.

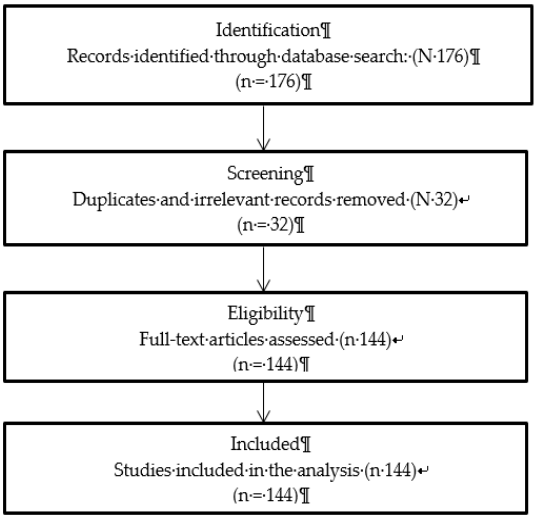


Figure 2. PRISMA diagram

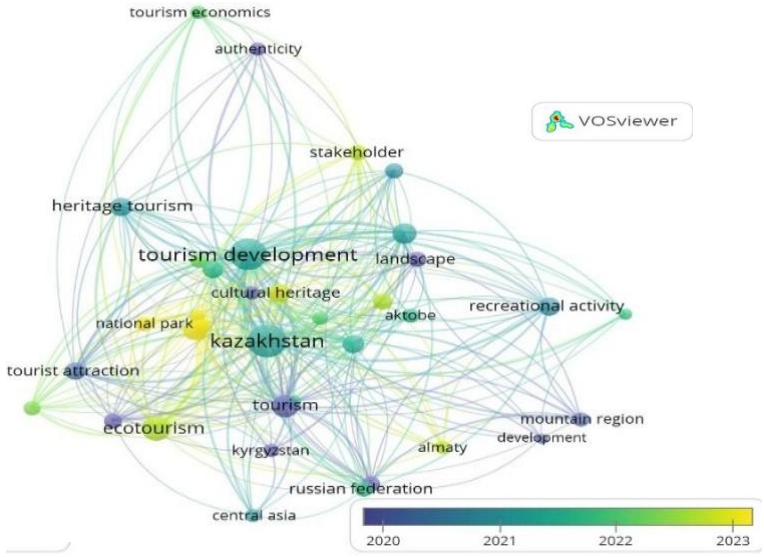


Figure 3. Overlay visualization of keywords

An overlay visualisation of keywords shows how the research focus has changed over time. Earlier works (marked in shades of blue) were mostly related to topics such as tourism, recreation and regional development, while more recent research (in shades of yellow) emphasises sustainable tourism, cultural heritage and the role of national parks. The most prominent terms remain 'tourism development' and 'Kazakhstan', which connect different thematic clusters (Figure 3).

Cluster visualization of keywords groups research topics into several interconnected clusters. The red cluster includes concepts related to sustainable development, ecotourism and tourist attractions, while the green cluster includes topics such as tourist destinations, stakeholders and tourism management. The blue cluster highlights regional aspects, including Central Asia, Kyrgyzstan and Almaty, while the purple one includes concepts related to development and tourism potential. The clusters formed in this way indicate the main research directions and their mutual connection (Figure 4).

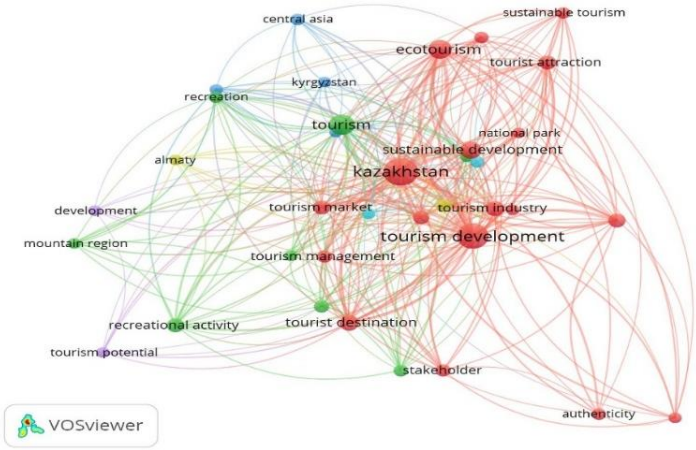


Figure 4. Cluster visualization of keywords

Trend analysis

In the period 2020–2024. the tourist region of Mangistau records an extremely strong growth in accommodation capacity and income. Income from accommodation increased from 4.1 to 17.5 billion tenge, while the number of tourists increased from 144.145 to 408.899. As incomes grew significantly faster than the number of visitors, an increase in the average consumption per tourist is evident, from about 28.5 to more than 42.8 thousand tenge, which indicates not only a quantitative growth, but also a qualitative shift in the tourist offer. The data from Table 1 confirm the long-term growth of tourist traffic in the regions of West Kazakhstan, with pronounced regional differences. Mangistau stands out as the most stable and dynamic destination, while Aktobe and the West Kazakhstan region record moderate but steady growth. In contrast, Atyrau shows pronounced oscillations, which indicate greater dependence on external factors. At the level of the West Kazakhstan Economic District, tourism is becoming an increasingly important part of the regional economy, which confirms the need for an integrated view of the development of tourism in the western part of Kazakhstan.

Table 1. The number of visitors served at the locations during the reporting (Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, Statistics of Tourism – Dynamic Tables (2003–2024) year).

Year	Aktobe region	Atyrau region	West Kazakhstan region	Mangystau region	West Kazakhstan economic district
2003	48.906	57.644	18.443	25.941	150.934
2004	51.133	97.737	21,.886	31446	202.202
2005	56.595	72.329	22.196	48.898	200.018
2006*	53.153	70.203	39.511	58.298	221.165
2007*	67.857	191.748	62,149	102.332	424.086
2008*	62.848	243.093	55.607	122.859	484.407
2009*	60.796	259.277	43.088	132.929	496.090
2010*	62.028	298.901	54.011	157.517	572.457
2011	87.879	213.579	52.882	146.633	500.973
2012	80.336	209.714	49.656	177.452	517.158
2013	84.258	232,283	71.032	176.298	563.871
2014	85.017	189.165	72.930	174.486	521.598
2015	83.589	211.756	94.461	176.068	565.874
2016	84.744	200.003	86.868	192.081	563.696
2017	100.450	184.353	112.321	205.904	603.028
2018	124.401	209.060	100.686	240.798	674.945
2019	133.417	249.766	108.454	222.539	714.176
2020*	85.050	84.534	41.466	160.504	371.554
2021*	145.023	46.303	76,180	291.931	559.437
2022*	186.637	160.149	101.276	310.217	758.279
2023*	185.326	171.775	166.560	390.332	913.993
2024*	248.295	156.473	172.315	462.723	1.039.806

Table 2 shows the growth of accommodation capacities in all regions of West Kazakhstan in the period 2003–2024, with differences in the intensity of growth. The largest absolute increase in the number of rooms was recorded in the Atyrau region, while Mangystau recorded stable and continuous growth throughout the period. Aktobe and the West Kazakhstan region show a gradual increase in capacity, but with lower values compared to Atyrau and Mangystau. At the level of the West Kazakhstan Economic District, the total number of rooms increased from 1.440 in 2003 to 13.037 in 2024, which indicates a strong expansion of accommodation infrastructure in the observed period.

Table 3 shows that the occupancy rate of accommodation facilities in the West Kazakhstan Economic District during the observed period moved at a relatively low level, with pronounced differences between regions. Mangistau records the highest values in certain years, with a maximum of 90.9% in 2011, but also later oscillations. Atyrau continuously has

lower occupancy rates, which remain below 15% after 2020. The Aktobe and West Kazakhstan regions show moderate and more stable values, mostly in the range of 20% to 35%. At the level of the whole economic district, the overall occupancy rate varies between 16.7% and 52.0%, with the lowest values recorded in the period after 2020.

Table 2. Number of rooms in the accommodation facilities (Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, 2004–2024).

Year	Aktobe region	Atyrau region	West Kazakhstan region	Mangystau region	West Kazakhstan economic district
2003	357	608	190	285	1.440
2004	373	754	316	327	1.770
2005	602	990	403	540	2.535
2006*	768	2,259	667	597	4.291
2007*	791	1.589	825	907	4.112
2008*	902	1.916	868	934	4.620
2009*	938	2.065	886	1.146	5.035
2010*	985	2.050	1.329	1.182	5.546
2011	1.011	1.948	1.256	1.322	5.537
2012	1.310	1.984	1.292	1.520	6.106
2013	1.278	1.865	1.447	2.124	6.714
2014	1.469	2.601	1.490	2.182	7.742
2015	1.578	2.605	1.484	2.512	8.179
2016	1.789	2.469	1.546	3.035	8.839
2017	1.894	2.735	1.510	2.857	8.996
2018	1.961	2.717	1.629	2.962	9.269
2019	2.052	2.977	1.700	3.226	9.955
2020*	2.010	3.216	1.751	3.672	10.649
2021*	2.088	3.426	2.014	3.785	11.313
2022*	2.158	4.156	2.208	3.812	12.334
2023*	2.205	4.051	2.430	4.066	12.752
2024*	2.210	4.133	2.520	4.174	13.037

Table 3. Occupancy rate of accommodation (Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, 2004–2024)

Year	Aktobe region	Atyrau region	West Kazakhstan region	Mangystau region	West Kazakhstan economic district
2004	67.7	67.5	14.4	36.4	46.5
2005	48.8	24.4	20.8	39.5	33.4
2006*	33.3	22.6	23.5	53.4	33.2
2007*	35.6	51.0	25.2	46.2	39.5
2008*	29.7	55.7	60.7	59.1	51.3
2009*	28.5	57.3	19.7	51.7	39.3
2010*	23.1	50.1	21.5	62.1	39.2
2011	25.9	50.1	41.1	90.9	52.0
2012	21.7	39.0	26.3	53.2	35.1
2013	28.2	51.8	31.9	33.1	36.2
2014	23.1	28.7	36.5	31.7	30.0
2015	19.9	28.0	31.8	28.2	27.0
2016	20.2	27.7	31.4	20.7	25.0
2017	20.3	26.7	33.4	21.8	25.6
2018	20.7	26.2	31.2	25.2	25.8
2019	21.1	24.5	32.7	21.0	24.8
2020*	14.8	13.5	19.2	19.4	16.7
2021*	21.6	9.2	21.5	23.6	19.0
2022*	23.0	11.9	18.1	22.6	18.9
2023*	21.1	11.7	20.4	22.7	19.0
2024*	23.9	11.0	21.4	23.7	20.0

Econometric forecasts of tourist traffic

In order to estimate the future flows of tourism in the West Kazakhstan Economic District, the ETS model based on time series was applied. Parameters were estimated using the maximum likelihood method. A value of $\alpha = 0.50$ shows a balanced appreciation of past and recent data, while a low $\beta = 0.05$ indicates gradual and stable growth. The damping coefficient $\varphi \approx 0.99$ provides moderate and realistic projections without excessive extrapolation (Table 4).

The validation results show that the ETS model provides relatively stable forecasts for most regions, with the lowest error rates observed in Mangystau and Aktobe, where MAPE remains below 30%. In contrast, the Atyrau region displays the highest forecast uncertainty (MAPE ≈ 98%), indicating significant volatility in tourist arrivals. The aggregated West Kazakhstan economic district shows moderate accuracy, with results consistent with regional heterogeneity (Table 5).

Table 4. Estimated parameters and validation metrics of the ETS model

Region	Alpha (α)	Beta (β)	Phi (φ)
Aktobe region	0.50	0.05	0.99
Atyrau region	0.50	0.05	0.99
West Kazakhstan region	0.50	0.05	0.99
Mangystau region	0.50	0.05	0.99
West Kazakhstan economic district	0.50	0.05	0.99

Table 5. Forecast accuracy of the ETS model for West Kazakhstan Regions (2020–2024)

Region	RMSE (2020-2024)	MAPE% (2020-2024)
Aktobe region	47260	28.67
Atyrau region	93165	97.76
West Kazakhstan region	49432	52.45
Mangystau region	81946	27.86
West Kazakhstan economic district	221883	33.32

Table 6. Forecast of the Number of Visitors in West Kazakhstan Regions (2025–2030)

Year	Aktobe region	Atyrau region	West Kazakhstan region	Mangystau region	West Kazakhstan economic district
2025	221670	167725	159186	430059	978639
2026	228903	174401	164723	447823	1015850
2027	236064	181011	170206	465409	1052689
2028	243153	187554	175633	482819	1089159
2029	250172	194032	181007	500055	1125265
2030	257120	200445	186326	517118	1161010

It is projected that the tourist inflow into all parts of West Kazakhstan will keep increasing, albeit in different dynamics, until 2030. The most sustainable and robust increase will be in the Mangistau region, where the number of visitors will grow between 430.059 in 2025 and 517.118 in 2030. The regions of Aktobe and West Kazakhstan demonstrate moderate and stable growth, with 257.120 and 186.326 visitors, respectively. The Atyrau region is even more unstable, but is also expected to grow to 200.445 visitors by the same year, out of 167.725. On the scale of the cohesive West Kazakhstan Economic District, the gross arrivals will rise to more than 1.16 million by 2030, which proves the overall promising tourism potential of the region (Table 6). Figure 5 highlights both past fluctuations and future growth trajectories, showing clear regional differences in stability and intensity of tourism development.

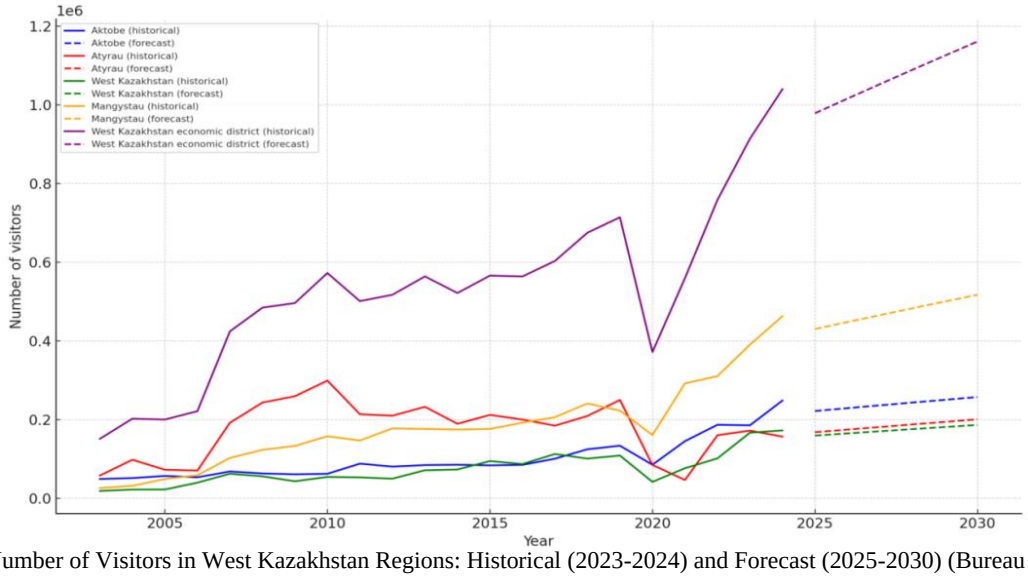


Figure 5. Number of Visitors in West Kazakhstan Regions: Historical (2023-2024) and Forecast (2025-2030) (Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, 2004–2024).
*Note: The y-axis uses scientific notation (e.g., 1e6 = 1.000.000). All values are expressed as the number of visitors

DISCUSSION

This research is focused on the analysis and projection of tourism development in the West Kazakhstan Economic District, with the aim of looking at regional differences, identifying key potentials and limitations, and providing quantitative forecasts that can contribute to strategic planning and sustainable development of tourism. Our results confirm that tourism in the West Kazakhstan Economic District is going through a phase of accelerated growth, but with marked regional differences. The dynamics of visitors shows a stable growth in Aktobe and West Kazakhstan region, while Mangistau is recognized as the engine of development, with the most intense and stable trends (RQ1). This finding coincides with the literature that emphasizes the wealth of natural and cultural resources of this region (Chashina et al., 2020), but also confirms previously identified infrastructural limitations that slow down the wider development of tourism (Saparov et al., 2024; Sergeyeva et al., 2023). In contrast to them, Atyrau shows oscillations, which is in line with research that indicates the dependence of tourism in this region on external factors, including the energy sector and underdeveloped promotional infrastructure (Omirzakova & Wendt, 2025). The analysis of accommodation capacity shows that the highest growth was recorded in Atyrau, but with a low and unstable occupancy rate (RQ2). This imbalance between supply and

demand indicates overcapacity, which confirms the criticisms of the authors who emphasize institutional weaknesses and inconsistency of tourism policies (Wendt et al., 2021; Konysbek et al., 2025). In contrast, Mangistau shows capacity growth accompanied by high utilization, which confirms the synchronized development of supply and demand. Aktobe and West Kazakhstan recorded a moderate increase in capacity, with a more stable ratio of supply and demand, but also without major qualitative shifts, which confirms that smaller regions remain in the shadow of more dominant destinations.

The observed differences in income further confirm the heterogeneity of the region (RQ3). Our findings show that in Mangistau, average spending per tourist has increased significantly, which is in line with global trends of the "experience economy" (Kenzhebekov et al., 2021). At the same time, in Atyrau, despite the strong growth of capacity, the average consumption stagnates, which indicates that the increase in infrastructure is not accompanied by the development of tourism products with more added value. This difference coincides with the conclusions of Kadyrbekov et al. (2024), who emphasize that cultural heritage and authentic experiences are becoming key differentiators, but are still underutilized strategically.

At the bibliometric level, our results confirm that research production in Kazakhstan is growing, but that the western regions remain marginalized (RQ4). While the works of Ramazanov et al. (2019) and Seken et al. (2019) highlight the potential of rural tourism, they rarely include the western areas, which remain in the shadow of the central and eastern regions. This gap in the literature justifies the integration of bibliometric analyzes with our empirical findings, as it shows how research flows do not fully match real growth trends. Finally, the econometric forecast until 2030 shows that Mangistau will continue to be the leading destination, while Aktobe and West Kazakhstan are experiencing stable but moderate growth. Atyrau remains unstable, with a high level of forecasting error (MAPE ≈ 98%), confirming its volatility and dependence on external shocks (RQ5). These results differ from the findings of Panibratov et al. (2025), who emphasize the role of international integration and the "Belt and Road" initiative in the growth of tourism, because our models show that such impulses are not evenly distributed across regions, but rather privilege certain areas.

This raises the important issue of sustainability and regional balance, which previous research has not sufficiently addressed. Our findings confirm previous claims about the importance of tourism for the diversification of the Kazakh economy (Salauatova et al., 2024), but at the same time emphasize that this development is not homogeneous. While some regions are experiencing stable growth and increasing attractiveness, others are facing institutional weaknesses, infrastructural gaps and fluctuations that make long-term planning difficult. This is precisely why the integration of bibliometric analyzes and econometric models offers a more reliable framework for viewing real processes and provides guidelines for the creation of differentiated regional tourism policies in Kazakhstan.

CONCLUSION

The analysis of tourism development in the West Kazakhstan Economic District showed that this part of the country has strategic importance in the national and regional context. As an area that encompasses various natural resources, cultural values and socioeconomic structures, the district is a training ground where both the advantages and limitations of tourism development in Kazakhstan can be best observed. Its importance is multifaceted: economic, because tourism increasingly contributes to the diversification of local economies; social, because it can encourage the participation of communities and strengthening of social cohesion; cultural, because it has a rich heritage that is important for positioning the country on the international market; and infrastructural, because it raises issues of even development and availability of regions. In this way, this district becomes a paradigmatic example of how tourism can shape the processes of transformation of post-Soviet spaces, but also how institutional restrictions and uneven regional patterns can slow down its potential.

The review and analysis confirm that the study of tourism in Kazakhstan requires an interdisciplinary framework. Early works emphasized macroeconomic aspects and competitiveness (Batyrova et al., 2018), while recent research increasingly includes dimensions of sustainability, participation of local communities and valorization of cultural resources (Saparov et al., 2024; Kadyrbekova et al., 2024). Thus, tourism in Kazakhstan fits into global theoretical debates on sustainable development and the experience economy, where authentic experiences and cultural values become key to attracting tourists (Issakov et al., 2025). The bibliometric analysis of this work confirms that research streams are moving from general descriptive studies to more analytically sophisticated approaches, including econometric models and GIS analyses, which contributes to a better theoretical understanding of tourism as a complex socio-economic phenomenon. The obtained results have direct consequences for the shaping of policies. It is necessary to strengthen the coordinated institutional framework that would connect national, regional and local actors in joint development strategies. Infrastructure investments, especially in transport and tourism capacities of rural areas such as Aktobe and West Kazakhstan, are a prerequisite for a more even inclusion of these areas in tourist flows. At the same time, digital promotion of cultural heritage and destinations is necessary, since global competitiveness increasingly depends on visibility on digital platforms. Greater participation of the local population is also key - not only through employment, but also through active participation in the creation and innovation of the tourist offer. In this way, tourism can contribute to economic benefits, social cohesion and long-term sustainability.

The research results also have important political implications that go beyond the purely economic significance of tourism in the West Kazakhstan Economic District. It is shown that tourism can become an instrument of regional cohesion, because more even development of the sector reduces socioeconomic differences between more developed areas (eg Mangistau) and those that are lagging behind (Aktobe, West Kazakhstan). Thus, tourism contributes not only to the diversification of the economy, but also to political stability through the balancing of regional inequalities. Also, tourism can be used as a tool of foreign policy. The role of the Belt and Road Initiative and the growing connectivity of Kazakhstan with international markets (Daye et al., 2020; Panibratov et al., 2025) show that tourism development strengthens the country's position as a bridge

between Europe and Asia. Especially the western regions, due to their geographical position, can become a symbol of the "land-linked" economy, which opens up space for the strategic positioning of Kazakhstan within the framework of global integration. Institutional weaknesses and fragmented tourism policy, pointed out by numerous authors (Wendt et al., 2021; Konysbek et al., 2025), require the consolidation of the regulatory framework. This implies the adoption of a unique national tourism strategy that would include local authorities, the private sector and international actors, as well as control mechanisms to ensure sustainability, not just quantitative growth. Strengthening tourism has the potential to increase the political participation of local communities. The inclusion of the population in shaping tourism policies not only strengthens social cohesion, but also encourages trust in institutions, which is especially important in rural and peripheral areas.

This research has several important limitations. The analysis is primarily based on secondary sources and includes only works published in English, while publications in Russian and Kazakh could have provided additional insights. In addition, the work is focused on scientific articles indexed in international databases, while the so-called "grey literature" (reports of international organizations, national strategies, local plans) was not part of the analysis, although it often contains valuable practical data. Most of the analyzed studies remain descriptive, with a short-term time horizon and without longitudinal comparisons that would allow a deeper understanding of the dynamics of development.

These limitations reduce the possibility of full generalization of the findings, but at the same time point to directions for improvement of methodological approaches. Based on the identified findings, key directions for future research can be identified. It is necessary to develop longitudinal studies that would enable the monitoring of changes in a longer time frame and the testing of the effects of tourism policies. An integration of quantitative and qualitative methods, including bibliometric networks, GIS technologies and econometric forecasting models, is needed to provide a comprehensive analysis. Special attention should be paid to the western regions of Kazakhstan, as they remain underexplored compared to the central and eastern parts of the country, although they possess significant resources and potential. Future research should also focus more on the impact of tourism on local communities, social justice and participation, because sustainable development does not only mean economic growth, but also the strengthening of social capital and cultural cohesion.

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FROM GEODIVERSITY TO CULTURAL NARRATIVES: AN INTEGRATED ECOCULTURAL TOURISM FRAMEWORK FOR SUSTAINABLE DEVELOPMENT IN BELITONG UNESCO GLOBAL GEOPARK, INDONESIA

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Abstract: Belitong UNESCO Global Geopark possesses outstanding geological, biological, and cultural resources; however, its tourism development has predominantly emphasized geodiversity, while cultural heritage remains insufficiently integrated into destination management. This study develops an integrated ecocultural tourism framework that positions cultural heritage as a core component of sustainable geopark development. A qualitative exploratory approach was employed through a systematic literature review, field observations, semi-structured interviews with key stakeholders, and focus group discussions. The collected data were analysed using SWOT analysis supported by Internal Factor Analysis Summary (IFAS) and External Factor Analysis Summary (EFAS) matrices to formulate strategic development priorities. The findings reveal that Belitong Global Geopark possesses substantial strengths, including rich geodiversity, biodiversity, tangible and intangible cultural heritage, strong community participation, and UNESCO Global Geopark status. The IFAS–EFAS assessment places the geopark in Quadrant I, indicating that an aggressive (SO) strategy is the most appropriate approach for sustainable destination development. The proposed framework prioritises the integration of cultural narratives into geotourism interpretation, community empowerment, conservation-based tourism products, responsible digital promotion, and collaborative governance among stakeholders. This study contributes theoretically by advancing an ecocultural perspective that challenges conventional geocentric geopark management and methodologically by combining qualitative inquiry with structured strategic analysis. The proposed framework offers a transferable model for integrating geoheritage conservation, cultural sustainability, and community-based tourism in UNESCO Global Geoparks and comparable heritage destinations worldwide.

Keywords: cultural heritage, sustainable tourism, geopark, ecoculture tourism, SWOT analysis

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INTRODUCTION

The growing demand for authentic and distinctive travel experiences has driven the rise of ecoculture tourism, a form of tourism that blends ecological conservation with the protection of cultural heritage (Hurdawaty & Dhalillah, 2022). This approach is a tourism strategy that integrates the natural environment, cultural heritage, and local communities to provide economic benefits while preserving cultural identity and promoting environmental management (Moli, 2011). Ecoculture tourism is increasingly recognized as a valuable approach for boosting regional economies. It aims to balance the preservation of cultural heritage with tourism growth, despite potential conflicts between the two (Diarta, 2017). This supports the goal of sustainable and inclusive tourism, which aims to balance environmental and social safeguarding with economic benefits (Nenotek et al., 2025). The ecocultural tourism approach to the development of geoparks is a strategic approach that integrates nature conservation, cultural heritage, and local economic development.

An example of a developing geopark in Indonesia is the Belitong Global Geopark, designated a UNESCO Global Geopark in 2021. This recognition offers Belitung Island many opportunities to enhance its tourism appeal by leveraging its geological wealth, biodiversity, and cultural potential. The concept of geoparks, which integrates the protection and sustainable use of geological heritage, has become a popular natural tourist attraction in Indonesia (Sagala et al., 2018).

Geoparks are not just places to protect geological features; they are also places to promote local economic growth through tourism and education (Fauzi & Misni, 2022). For Belitung Island, incorporating cultural heritage into the geoparks framework is essential to draw tourists from Indonesia and abroad (Gordon, 2018b).

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Integrating cultural elements into geotourism is crucial; it enriches visitors' experiences and fosters a greater understanding of the region's identity (Santangelo & Valente, 2020).

Belitong Global Geopark can boost its economic gains from tourism while protecting its unique cultural assets by incorporating cultural heritage into sustainable tourism plans. Geoparks emphasize environmental protection, improving tourism infrastructure, and fostering local economic development. For them to be successful, people in the area need to be involved to help people and the environment get along (Rosyidie et al., 2018). The integration of cultural heritage into the sustainable management of the Belitong Global Geopark requires a holistic, multidisciplinary approach that involves collaboration among government agencies, local communities, tourism operators, and academic institutions.

The integration of cultural heritage into sustainable tourism management requires a deep understanding of the interaction between tangible and intangible cultural heritage. Cultural heritage, such as sites and artifacts, provides a picture of man's relationship with his environment in the region's past. In contrast, intangible cultural heritage, including traditional music, dance, cuisine, and folklore, continues to be part of the daily lives of the people of Belitung.

This thorough approach ensures that tourism development respects and strengthens local communities' cultural identity, fostering pride and a sense of belonging. The sustainability of ecoculture tourism in Belitong Global Geopark relies on adopting sustainable tourism practices that reduce environmental impacts while increasing benefits for the local community. Implementing sustainable tourism practices can also stimulate economic activity and create employment opportunities in rural areas surrounding geoparks (Kikuchi et al., 2011; Ólafsdóttir & Dowling, 2014).

Belitong Global Geopark includes geosites spread across Belitung Regency and East Belitung Regency. The development of this geopark is the result of collaboration between two local governments aimed at encouraging local economic growth through sustainable tourism. Although the potential of biodiversity and geology has been recognized in the management of geoparks, cultural heritage, especially tangible cultural heritage, has not been fully integrated into their development strategies. In fact, this cultural heritage significantly enriches the narratives of tourist destinations and provides a more authentic experience for tourists.

The cultural heritage of the objects in the Belitong Global Geopark reflects the way of life of the people of Belitung, who have long interacted with and adapted to their environment. These values not only strengthen local identity but can also be an important element in the development of culture- and environment-based tourism, or ecoculture tourism. Therefore, it is important to evaluate the approach to developing tourist destinations in the region, especially in integrating the cultural dimension into geopark management. Belitong Global Geopark aims to promote environment-focused tourism on Belitung Island by engaging the local community, visitors, and tourism stakeholders (Farsani et al., 2011). Several studies have examined Belitong Global Geopark, emphasizing the need to develop it into a sustainable tourism destination. These studies mainly focus on strategies such as conservation, empowering local communities, encouraging collaboration among stakeholders, and promoting locally based approaches. They offer both conceptual and practical frameworks for developing geoparks that not only boost the economy but also enhance local identity and protect the environment.

Although several studies have comprehensively reviewed aspects of geotourism, community empowerment, environmental conservation, and collaborative destination management, most have not discussed in depth the role of cultural heritage, both tangible and intangible, in supporting the development of the Belitong Geopark.

Most geopark research focuses on geodiversity but ignores cultural narratives as an adhesive—studies such as those conducted by Aryanto et al. (2022), Khoirunnisa et al. (2021), and Wibowo et al. (2024) concentrate more on geology, ecotourism, and community empowerment aspects, without detailing how local culture, traditions, history, and customary practices can serve as interpretive and educational assets in geotourism development. Although some studies mention cultural heritage, such as folklore, myths, or traditional products (geoproducts), culture is generally treated as a supplementary or contextual element rather than as a core strategic component of geopark management. In fact, within the UNESCO Global Geopark, cultural heritage—particularly when combined with the geological landscape—serves as one of the key pillars of a holistic and sustainable geopark approach. This gap underscores the need for research to explore and promote local cultural heritage as a core component of geopark interpretation, enhance tourism experiences, and develop strategies to maintain regional identity. This paper proposes an integrated framework that makes cultural heritage the heart of destination development rather than just a complement. The cultural approach will enhance the geopark's storytelling and foster a stronger sense of community in the local area. Thus, the current studies provide a solid foundation in the physical and socio-economic aspects, but still leave ample room for exploring cultural meaning, local values, and traditional wisdom to support the sustainability and differentiation of geopark destinations globally.

This research aims to develop a framework for creating ecoculture tourism-based tourist destinations in Belitong Global Geopark by evaluating prior research and in-depth interviews with local communities and policymakers. The findings of this study are expected to serve as a reference for developing sustainable tourism that is not only oriented towards nature conservation but also towards cultural preservation and the improvement of local community welfare.

This research makes two main contributions. Firstly, it provides empirical evidence that underscores the importance of the often-overlooked cultural pillar as a key strategic component in geopark management, going beyond traditional geocentric approaches. Secondly, it introduces quantified IFAS-EFAS analysis, adding rigor and depth to the development of accurate, data-driven strategies (SO/WO/ST/WT).

Thus, the framework of thought and strategic approaches generated in this study offers a template that other geoparks can adapt to systematically integrate cultural heritage into their sustainable tourism development planning, while bridging the gap between geo-heritage conservation and socio-cultural vitality.

LITERATURE REVIEW

The foundation of geoparks, consisting of geodiversity, biodiversity, and cultural diversity, must be managed and developed sustainably. A UNESCO Designated Sites (UDS) model plays a significant role in achieving the 17 Sustainable Development Goals (SDGs) under the United Nations 2030 Agenda. UDSs are not only important as cultural or natural heritage locations; They also play a direct and indirect role in the achievement of various sustainable development goals, from basic human needs to social, economic, cultural, environmental, and global collaboration aspects (Luo et al., 2022).

An analysis of several studies on the development of the Belitong UNESCO Global Geopark reveals a consistent trend: cultural heritage, both tangible and intangible, is more often positioned as a complementary element than as a significant attraction—most studies, including those conducted by Kusumah et al. (2023) acknowledge local cultural values, such as myths and medicinal plant knowledge, but the primary focus remains on the site's geological characteristics—similarly, research by Wibowo et al. (2024) and Surya-& Efrianto (2022) that highlights the transformation and promotion of Open Pit Nam Sa Lu; the constructed narrative remains centered on the mine's geological heritage, with culture serving as a backdrop that enriches the story. The dominance of geological heritage as a significant attraction reflects an approach to management in which culture serves as a value binder to create a holistic tourism experience, not as an equal partner.

A study on geodiversity in Khorat Geopark, Thailand, was done by Jaroon Duangkrayom et al. (Duangkrayom et al., 2022). The Khorat Geopark region has a geological diversity from the late Jurassic period to the present. Sedimentary rock formations undergo uplift and erosion, forming the Khorat Plateau with unique landscapes, such as a cuesta. Traces of geological history include dinosaur fossils from the early Cretaceous period, mammal fossils, including ancient elephants, and other important geological features. The management of this Geopark is carried out through a bottom-up approach, namely the involvement of local communities, local governments, and education. One of the models used is the Home-Temple-School (HTS) approach to increase awareness of geoconservation and community empowerment.

In fact, if examined more deeply, the potential for cultural heritage to become the main attraction equivalent to geological heritage is enormous. The concept of ecocultural tourism offers a new paradigm by positioning ecological and cultural diversity as the main attractions, integrated and equal. In the context of Belitong Global Geopark, this means that the cultural heritage contained in a geosite is not just an addition to the story, but is the core of a tourism narrative that explains the relationship between the community and its landscape—the local knowledge of medicinal plants identified by Kusumah et al. (2023) can be transformed into distinctive health education tour packages—additionally, derivative products like teran honey and handicrafts, studied by Arrosyad et al. (2021) and Aryanto et al., (2022) are more than mere souvenirs; they serve as tangible symbols of sustainable local knowledge.

Adopting an ecocultural tourism approach shifts cultural heritage from a secondary consideration to a crucial element that enriches tourism stories and reinforces the local community's identity. This supports sustainable tourism principles focused on adaptability and inclusive participation, allowing the wider community to benefit from engagement. The tourism narrative evolves from simply explaining how granite rocks form to depicting how Belitung's people adapt, survive, and develop civilization within this distinctive geological setting. An interpretive process, as described by Henriques & dos Reis (2021), which blends cultural resources with their natural surroundings, will create a more meaningful and transformative experience for visitors and help protect the local area's identity. The combination of cultural heritage and unique landscapes can also be observed in the Sangkurilang Mangkalihat Karst area of East Kalimantan. In this area, rock art and archaeological remains represent civilization, depicting the livelihoods and culture of prehistoric humans. At the same time, the landscape displays a beauty rooted in the unique karst landscape (Haryono et al., 2022).

Furthermore, this approach directly supports the growth of sustainable, inclusive alternative economies. It involves developing geoproducts from local materials, as mapped by Yuliawati et al. (2019), fits within a broader ecocultural tourism framework. The micro, small, and medium enterprises ecosystem not only sells products, but also sells the stories, traditions, and knowledge inherent in those products. This creates a global value chain that not only strengthens the local economy post-pandemic, as Arrosyad et al. (2021) have found, but also serves as a vital instrument in preserving local people's cultural traditions in daily life from extinction. Therefore, a paradigm shift from viewing cultural heritage as a complement to seeing it as the main attraction, on par with geological heritage, is inevitable. The concept of ecocultural tourism provides a theoretical and practical framework to make this happen. With the multi-actor collaboration highlighted by Pujiyono (2022) furthermore, the ongoing community empowerment emphasized by Khoirunnisa et al. (2021) Belitong Global Geopark has the potential to become a destination showcasing geological marvels. It would serve as a living museum, revitalizing and preserving its cultural traditions and people. In the end, this balanced approach will foster a sustainable, inclusive, and conservation-focused tourism model, while also supporting the socio-economic empowerment of the local communities. Based on the previous descriptions, this research aims to develop an integrated ecocultural tourism framework for Belitong UNESCO Global Geopark by positioning cultural heritage as a core component of sustainable geopark management, rather than merely a complementary element to geological heritage.

MATERIALS AND METHODS

This research employs a qualitative, exploratory, and analytical approach to examine sustainable tourism development strategies grounded in cultural heritage in geopark areas. This approach was chosen to capture the complexity of interactions between cultural, environmental, and governance elements in the context of destination management.

The research was carried out in layers, starting with literature reviews and field surveys and progressing to strategic analysis to gain a comprehensive understanding of local dynamics.

The research begins with a systematic literature review of national and international scientific publications on sustainable tourism, geoparks, and cultural heritage. The scope review was conducted according to the protocol of Arksey & O'Malley (2005) by analyzing 13 peer-reviewed articles published between 2019 and 2024. This stage aims to identify conceptual frameworks, research gaps, and relevant strategic indicators for further analysis in the local context.

Field surveys were conducted to validate findings from literature studies and collect primary data. Data collection techniques include participatory observation and semi-structured interviews. Observations were conducted at nine geosites related to tangible and intangible cultural heritage. The focus of observation includes destination elements such as attractions, accessibility, amenities, activities, ancillary, and the role of local communities (Andrianto & Sugiama, 2016). Interviews were conducted with 10 groups of key informants, selected purposively for their participation and expertise in the research topics.

Interviews were conducted using an open-ended approach to allow in-depth and interpretative data exploration. The data obtained include perceptions, experiences, and evaluations of informants regarding the condition of the destination. These data serve as the basis for identifying strategic indicators.The selection of informants is based on the criteria proposed by Sugiyono (2017): direct relevance to the research issue, capacity to understand the context, active involvement, and availability of time. Based on these criteria, the informants selected were academics, administrators of the Tourism Awareness Group (Pokdarwis), village heads, traditional leaders, cultural experts, historians, and officials from the Tourism Office and the Geopark Management Agency. This method seeks to gather extensive, varied data and facilitate cross-verification of perspectives from different stakeholder sources. To strengthen the data's validity, a Focus Group Discussion (FGD) was conducted with representatives from the informant group. The FGD acts as a triangulation method to verify findings and complement data from observations and interviews. The entire data collection process follows ethical research protocols by obtaining informed consent, maintaining anonymity, and respecting participants' right to withdraw at any time. The qualitative data is then analyzed through a content-based approach that involves coding and categorizing themes. Additionally, the data is categorized into internal factors (strengths and weaknesses) and external factors (opportunities and threats), and analyzed using the SWOT framework. The IFAS and EFAS matrices are used to quantify the weight and score of each strategic indicator. The assessment was conducted by the research team using a qualitatively adjusted Likert scale based on consensus. Weights and ratings were assigned based on the importance and actual conditions of each indicator. The total weight of all factors was set at 1.00 to ensure proportionality.

To identify the strategic steps needed in the development of ecocultural tourism-based tourist destinations, SWOT quadrant analysis is used in the context analysis, taking into account the influence of internal and external factors derived from the scoping data. The use of the SWOT matrix aims to formulate a development strategy plan by comparing external factors, including opportunities and threats, with internal factors, including strengths and weaknesses (Iversen, 2011; McTavish & Pirro, 1990). The results of this analysis will provide a basic overview of the strategies needed to achieve the goals based on the logic of maximizing potential and opportunity while minimizing obstacles and threats, in the hope of producing outputs in the form of targets and actions to achieve those goals (Goranczewski & Puciato, 2011). Data and information from internal and external factors were analyzed using the Internal Strategic Factor Analysis Summary Matrix (IFAS) and the External Strategic Factor Analysis Summary Matrix (EFAS) to determine the best development strategy.

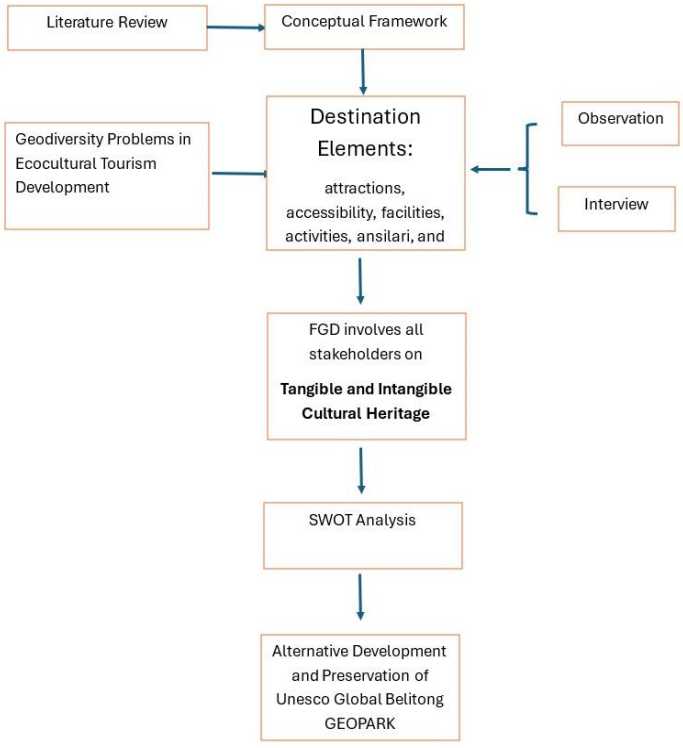


Figure 1. Flow chart of the methodology step

Furthermore, weights, ratings, and scores for each indicator of strengths, weaknesses, opportunities, and challenges were calculated by researchers. They were determined by comparing the importance of each indicator for each criterion, based on the results of surveys, interviews, and focus group discussions (FGDs). The total weight was 1.00, distributed on a scale from 1 (very significant) to 0.0 (unimportant). The rankings used a scale ranging from 4 (excellent) to 1 (very weak), with intermediate scores of 3 (good) and 2 (weak) (Benzaghta et al., 2021; Gurel, 2017). The results of this analysis then serve as a reference for the development of sustainable tourism in the Belitung Geopark area and the surrounding environment through an ecocultural tourism approach, in line with the guidelines for sustainable tourism destinations developed by the UNWTO-Global Sustainable Tourism Council (Day & Romanchek, 2020). The problem solving of integrated ecocultural tourism for sustainable development in Belitong UNESCO Global Geopark can be described as the following flow chart (Figure 1.).

RESULTS

The Belitong Global Geopark and the surrounding environment

Geographically, Belitong Global Geopark is located on Belitung Island. Administratively, this geopark is located in two regencies, namely Belitung and East Belitung, in the Bangka Belitung Islands Province, Indonesia. The region was officially recognized by UNESCO as part of the Global Geopark network in 2021 for its unique geological heritage, high biodiversity, and a rich local culture that is still preserved and integrated into a single intact landscape. From a geological perspective, this area holds extraordinary geological value, including old granite rocks, metasedimentary rocks of the Kelapa Kampit Formation, distinctive tor formations, ancient rock outcrops, and former tin mines, which are now a center for geotourism and education. In terms of biodiversity, Belitong Global Geopark includes a diverse ecosystem, ranging from lowland tropical forests, rangas forests, mangrove areas, to shallow sea areas rich in coral reefs and endemic biota. Unique species such as the Belitong tarsier (*Cephalopachus bancanus saltator*) and the *kantong semar* (*Nepenthes sp*.) add to the importance of this area as a conservation habitat. Meanwhile, from a cultural perspective, this geopark represents the rich local heritage, including the customs and traditions of coastal communities and fishermen, typical cuisine, mining historical sites, and folklore and myths that are still alive in the community's collective memory. The combination of these three elements—geology, biodiversity, and culture—makes Belitong Global Geopark not only a conservation area but also an educational, inspiring, and representative space for the principles of sustainable development grounded in earth heritage (Ismayanti et al., 2022).

This geopark has a regional character, encompassing land, coastal, and ocean areas, with geosites spread across various sub-districts. This area also includes a geosite that presents ancient granite landscapes, tropical forests, coastal ecosystems, and cultural heritage that continues to this day (Table 1). The physical environment around the geopark is very diverse, ranging from outcrops of metasedimentary rocks hundreds of millions of years old, mangrove forests, marine waters with coral reefs, to reclaimed areas of former mines that have been restored as ecotourism zones (Ismayanti et al., 2022). Geographically, several geosites are associated with past cultural heritage, such as past settlement sites and other archaeological remains that reflect the past Belitung people's adaptation strategy to the surrounding environment (Novita, 2019; Novita & Adi, 2020). In addition, geosites in the water are associated with maritime cultural heritage, such as sunken ships and colonial-era lighthouses, indicating that this waterway is a busy shipping route along the world's spice route (Novita et al., 2020).

Table 1. List of Belitong Global Geopark Geosites (source: Ismayanti 2022)

No.	Geosite	Administrative Location	Category Dominance
1	Tanjung Kelayang	Sijuk District, Belitung Regency	Geology + Culture
2	Pulau Lengkuas	Sijuk District, Belitung Regency	Geology
3	Batu Berlayar	Sijuk District, Belitung Regency	Geology
4	Bukit Peramun	Sijuk District, Belitung Regency	Geology + Biodiversity + Culture
5	Open Pit Nam Salu	Kelapa Kampit District, East Belitung Regency	Geology + Culture
6	Tebat Rasau	Simpang Renggiang District, East Belitung Regency	Biodiversity + Culture
7	Gunung Lumut	Simpang Pesak District, East Belitung Regency	Biodiversity + Geology
8	Juru Seberang	Tanjungpandan District, Belitung Regency	Geology + Ecology
9	Burung Mandi	Damar District, East Belitung Regency	Geology + Culture
10	Desa Buku Limau	Manggar District, East Belitung Regency	Culture + Biodiversity
11	Batu Itam	Sijuk District, Belitung Regency	Geology
12	Batu Kembar	Sijuk District, Belitung Regency	Geology
13	Batu Garuda	Sijuk District, Belitung Regency	Geology
14	Batu Baginde	Membalong District, Belitung Regency	Geology + Culture
15	Tanjung Tinggi (Pantai Laskar Pelangi)	Sijuk District, Belitung Regency	Geology + Pop Culture
16	Batu Mentas	Badau District, Belitung Regency	Biodiversity + Geology
17	Gunung Kubing	Membalong District, Belitung Regency	Geology
18	Tebing Kelambu	Sijuk District, Belitung Regency	Geology
19	Pantai Punai	Membalong District, Belitung Regency	Ecology + Culture
20	Batu Begalang	Manggar District, East Belitung Regency	Geology + Culture
21	Pulau Pasir	Sijuk District, Belitung Regency	Geology
22	Danau Biru	Badau District, Belitung Regency	Geology + Ecology
23	Kerangas Forest	Simpang Pesak District, East Belitung Regency	Biodiversity
24	Gurumedang Tektite	Kelapa Kampit District, East Belitung Regency	Geology

Tangible Cultural Heritage associated with Geosite in Belitong Global Geopark

Of the total geosites in the Belitong Global Geopark, there are nine geosites associated with archaeological remains. In general, these remains date to the period before tin was industrialized on this island. Archaeological research shows that Belitung Island was a developing area in the past because it lay along maritime trade routes. In addition, this area is a stopover for foreign traders and a place for exchanges with locals.

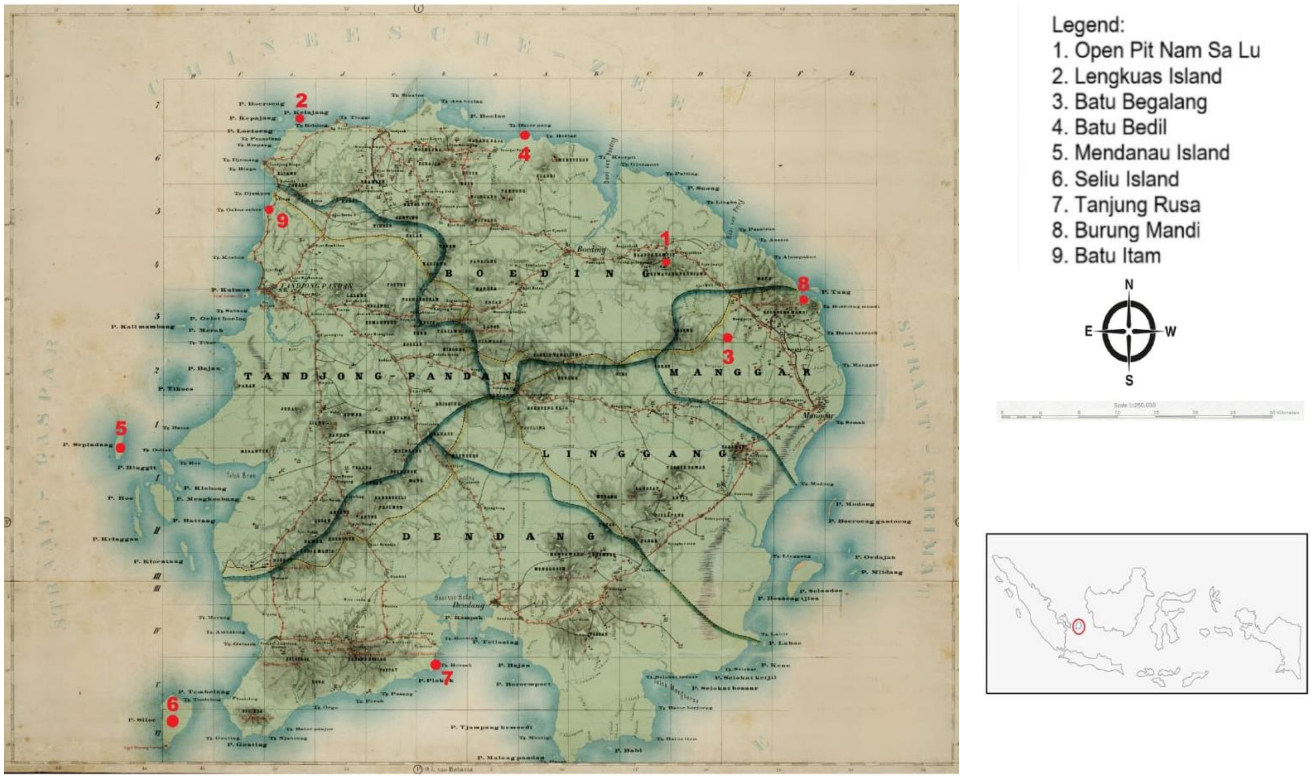


Figure 2. Geosites in Belitong Global Geopark Associated with Archaeological Sites (Source: Modified by Author from Orienteeringskaart. Ruiting van den topograph-dienst voor kaartbladen Billiton Maatschapij, 1892; Ismayanti, 2022)

Based on archaeological remains found on the mainland, housing on Belitung Island is estimated to have developed since the 13th-14th century. However, based on archaeological remains found in the waters off Belitung, it is possible that settlements in this area existed as early as the 9th-10th centuries. The existence of archaeological sites also suggests that settlements in the past were not coastal but inland, near fields, and mobile, following the growing season. The crops they grow in the fields are used to meet their daily needs. In addition to farming, the people of Belitung Island also process forest products for trade (Nijhoff, 1927; Novita et al., 2023). Settlements in this inland area developed until the end of the 19th century. When the Dutch East Indies government opened tin mines on Belitung Island, these settlements were moved. The settlements were arranged along a network of roads connecting Tanjungpandan, the administrative center, with Manggar, the central production city, and the tin-mining areas. Based on the road network, Belitung Island appears to be divided into two parts: the coastal part, which stretches north and south, and the central part, which divides the island's interior (Figure 2). Overall, geosites in Belitung associated with archaeological remains are listed in Table 2.

Table 2. Tangible Cultural Heritage at Belitong Global Geopark

No.	Geosite	Geographical Location	Tangible Cultural Heritage	Chronology
1	Open Pit Nam Sa Lu	• Terrestrial landform • Located in the mainland area of Belitung Island, not in the coastal area	Remnants of colonial tin mining (open pits, chimneys, house of parit head)	Early 20th century
2	Pulau Lengkuas	• Insular landform • Small islands in the waters off the coast of Belitung Island	Colonial Era Lighthouse	Late 19th century
3	Batu Begalang	• Terrestrial landform • Located in the mainland area of Belitung Island, not in the coastal area	• Remnants of pre-colonial settlements • Ancient Cemetery	17th century-Early 20th century
4	Batu Bedil	• Coastal landscape • Located in the coastal area of Belitung Island	• Remnants of pre-colonial settlements • Ancient Cemetery • Wrecksite	• 13th-14th century • 17th century-Early 20th century • Early 20th century
5	Kepulauan Mendanau	• Insular landform • Small islands in the waters off the coast of Belitung Island	Colonial Era Lighthouse	Late 19th century

6	Pulau Seliu	• Insular landform • Small islands in the waters off the coast of Belitung Island	Wrecksite	Early 20th century
7	Tanjung Rusa	• Coastal landscape – cape • Located at the tip of Belitung Island's mainland, which juts out into the sea	• Remnants of pre-colonial settlements • Ancient Cemetery • Wrecksite	• 13th-14th century • 17th century-Early 20th century • Early 20th century
8	Burung Mandi	• Coastal landscape • Located in the coastal area of Belitung Island	Ancient temples	Early 20th century
9	Batu Itam	• Marine landform • Located in marine waters, not on the mainland	Wrecksite	9th century

Within the UNESCO Global Geopark framework, geosites are assessed not only for their geological value but also for their capacity to illustrate the interaction between Earth processes and human history. The geosites associated with archaeological remains in Belitung Island and its surrounding waters exemplify this geo-cultural dimension, where geomorphological settings have directly influenced patterns of human occupation, resource utilization, and maritime activities across time. From a geomorphological perspective, the geosites are distributed across inland terrestrial, coastal, insular, and marine environments. This spatial diversity aligns with UNESCO's emphasis on landscape-scale interpretation, whereby geological features provide the physical framework for cultural development.

The inland geosite of Open Pit Nam Sa Lu, located within the interior of Belitung Island, represents a terrestrial geomorphological unit shaped by mineral resources. Its associated archaeological remains of colonial tin mining demonstrate how geological endowment structured historical land use and technological adaptation, reinforcing the site's geo-cultural significance (Novita & Adi, 2020) (Figure 3). In contrast to the Batu Begalang Geosite, although located in the mainland area of Belitung Island, this geosite represents a land geomorphological unit that shows sustainable use as a residential space, social activities since pre-colonial times (Novita et al., 2025) (Figure 4).

(a)   (b)

Figure 3. Geosites Nam Sa Lu located within the interior of Belitung Island. (a) Geosite open pit Nam Sa Lu, (b) Remain of a Chimney at a Colonial Tin Mining Site (Source: Research Documentation, 2022)

(a)   (b)

Figure 4. Geosites Batu Begalang Associated with Pre-Colonial Settlement Sites. (a) Batu Begalang Geosite, (b) Kubuk Kik Dukun Site (Source: Research Documentation, 2022)

The Burung Mandi geosite further demonstrates the geo-cultural complexity of coastal environments. Located adjacent to the shoreline, its geomorphological stability supported the construction of ancient temple structures, underscoring that coastal landforms were not solely utilized for economic or maritime purposes but also held religious and symbolic meanings within past societies (Novita & Adi, 2020) (Figure 5). Coastal and insular geosites such as Pulau

Lengkuas, Kepulauan Mendanau, and Pulau Seliu are situated within offshore island geomorphological settings. Their isolation from the mainland and direct exposure to marine processes rendered these locations strategically important within historical maritime networks. The presence of colonial lighthouses and shipwreck sites illustrates the role of insular landforms in navigation, trade, and sea-based mobility, reflecting the inseparable relationship between coastal geomorphology and maritime cultural heritage (Novita & Adi, 2020) (Figure 6).

(a)   (b)

Figure 5. (a) Geosites Burung Mandi Associated with (b) Kwan Im Temple as Religion Sites (Source: Research Documentation, 2022)

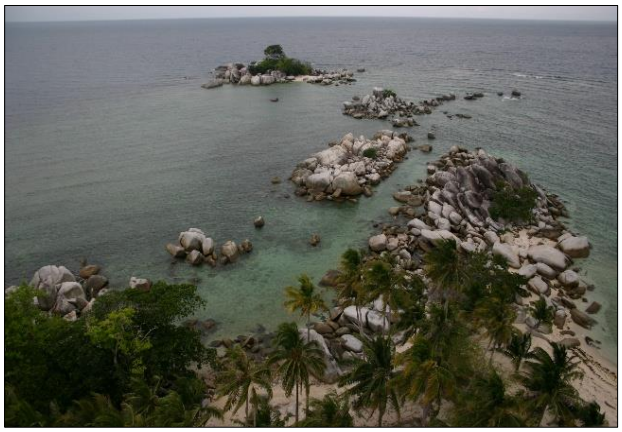
(a)   (b)

Figure 6. (a) Geosites Kelayang Island Associated with Kelayang Island Lighthouse as Colonial Sites (Source: Research Documentation, 2022)

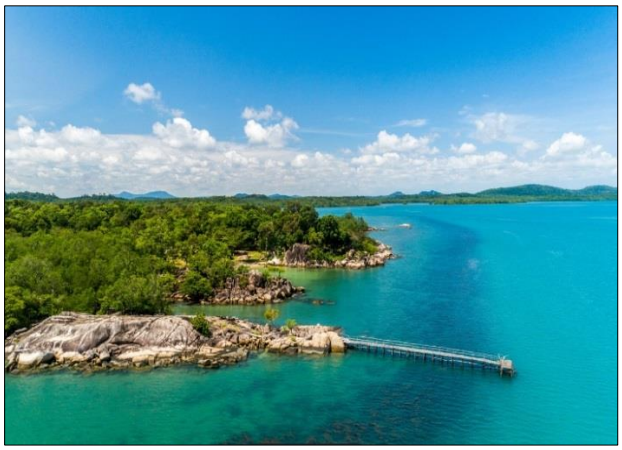
(a)   (b)

Figure 7. Geosites Batu Bedil Associated with Pre-Colonial Settlement Sites and Colonial Era Wrecksite (a) Geosite Batu Bedil, (b) Padang Pendam Site (Source: Research Documentation, 2022)

Geosite Batu Bedil and Tanjung Rusa, occupy coastal geomorphological units characterized by rocky shorelines and promontories (Novita & Adi, 2020; Purnama et al., 2025). These transitional landforms function as interfaces between terrestrial and marine systems, a key concept in geo-cultural heritage interpretation.

Archaeological evidence of pre-colonial settlements, ancient cemeteries, and shipwrecks at these locations indicates sustained human engagement with coastal landscapes, highlighting their long-term cultural significance shaped by

geomorphological conditions (Figure 7). Finally, Batu Itam, situated within a fully marine geomorphological setting, represents underwater geo-cultural heritage. Its association with shipwreck remains emphasizes the importance of submerged landscapes in preserving archaeological evidence of historical seafaring, consistent with UNESCO's recognition of underwater cultural heritage as an integral component of geo-cultural systems.

(c)   (d)

Figure 7. Geosites Batu Bedil Associated with Pre-Colonial Settlement Sites and Colonial Era Wrecksite (c)Karang Kapal Wrecksite 1, (d) Karang Kapal Wrecksite 2 (Source: Research Documentation, 2022)

Intangible Cultural Heritage associated with Geosite in Belitong Global Geopark

The existence of intangible cultural heritage around the geosite is inseparable from the people who have lived in this area over time. The natives of Belitung Island are Malays. Vorderman (1891) called it Billiton Maleisch or Belitung Malay. It is also mentioned that the Malay people of Belitung speak a Malay dialect, but it differs from other Malay dialects. Archaeological research shows that, to fulfill their lives, the people of this island use two ecosystems: land and water. People in the central part of the island live as farmers, while in the coastal part, in addition to being fishermen, some live as farmers. In some areas of Belitung's coastal region, people use both subsistence systems.

In the past, the agrarian tradition of the Belitung people involved moving fields, known as beume. The cultivated crop is rice, harvested once a year. The *beume* tradition is a farming practice among the Belitung Malay community that begins with clearing land by cutting down trees and burning them. This process is known as *nebas nunu*. After the land is cleared, the following process is to plant seeds called *nugal*. The following process is the harvest period, known as *ngetam*, during which the crop is taken. As the last procession of this farming tradition, a traditional ceremony called *maras taun* was held. *Maras Taun* is a rice-harvest thanksgiving ceremony held once a year.

Currently, the people of Belitung no longer plant rice; they cultivate pepper and palm oil. Pepper has been cultivated for generations, while the people of Belitung have cultivated palm oil for only the last 20 years. Even though rice is no longer grown by the people of Belitung, the tradition of moving fields is still practiced. This is evident in the pepper planting system. The people of Belitung know the pepper plant as *sahang*. Pepper gardening activities begin with cutting and burning to clear shrubs and secondary forests. The slashing was carried out using a machete and an axe. The land used as a garden is used for 7 to 10 years, corresponding to the productive period of pepper plants. After this time, they usually move to another place to start planting new seedlings. This activity lasted continuously until finally returning to the first land.

The maritime tradition of the people of Belitung is reflected in their subsistence system, which utilizes aquatic resources from rivers and the sea. The maritime tradition of the Belitung people is reflected in the term used to describe sea activities. Some terms in the seafaring tradition are based on the tools used to catch fish. The equipment used to catch fish includes nets, spears, and *bubu*. In addition to fish, the collected aquatic resources include crabs, shrimp, squid, shellfish, and sea cucumbers.

In addition, this maritime knowledge is also seen in the tradition of water transportation. The people of Belitung use two types of boats to explore their waters. Based on their size, the boats found in Belitung are medium- and small-sized, known locally as sampan. Geographically, the rivers in the northern and southern parts of Belitung Island differ. The rivers in the northern part are generally sloping and easy to navigate. Therefore, the people of Belitung trade commodities using medium-sized boats with a cruising range of 12-15 miles, which can travel down rivers to the interior. Ethnographic observations show that to reach dwellings in the interior, small boats are used to explore areas where former dwellings once stood. These boats can also explore the sea for up to 5 miles.

In general, medium-sized boats are built by combining Southeast Asian and Chinese shipping traditions. The Southeast Asian shipping tradition is characterized by the use of wooden pegs to connect the hull boards and between the hull boards and the tusks (Al Fiqri, 2020; Manguin, 1980). The boat's structure generally retains a tapered bow with a crowbar that fuses with the keel. While the Chinese shipbuilding tradition can be seen in the use of nails to connect boards and tusks, the rudder fins at the back of the boat, and the creation of spaces under the deck to place the ship's engines or cargo (Al Fiqri, 2020; Manguin, 1993).In addition to boats with combined technology, in Belitung, there are also medium-sized boats known as *kater*. This boat is a type built from a single log, with a hole drilled through its center. *Katers* in Belitung are used only for sea exploration because they feature outriggers that maintain stability,

preventing them from being easily overturned by waves or wind. Geographically, this boat is used primarily by people on the east coast of Belitung. In general, the shape of the *kater* is influenced by the Bawean people's boat, introduced by the Dutch East Indies government during tin mining in the 19th century.

Using cultural heritage in geopark areas offers valuable insights into how coastal communities adapt to their environment. The maritime tradition in the geopark showcases how Belitung's people have adapted to their coastal surroundings. As an ecotourism draw, these maritime practices can attract visitors by providing a genuine and distinctive experience of the region's cultural and natural heritage (Lacher et al., 2013). The maritime tradition within the geopark is a key aspect of its tourism appeal, promoting sustainable travel and enhancing the area's cultural richness. Visitors can experience the natural beauty and distinctiveness of the geopark's ecosystem while gaining insight into and valuing the culture of the Belitung Malay community. By leveraging maritime traditions, such as fishing practices and boatbuilding techniques, coastal communities can showcase their cultural heritage and generate income through ecotourism.

Using cultural heritage offers numerous opportunities for sustainable development, preserving cultures, stimulating economic growth, and encouraging cross-cultural exchange (Singtuen et al., 2022). By adopting responsible tourism practices, local communities can preserve their unique identities and increase their environmental awareness and socio-economic well-being (Rodrigues, 2006). The development of ecotourism, including geotourism, cultural preservation, and protection of community interests in the Belitong Global Geopark, must be carried out in a balanced manner so that the local community can benefit in the long term.

SWOT Analysis of Ecoculture Tourism in the Belitong Global Geopark Area

Recognizing the importance of the value and existence of diverse resources in the Belitong Global Geopark area and its surroundings, the people of Belitung Island, with the support of the local government, initiated the formation of a community institution called the Tourism Awareness Group (*Pokdarwis*). The goal is to manage the use of protection-based resources as an integrated sustainable geotourism attraction. Geotourism, which is often thought to focus only on geological tourism, actually refers to the relationship of a much broader geological heritage, which shapes the character of the fauna and flora of the region, as well as the adaptation efforts of the people from the past to the present that determine the heritage of traditions and cultures of daily life (Dowling, 2014; Gordon, 2018b). This relationship is rarely explored as an alternative to integrating the site's heritage diversity into a sustainable ecotourism-based tourist destination.

Results from secondary data analysis, derived from literature reviews across various sources, can identify dominant variables related to internal factors within the geopark area and its surroundings. These factors include, among others, the diversity of attractions, accessibility, facilities, activities, and quality of life of the local community. Meanwhile, external factors include a range of strategic elements that affect the geopark area and its surroundings, including policies, paradigm shifts, tourism trends, institutional and community programs, and competitors.

The data and information were then analyzed using the SWOT method to identify internal factors that reveal potential strengths and weaknesses, as well as external factors that highlight opportunities and challenges in developing ecotourism in the Belitong Geopark area as an integrated, sustainable tourism destination. The potential strengths and weaknesses in the Belitong Global Geopark area are shown in Table 3.

Table 3. SWOT Analysis of Ecoculture Tourism in the Belitong Global Geopark Area (Source: Data processed, 2024)

Key Internal Factors	
Strengths	**Weaknesses**
Attraction of Geodiversity and Biodiversity	Special interest tourism has not been optimally developed
Attraction of Cultural Heritage Diversity and Living Culture Diversity	Tourism activities provide less experience and knowledge to tourists
Village Tourism Awareness Community Group	Homestay facilities have not been developed
Diversity of traditional culinary production	Inadequate Infrastructure in Some Areas
Attraction of Plantations, Fisheries, and Livestock	
Diversity of Tour Packages	
Listed as a UNESCO Global Geopark	
Local Communities' openness to visitors	
Accessibility to and from tourist attractions in destinations is adequate	
Key Eksternal Factors	
Opportunities	**Threats**
Local Government's Sustainable Tourism Development Policy	Climate Change
Advances in information technology in support of responsible promotion	Impact of garbage and waste from tourism activities
UNESCO Global Geopark becomes a strong brand of Belitong Global Geopark	Changes in land use and ownership
	Competition from Other Destinations
	Cleanliness, Health, Safety, and Environmental Concerns

This potential will serve as the basis for the strategy's approach to leveraging strengths to overcome weaknesses by reviewing existing opportunities and threats. To develop the necessary strategies for cultural ecotourism in the Belitong Global Geopark area, an external-internal factor analysis strategy (EFAS-IFAS) was used to assign weights and assessments to each variable in the SWOT analysis. Data and information from internal and external factors were analyzed

using the Internal Strategic Factor Analysis Summary Matrix (IFAS) and the External Strategic Factor Analysis Summary Matrix (EFAS) to determine the best development strategy (Benzaghta et al., 2021; Gurel, 2017).

The examination of internal and external factors was displayed in matrix format, with weights allocated to variables indicating their impact on the ecoculture tourism in the Belitong Global Geopark. The researchers weighted and ranked the factors based on the results of surveys, interviews, and focus group discussions (FGDs). The total weight was 1.00, distributed on a scale from 1 (very significant) to 0.0 (unimportant). The rankings used a scale ranging from 4 (excellent) to 1 (very weak), with intermediate scores of 3 (good) and 2 (weak). The score was derived from the multiplication of weights and rankings to calculate the total score for both internal and external criteria. The scores and weights for each indicator on the strengths, weaknesses, opportunities, and challenges variables are calculated as described in Tables 4.

Table 4. The Weighting of Internal and External Factors of Ecoculture Tourism in the Belitong Global Geopark Area (Source: Data processed, 2024)

Key Internal Factors	Weight	Rating	Score
Opportunities			
Local governments' Sustainable Tourism Development Policy	0.3	4	1.2
Advances in information technology in support os responsible promotion	0.2	3	0.6
UNESCO Global Geopark becomes a strong brand of Belitong Global Geopark	0.5	4	2
Total Opportunities	**1.00**		**3.8**
Threats			
Climate Change	0.1	2	0.2
Impact of garbage and waste from tourism activities	0.2	3	0.6
Changes in land use and ownership	0.3	3	0.9
Competition from other destinations	0.1	3	0.3
Cleanliness, Health, Safety, and Environmental Concerns	0.3	4	1.2
Total Threats	**1.00**		**3.2**
Key Internal Factors	**Weight**	**Rating**	**Score**
Strengths			
Attraction of Geodiversity and Biodiversity	0.15	4	0.6
Attraction of Cultural Heritage Diversity and Living Culture Diversity	0.15	4	0.6
Batu Bedil Tourism Awareness Community Group	0.11	3	0.33
Diversity of traditional culinary production	0.09	2	0.18
Attraction of Plantation, Fisheries, and Livestock	0.1	3	0.3
Diversity of Tour Packages	0.1	2	0.2
Listed as a UNESCO Global Geopark	0.11	4	0.44
Local Community openness to visitors	0.09	2	0.18
Accessibility to and from tourist attractions in destinations is adequate	0.1	3	0.3
Total Strengths	**1.00**		**3.13**
Weaknesses			
Special interest tourism has not been optimally developed	0.15	2	0.30
Tourism activities provide less experience and knowledge to tourists	0.25	3	0.75
Homestay facilities have not been developed	0.35	3	1.05
Inadequate infrastructure in some areas	0.25	2	0.50
Total Weakness	**1.00**		**2.60**

DISCUSSION

Based on Table 5, it can be seen that for internal factors describing the feasibility of the Belitong Global Geopark area and its surroundings as a sustainable and integrated cultural ecotourism destination, a total score of 3.13 and a weakness score of 2.60 were obtained. Meanwhile, based on Table 6, it can be seen that for external factors affecting the development of the Belitong Global Geopark area and its surroundings as a sustainable and integrated tourist destination based on cultural ecotourism, the opportunity score is 3.80 and the threat score is 3.2. These values describe the basic framework of the strategy, using strengths as the primary capital to maximize the resources of attraction owned, while minimizing remaining weaknesses by taking advantage of opportunities and addressing threats effectively. The results of the calculations for these values are presented in Table 5, based on the priority coordinate position of the cultural ecotourism development strategy within the Belitong Global Geopark Area and its surroundings.

Table 5. IFAS and EFAS Coordinate (Source: Data Processed, 2024)

Location	∑ S - W	∑ O-T	Coordinates (X, Y)
Belitong Global Geopark Area	3.13 – 2.60 = 0.53	3.8 – 3.2 = 0.6	0.53; 0.60

Furthermore, by placing the IFAS value on the horizontal (x) axis and the EFAS value on the vertical (y) axis in the diagram, it can be determined that the best strategy is Quadrant I (Offensive Strategy), as both x and y values are positive. Furthermore, by placing the IFAS value on the horizontal axis (x-axis) and the EFAS value on the vertical axis (y-axis) on the diagram, it can be determined that the best strategy is in Quadrant I, i.e., the Offensive Strategy, because the x and y values are both positive, as shown in Figure 8.

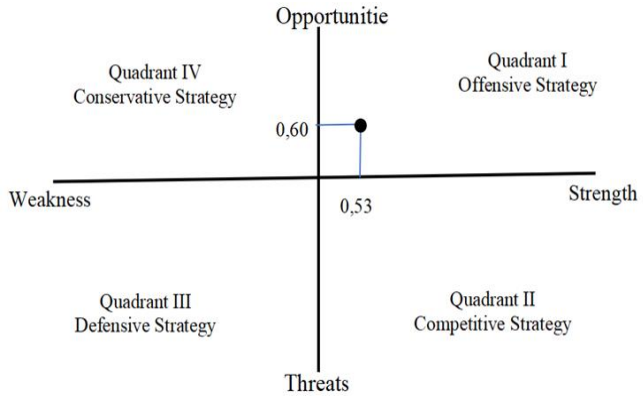


Figure 8. SWOT Diagram 4 Quadrant (Source: Data Processed, 2024)

The diagram above explains that to develop ecotourism in the conservation area of Belitong Global Geopark and its surroundings, it is necessary to implement an aggressive strategy by leveraging internal forces to capitalize on existing external opportunities (SO). Given that most of the region's natural and cultural resources are non-renewable, such as geological and cultural heritage sites (tangible and intangible) from the past, priority should be given to the three main pillars of geopark development: conservation, education, and the economic empowerment of local communities. Some alternative (aggressive) strategies that can be developed in the Belitong Global Geopark area and its surroundings as integrated sustainable tourism destinations include:

1. Preservation of the environment, natural resources, and cultural resources
2. Involvement of local communities in an active role through community-based tourism
3. Improving the quality and quantity of infrastructure, accessibility, and tourism facilities
4. Digitally responsible marketing
5. Development of eco-friendly special interest tourism products based on education
6. Implementation of sustainable tourism destination governance policies

By combining strengths, weaknesses, opportunities, and threats, several alternative strategies have been identified, as shown in Table 6.

Table 6. Internal and External Analysis Strategy of Ecoculture Tourism in the Belitong Global Geopark (Source: Data Processed, 2024)

	Strength	**Weakness**
Opportunities	**SO Strategy**	**WO Strategy**
	• Integration of the diversity of local natural and cultural attractions. • Improvement of geological sites as global geoparks through sustainable tourism approaches • Strengthening conservation efforts of geoparks as education-based tourism attractions • Increasing the involvement of the community in the management of the area through cooperation with stakeholders • Development of local community empowerment through patterns of cooperation on a regional, national, and international scale. • Development of special interest tourism products based on conservation and education.	• Empowerment of local communities through capacity building in the field of Ecoculture tourism. • Increased collaboration with stakeholders related to infrastructure and tourism facilities. • Strengthening digitally responsible promotion. • Developing various environmentally friendly events in a sustainable manner
	Strength	**Weakness**
Threats	**ST Strategy**	**WT Strategy**
	• Maintaining the carrying capacity and capacity of the area through visitor governance that can provide a quality experience and knowledge • Strengthening the sustainability of supervision and control of the use of the geopark and its surroundings through clear regulations • Development of special interest tourism products that are environmentally friendly, unique, and high-quality.	• It is necessary to improve the quality of human resources, including foreign language skills and the regeneration of tourist village managers. • Strengthening the quality and capacity of local communities related to tourism management. • Development of economic activities through local products • Strengthening the protection, development, and utilization of the diversity of natural and cultural attractions in a sustainable manner • Increasing the role and involvement of the community in the development of facilities, product development, and waste management.

The aggressive strategy (SO) derived from this analysis has a high potential for success because it directly leverages Belitong Global Geopark's greatest strength—its diverse natural and cultural heritage, both tangible and intangible—to

seize key opportunities such as UNESCO status and government policies. This strategy works by transforming the existing 'diversity' from merely a list of assets into an integrated narrative of the journey. Thus, each strength does not stand alone but is reinforced by other strengths and elevated by the UNESCO brand (Opportunity) to create a unique tourism experience that is highly educational and difficult for competing destinations to imitate.

Research findings on the weak integration of culture in geopark management align with Gordon's (2018a) study, which identified similar tendencies in several European geoparks, where cultural heritage is often still considered a supplementary element to geosites. However, the aggressive, community-based strategies proposed for Belitong Global Geopark actually offer a fundamentally different model, born from its unique socio-ecological context. Unlike many European geoparks, where communities may be highly structured and industrialized, the communities in Belitong still firmly hold onto traditional agricultural (*beume*) and maritime practices in their daily lives. This context is crucial. Strategies like boosting community involvement in management (SO-4) and enhancing responsible digital promotion (SO-2) will not be effective if they copy the European model. Instead, these initiatives should leverage existing social networks, such as Pokdarwis (Tourism Awareness Groups), to foster authentic tourism stories. Visitors will not only experience the scenery but also gain firsthand insights from local cultural practitioners into traditions such as pepper farming and boatbuilding.

Although this SO strategy is promising, implementing it faces complex challenges inherent to the local context. The main difficulty lies in converting social and cultural capital into a globally recognized tourism product without sacrificing authenticity. Capacity building efforts (WO-1) aim to empower the community, extending beyond just offering foreign language training. Instead, they focus on enabling locals to act as 'interpreters' of their cultural heritage. This enables them to share traditional knowledge with tourists engagingly and educationally. Additionally, a key challenge is preserving ecological sustainability amid growing digital promotion and increased visitor numbers (SO-2). As popularity rises, it can quickly threaten the fragile geosite's carrying capacity and turn cultural traditions into performances. To address this, the strategy must be balanced with strict destination management policies (SO-6), such as a quota-based ticket reservation system and tourism protocols that include conservation messages in promotional content, ensuring opportunities are exploited without compromising the site's core values.

CONCLUSION

This research found that to understand the value of Belitong Global Geopark and to design its sustainable development strategy, it is essential to integrate three main pillars: geological heritage, biodiversity, and cultural heritage. The results of the SWOT-IFAS-EFAS analysis indicate that the most recommended strategy is the Aggressive (SO) approach. It emphasizes internal strengths, such as diversity, biodiversity, and local culture, while also capitalizing on external opportunities, including UNESCO branding, government policies, and technological advancements. With this integration, the geopark can serve as a platform to enhance the economy, education, and the preservation of Belitung's cultural identity, in addition to serving as a conservation site.

Theoretically, this research makes a significant contribution by offering a nature tourism framework that places culture—both visible and invisible—central to the management of a geopark. It questions the traditional geocentric model. This method views culture as a strategic tool that can differentiate destinations rather than just as a complement. The methodological innovation comes from the use of a quantified IFAS-EFAS matrix and an enriched SWOT analysis. This provides more accurate and applicable strategic priorities for other geoparks.

In terms of implementation, the results of this study provide recommendations for geopark managers, the government, and local communities. This guide covers creating tourism products tailored to specific interests through cultural narratives, building capacity among local tourism groups, improving infrastructure, and promoting digital tourism, while adhering to conservation principles. To preserve the geopark ecosystem, it is crucial to enforce destination management regulations, especially concerning waste management, land-use controls, and the area’s carrying capacity.

However, research findings may be affected by the extent to which they are generalized. These limitations include a limited number of informants, uneven coverage of geosites, and subjectivity in assigning weights to SWOT-IFAS-EFAS. Therefore, future research is recommended to identify the most effective methods for integrating culture by quantitatively validating the impact of SO strategies, studying tourists' perceptions and experiences, and conducting comparative studies with geoparks in Southeast Asia. To assess the long-term impact of tourism development on cultural authenticity and environmental carrying capacity, ongoing monitoring is necessary. To enrich the interpretive narrative of the geopark and ensure the sustainability of local knowledge, in-depth ethnographic research related to intangible cultural heritage, such as beume traditions, maras taun, and boat technology, should be conducted.

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THE END OF THE VALDIVIA CULTURE - ORIGIN AND HISTORICAL IMPORTANCE OF THE PAPAYITA GEOSITE IN ECUADOR: HERITAGE SCIENCE PERSPECTIVES

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Abstract: Throughout human evolution, cultures and societies form and transform with time. In some cases, societies change their unique cultural representations and develop into something quite different. In other cases, entire social structures disappear and are replaced by new ones that subsequently often repopulate an area. Some societies or cultures ended abruptly, the reasons for their disappearance in many cases remain either unknown, obscured and/or debatable, like the Classic Maya period in Meso America. In Ecuador, such questions have been formulated regarding the end of the Valdivia culture in coastal Ecuador. Valdivia was one of the earliest and most complex ceramic cultures of the Americas, dating back to the Early Formative period of pre-Hispanic Ecuador, where it inhabited between 3800-1450 BC. The circumstances that contextualize the end of the Valdivia tradition have long been an issue of debate. New discoveries at the Papayita geosite near the city of Portoviejo, have yielded specifically a domestic activity area of the Valdivia Phase 8 culture (ca. 1700 BC). Such new data may contribute to adding some information about the socioenvironmental dynamics that probably contributed to the end of the Valdivia tradition in this region. Besides late Valdivia ceramics, we encountered burials inside the approximately 85 cm thick greyish-beige colored ash layer. This context suggests that the internment took place shortly after the pyroclastic material fell and thus bear a direct chronological relation to the phenomenon. The excavation results and the stratigraphic units studied clearly indicate that after the ashfall, the place remained uninhabited or abandoned and never resettled until modern times. The following geochemical, geochronological and provenance studies of the ashes identified a previously documented volcanic event in northern Manabi, but revealed its true extent as an enormous volcanic eruption of the Pichincha Volcanic complex, some 3,500 years ago. Additionally, we speculate that there is further evidence that the volcanic event might have been triggered by a very strong marine earthquake, which also generated a mega-tsunami on the nearby shoreline. Such revelations are new and may allow the most adequate reconstruction of the abrupt ending of the Valdivia culture in significant areas of coastal Ecuador, converting the Papayita area into an extraordinary geosite of high geological and historic importance.

Keywords: Valdivia Culture, Pichincha Volcanic Complex, Disaster Archaeology, Tephrochronology, Holocene Volcanism

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INTRODUCTION

Throughout human evolution, cultures and societies form and transform with time (Boyd & Richerson, 1985). In some cases, societies change their unique cultural representations and develop into something with enough differences to distinguish themselves as a different culture from their ancestral origins, even though they still maintain cultural similarities (Mace & Holden, 2005). In other cases, entire social structures disappear and are replaced by radically different new ones that may subsequently expand into a region (Tainter, 1988). These complex transformations have been subsumed in literature under the general concept of cultural evolution (Stark et al., 2008).

In certain historical contexts, entire societies disappear and are replaced by new ones that subsequently often repopulate an area after a significant period of abandonment (Zeidler, 2016). Some groups change so fast that, in a few centuries, their material culture, economic systems, and social organization change entirely; as such, archaeologists have classified them as separate cultural entities (Hood, 1996). Furthermore, there are also cultures or societies that exhibit a

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remarkably long trajectory, continuing their activities with very few changes over millennia. Thus, the duration, paucity, and success of a certain group of people, together with their territorial expansion and cultural transformation, are still major issues in the understanding of their survival as a resilience process of humankind.

However, a phenomenon cannot be understood simply through the knowledge of how it began; we also need to know how it ends to comprehend the full nature of the socio-historical process. This applies to both natural and sociohistorical processes alike. Understanding the origin of a society, as well as how it manifests itself in the archaeological record, is just as important as understanding its demise. The disappearance or replacement of a culture may be sudden and due to multiple reasons, such as natural disasters, warfare, or internal social crises. Often, the vanishing of a previously prosperous and productive society remains unsolved due to a lack of documented evidence. The reasons for abrupt endings in many cases remain either unknown, obscured, or debatable, as seen in the Classic Maya period in Mesoamerica, the Mesopotamian cultures in the Middle East, or the Viking settlements in Greenland (Braun et al., 2023; Evans et al., 2018; Borreggine et al., 2023). In the history of the Ecuadorian coast, such issues of collapse and replacement occurred almost regularly. A society that abruptly ended more than three thousand years ago was the Valdivia Culture. This group disappeared almost suddenly around 3.5 ka ago (Hill, 1972; Lunniss, 2019; Lunniss, 2023a; Lunniss, 2023b; Lunniss & Ubelaker, 2025; Zeidler et al., 1998; Jadán Veriñez, 2017). Despite the multiple causes that might have caused the Valdivian collapse, we propose that an ecological cataclysm following the volcanic eruption of Guagua Pichincha, dated approximately to 1500 BC, triggered the end of Valdivia.

The predominant aim of the current research has been to present new evidence contributing an explanation of the most likely cause of the demise of the Valdivia tradition. The data presented are focused to the archeological geosite of Papayita in the central part of the Manabí Province on the Ecuadorian coast. There, the recent archeological excavations combined with geochemical provenance analysis and the evaluation of a major volcanic impact, allowed reconstruction of a major catastrophic event that has been responsible for an environmental and human disaster leading to the end of Valdivia society in the form it existed for over two thousand years. The results may also indicate that such natural events with their associated consequences for humanity may repeat themselves and the lessons to be learned should be used and applied in modern society.

EVOLUTION AND DEVELOPMENT OF THE VALDIVIA CULTURE IN ECUADOR

The Valdivia Culture is one of the earliest and most complex ceramic cultures of the Americas (Ford, 1969; Hoopes, 1994; Raymond, 2008). It is a significant subject of research due to its early development and influence on subsequent regional cultures. This culture dates back to the Early Formative period of pre-Hispanic Ecuador, existing between 3800-1450 BC (Zeidler & Ubelaker, 2021; Marcos, 1998). When first identified in the late 1950s, researchers initially believed Valdivia represented a simple hunter-fisher society (Estrada, 1958; Meggers et al., 1965). The people of the Valdivia culture have been gatherers and fishermen, but from their beginnings, their main subsistence activity was based on a sophisticated, structured agriculture, which allowed them to maintain a greater degree of sedentism and higher quality of life than their preceramic predecessors, the Las Vegas people (Zevallos Menéndez, 1980; Marcos, 1978; 1982; 2010; Pearsall, 1979; Stahl & Stothert, 2020). As a matter of fact, it was famously claimed that its appearance in the Pacific coast of Ecuador was due to a transpacific connection with the Jomon culture from Japan (Estrada et al., 1962). This hypothesis has since been strongly discredited by evidence for an *in-situ* Valdivia evolution (Lathrap et al., 1975). Archaeological data confirms that Valdivians were a fully agricultural society that shifted to sedentary village life, building upon the domestication of plants initiated during the prior Las Vegas culture (Lathrap et al., 1977; Rowe & Duke, 2020; Staller, 2001; Delgado-Espinoza, 2008; Staller, 1994; Raymond et al., 2003; Zeidler, 1994; Kanomata et al., 2019; Zeidler & Isaacson, 2003).

Valdivia sites are distributed across the western lowlands, where populations established themselves near fertile riverbanks, developing technological solutions such as the construction of *albarradas* (water reservoirs) to collect rainwater. At the eponymous site and Real Alto, excavations revealed large villages organized around central plazas with ceremonial mounds reaching up to 13 meters in height. These structures served ritual and social purposes, as evidenced by the decorated pottery and the famous female figurines found in association with ceremonial offerings. Their survival was based on sophisticated, structured agriculture applied to maintain a certain quality of life (Zevallos Menéndez, 1980).

The ending of the Valdivia culture, however, is still controversial and of high interest to researchers of social as well as natural sciences, as its trigger or reason may contribute to understand the potential survival or demise of societies in the past (Tainter, 1988; Brunk, 2002; Middleton, 2012). In the case of Valdivia, it was stated that while its appearance is somehow better known, its vanishing is unclear (Hill, 1972). Furthermore, Zeidler and Pearsall's groundbreaking study in the Jama valley have provided sound evidence and generated some provocative hypotheses, among them the possibility of the Valdivia collapse due to major environmental transformations (Zeidler & Pearsall, 1994). Mainly of those, the various Andean volcanic eruptions that affected the coastal regions of Ecuador during the Late Formative (Zeidler, 1994; Isaacson, 1994). A further cause may imply overpopulation with a subsequent societal crisis due to less available food resources (Hendrixson & Hartmann, 2019). Also, it has been discussed that a climatic crisis, most likely based or associated with a prolonged drought has emerged the culture to leave these coastal lowlands, towards further south (Zeidler, 2012). Whichever the real cause was of the most likely southern migration of the greatest part of the Valdivia culture from the Ecuadorian shores, it occurred at once, meaning in a very short period some 1500 years B.C. (Schwarz & Scott Raymond, 1996).

Therefore, regarding the end of this tradition, the archaeological record reveals a complex and fragmented regional landscape. In the southern and central-southern coast, studies illustrate a gradual process of cultural transformation. There, Valdivia appears to evolve into the Machalilla phase (1500–800 BC), which acted as a direct heir to Valdivian

traditions (Staller, 1994). However, this continuity is not observed elsewhere. In the central coast of Manabí, specifically in areas like the Jama Valley, there is a stark hiatus representing nearly 400 years of total abandonment following the volcanic cataclysm (Zeidler, 1993). This region shows no immediate transition, remaining depopulated until the eventual arrival of the Chorrera Culture (1000–300 BC). Further to the North, a third pattern emerges. In these regions, Valdivian populations seem to have bypassed the Machalilla stage entirely, exhibiting a direct transition toward Chorrera or its local northern variant known as Tabuchila (1200–500 BC). In the Coaque Valley, for instance, Valdivian traditions persisted until approximately 1300 BC, showing subtle cultural shifts that align more closely with highland groups like Cotocollao than with the coastal Machalilla. This regional divergence, transformation in the south, abandonment in the center, and a separate transition in the north, highlights the devastating and localized impact of the Guagua Pichincha eruption (Isaacson, 1994), which specifically disrupted the central Manabí province as evidenced at Papayita. Subsequently, based on the importance of the archeological and volcanic findings at this area, Papayita qualifies to be a geosite, which should be protected and allowed to be visited by generations to come. Therefore, it is clear that a this specific geosite, the evidenced catastrophe marked the conclusion of a tradition that had endured for nearly 2400 years, forcing a radical reconfiguration of the prehistoric Ecuadorian landscape.

GEOLOGY AND CORRESPONDING HAZARDS OF THE STUDY AREA

Geodynamic setting

The western rim of the South American continent is an active geodynamic setting (Taboada et al., 2000; Hinz et al., 1999). Ecuador which is situated on the northwestern edge of South America, undergoes subductional processes due to a convergent plate boundary as a result of the collision between the oceanic Nazca Plate and the continental South American and Caribbean continental plates, which are both separated by the Guayaquil-Caracas Mega Shear (Figure 1; Gutscher et al., 1999; Egbue & Kellog, 2010). The subduction of the Nazca plate gives rise to four extensive, NNW-SSE aligned volcanic arcs (Ferrari & Tibaldi, 1992; Aizprua et al., 2020). Some 1000 km west of the Ecuadorian continental platform, active volcanism in the archipelago is characterized mainly by the Galapagos hot spot, besides other origins (O'Connor et al., 2007; Harpp & Weis, 2020; Rojas-Agramonte et al., 2022). Volcanism in the Galapagos is evidenced by more than 3,000, mostly monogenetic volcanoes, besides some voluminous shield volcanoes (White et al., 1993). Hereby, due to the eastern drifting of the underlying Nazca oceanic plate, a volcanic alignment from west to east is created, which is named the Carnegie Ridge (Harpp et al., 2003). This volcanic chain represents an aseismic volcanic ridge, which moves and finally collides towards the Ecuadorian continental margin with a velocity of as low as 5 cm per year at a latitude between 1°N and 2°S (Pilger, 1984).

Nonetheless, an aseismic ridge like the Carnegie Ridge becomes an obstacle in the oblique subduction process, which have resulted in past and present as a potential valve within the subduction zone of very strong marine quakes, earthquakes as well as tsunamis along the Ecuadorian coast (Pararas-Carayannis, 2012; Toulkeridis et al., 2022; Toulkeridis et al., 2019).

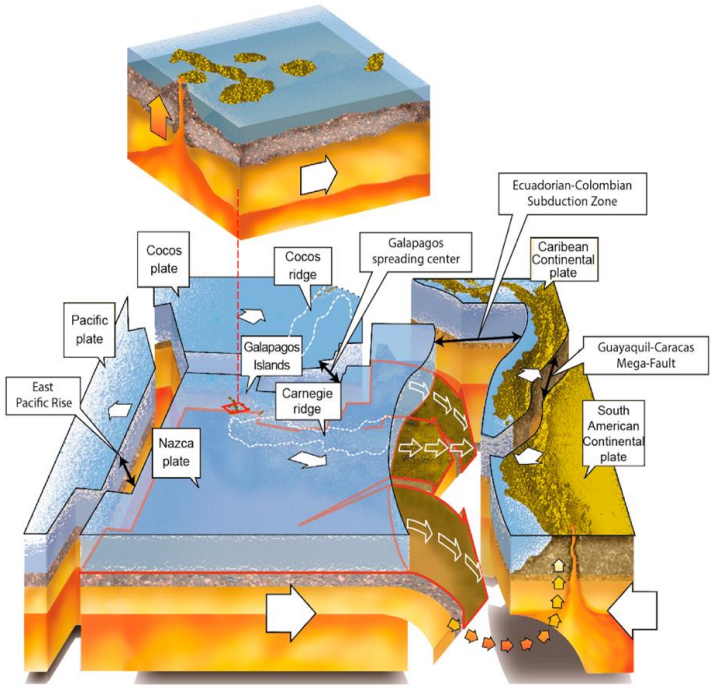


Figure 1. The geodynamic situation of Ecuador with its associated tectonic plates, corresponding separating plate boundaries and volcanic aseismic ridges (Toulkeridis et al., 2021)

Earthquakes and tsunamis in Ecuador

Due to the geodynamic constellation, the Ecuadorian continental platform which situated along the Pacific Rim, is a frequent target of earthquakes, marine quakes and tsunami impacts (Gusiakov, 2005; Matheus-Medina et al., 2018). There

appear primary-generated tsunamis of tectonic as well secondary-generated tsunamis due to submarine landslide origin (Shepperd & Moberly, 1981; Pontoise & Monfret, 2004; Ratzov et al., 2007; 2010; Ioualalen et al., 2011; Pararas-Carayannis, 2012; Toulkeridis et al., 2022). Severe seismic activity has reached registered magnitudes higher than 8 Mw, while, based on paleo-tsunami deposits, even stronger marine quakes may have appeared in the historic past (Figure 2; Quiñónez-Macías et al., 2023; Chunga & Toulkeridis, 2014; Satake et al., 2020). Further tsunamis along the Ecuadorian coast may be generated by seismotectonic extensional processes, like in the Gulf of Guayaquil, besides other zones (Chunga et al., 2019). Within the last two centuries, tsunamis with various intensities one being of up to 8.8 Mw in 1906 impacted the Ecuadorian coast (Rudolph & Szirtes, 1911; Kelleher, 1972; Beck & Ruff, 1984; Kanamori & McNally, 1982; Swenson & Beck, 1996). Other prominent events of tsunami impacts along the Ecuador–Colombia subduction zone occurred in 1942 (Mw=7.8), 1958 (Mw=7.7) and 1979 (Mw=8.2), which are within the 600-km long rupture area of the great 1906 event (Collot et al., 2004). Several strong earthquakes have also been registered within the Ecuadorian coastal area, of which the most recent one reached 7.8 in 2016 (Ye et al., 2016; Toulkeridis et al., 2017). Based on multiple studies of risk perception, preventive measures and degree of preparedness of the Ecuadorian public as well as authorities, any potential future impact of tsunamis as well as earthquakes along the coastal line, will have severe consequences in the strategic and highly developed infrastructure, socio-economic activities, human settlements as well as health and life situation of inhabitants and visitors (Suárez-Acosta et al., 2021; Toulkeridis et al., 2021; Celorio-Saltos et al., 2018; Del Pino de la Cruz et al., 2021).

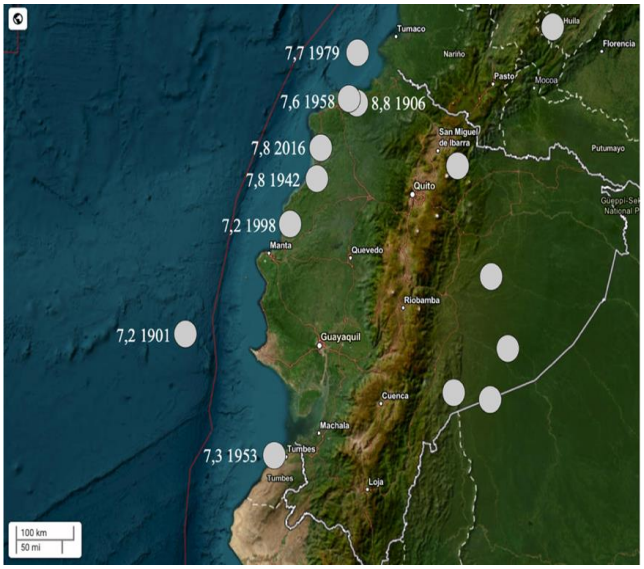


Figure 2. Different epicenters of earthquakes mostly along the coast of Ecuador with a magnitude higher than 7 Mw, of which some generated also tsunamis in the last 120 years (Navas et al., 2018; USGS/NEIC, 2026)

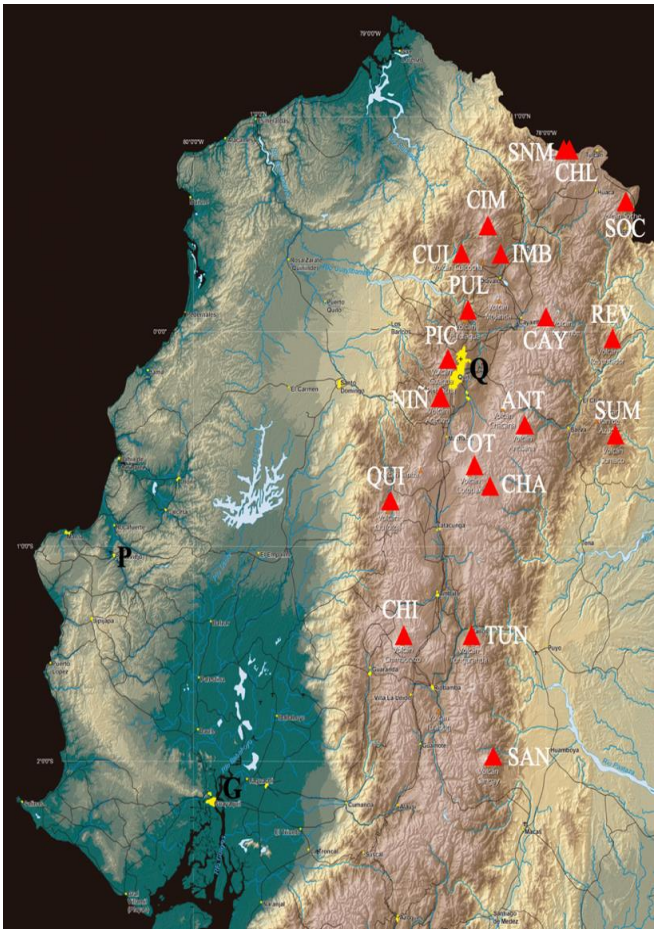


Figure 3. Distribution of the 19 active volcanoes of Ecuador. SNM = Siera Negra de Mayasquer; CIM = Chiles; SOC = Soche; CHA = Cha-chimbiro; IMB = Imbabura; CUI = Cuicocha; PUL = Pululahua; CAY = Cayambe; REV = Reventador; PIC = Pichincha; NIÑ = Niñahuilca;ANT = Antisana; SUM = Sumaco; QUI = Quilotoa; COT = Cotopaxi; CHA = Chalupas; CHI = Chimborazo; TUN = Tungurahua; SAN = Sangay; Q = Quito, P = Portoviejo (Papayita geosite), G = Guayaquil

Volcanism in Ecuador

Ecuador exposes one of the highest densities of volcanoes on the planet due to the Galapagos hot spot and due to the subduction zone, where some 250 volcanoes appear in the highlands, exposing some 19 volcanoes, which are considered to be active (Figure 3; Toulkeridis, 2011; Toulkeridis, 2013). Of these volcanoes, the Volcanic Explosivity Index (VEI) may reach a degree of up to 7 (Toulkeridis & Zach, 2017; Global Volcanism Program, 2025). There are at least seven volcanoes of the most dangerous which have reached VEI´s of 5 or higher, which as strong as to be able to alter significantly the local and may even the regional landscape. These volcanoes are Cotopaxi, Guagua Pichincha, Sumaco, Soche, Cuicocha, Quilotoa, Pululahua and Chalupas distributed on all four volcanic arcs of Ecuador forming part of the Northern Andean Volcanic Zone (NAVZ; Stern, 2004; Melián et al., 2021; Padrón et al., 2008). While Chalupas has been active some 200 ky and potentially 18 ky ago, all other volcanoes have been active in more recent times (Córdova et al., 2020; Hammersley et al., 2022). Volcanic deposits of different hazards, such as debris avalanches, far-reaching lava flows and pyroclastic density currents are usually encountered within the vicinity of the volcanic edifices or complexes, while ash deposits may reach thousands of kilometers covering extensive areas (Jenkins et al., 2015; Favereau et al., 2018; Pardini et al., 2025).

METHODOLOGY

Fieldwork

The discovery of the Papayita geosite happened during the construction of an *albarrada* or water reservoir for irrigation purposes and farming activities. The area is located on a hilltop characterized by gentle slopes and a relatively narrow East-West extension that measures approximately 400 meters east to west. The site lies between the city of Portoviejo to the east and the town of Picoaza to the west. It is part of the foothills that face the famous Cerro Hojas-Jaboncillo that contains the immense 35 km^2 Manteño site (Figure 4). The excavation was initiated as a response to an emergency situation when the construction exposed some aboriginal burials as well as ceramic artifacts. At that point since the site is located within the boundaries of the heritage area of the Hojas-Jaboncillo Archaeological Park, the National Institute of Cultural Heritage (INPC) joined forces with the Archaeological Laboratory of the Universidad Técnica de Manabí and organized a small rescue archaeology mission in order to recuperate as much of the scientific data possible from the exposed and impacted zone of the geosite.

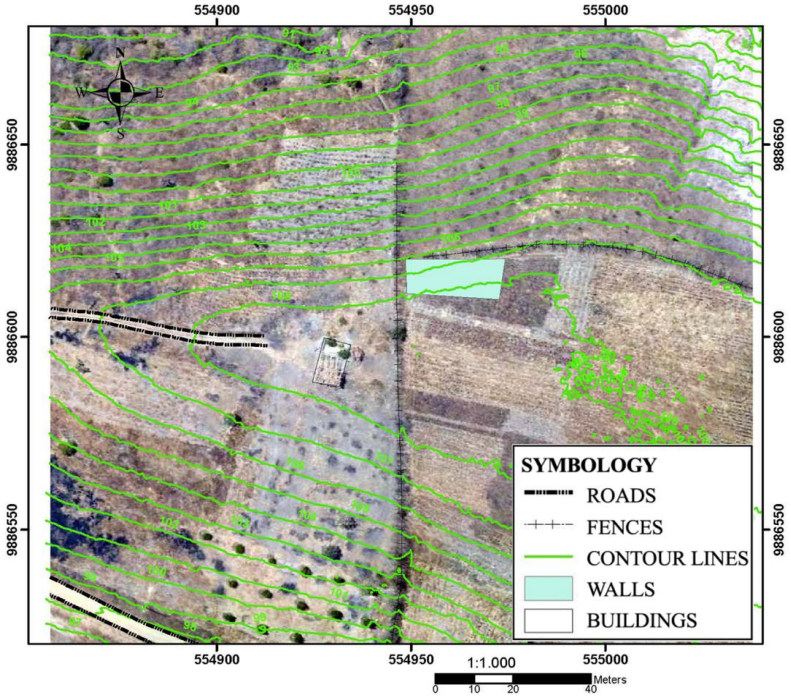


Figure 4. The field area of the Papayita geosite is situated right next to the city of Portoviejo (Parish of Picoazá), within the archeological park Cerros Hojas-Jaboncillo, some 15 km from the current shoreline (Topography and Photo image courtesy of INPC)

Microscope and geochemistry

Since in a previous study some charcoal material has been separated of the Papayita geosite and subsequently dated by the C14 method, it was known that the timeframe of the explosive event that produced the studied coastal ash layer to have an age of some approximate 3,500 years. Therefore, we sampled several ash layer horizons of a variety of volcanoes, which have had a past activity around the time of the deposition of the studied geosite and correspondingly seemed to be the most likely provenances. These included volcanoes and their corresponding deposits of the Cotopaxi and Niñahuilca stratovolcanoes, the Chalupas super-volcano, Cuicocha, Pululahua and Quilotoa calderas and the Pichincha volcanic complex (Toulkeridis, 2013; Hidalgo et al., 2008; Robin et al., 2008; Papale & Rosi, 1993). The further procedure has been previously described in a variety of studies (Toulkeridis et al., 2015; Vaca et al., 2016; Toulkeridis et al., 2025). The ash samples were characterized through a multi-scale analytical workflow combining optical microscopy, field emission scanning electron microscopy (FEG SEM) with energy dispersive spectroscopy (EDS), and X-ray diffraction (XRD). The investigation began with direct visual inspection to establish an initial textural and mineralogical context. High magnification digital microscopy (up to 1000X) enabled the rapid recognition of particle morphologies and mineral fragments, while complementary observations with a Celestron portable optical microscope (model 44302 A; 10X–150X) provided micrometric resolution down to 0.01 mm, refining early assessments of grain size and surface features.

Building on these preliminary observations, high-resolution imaging was conducted using a TESCAN MIRA3 FEG SEM, capable of resolving features as small as 1.2 nm. Fine-grained material was mounted on SEM stubs using a dual adhesive system to avoid compositional interference during elemental analysis and subsequently sputter coated with 99.99% pure gold to ensure optimal conductivity (Toulkeridis et al., 1998; Paéz-Barrera et al., 2024; Toulkeridis et al., 2025). Micrographs acquired under high vacuum conditions at magnifications of 150X and 8000X (4096 × 4096 pixels) revealed the detailed surface textures, vesicular structures, and morphological diversity characteristic of the ash particles. Elemental compositions were determined using a BRUKER EDS system integrated within the SEM chamber, equipped with an XFlash 6 30 detector offering a spectral resolution of 123 eV at Mn Kα. This configuration enabled precise quantification of major and minor elements associated with individual particles. Crystalline phases were identified through XRD analysis using a PANalytical

EMPYREAN diffractometer operating in Bragg–Brentano (θ–2θ) geometry. The instrument employed a Cu Kα radiation source (λ = 1.5406 Å) and an XCELERATOR detector capable of angular steps as fine as 0.0001°, yielding high fidelity diffraction patterns. Mineralogical assignments were performed using the Crystallography Open Database (COD), allowing robust discrimination of the crystalline constituents (Velez et al., 2025; Cadenbach et al., 2025; Moreno et al., 2026). To facilitate geochemical comparison and interpretation, all elemental data were recalculated to their corresponding oxide forms, incorporating atomic weights and stoichiometric equilibrium with oxygen (Rollinson, 2014).

Volcanic ash distribution

The preferred direction of ash-laden clouds of Ecuadorian volcanoes has been obtained by evaluating satellite images of active volcanoes in the period of September 1999 up to December 2025 from the data base of Global Forecast System / North American Model of the National Oceanic and Atmospheric Administration (NOAA, 2026). In this time frame five of the potential 19 active volcanic complexes demonstrated signs of volcanic unrest with visible and determined ash distributions in their surroundings. The five active volcanoes have been Sangay (higher, registered intensity in 2004-2011, 2013, 2016 and since 2020), Guagua Pichincha (1999-2001 and 2009), Reventador (since 2002), Tungurahua (1999-2016 with few interruptions) and Cotopaxi (2015 and 2022-2023) (Toulkeridis et al., 2015; NOAA, 2026). The ash movement or distribution model was realized by using rose-diagrams based on a known methodology of previous studies (Toulkeridis & Zach, 2017; Toulkeridis et al., 2025). Hereby, some 18805 satellite images were considered and evaluated as well as exhibited by months to capture potential anomalies during seasonal changes (Figure 5).

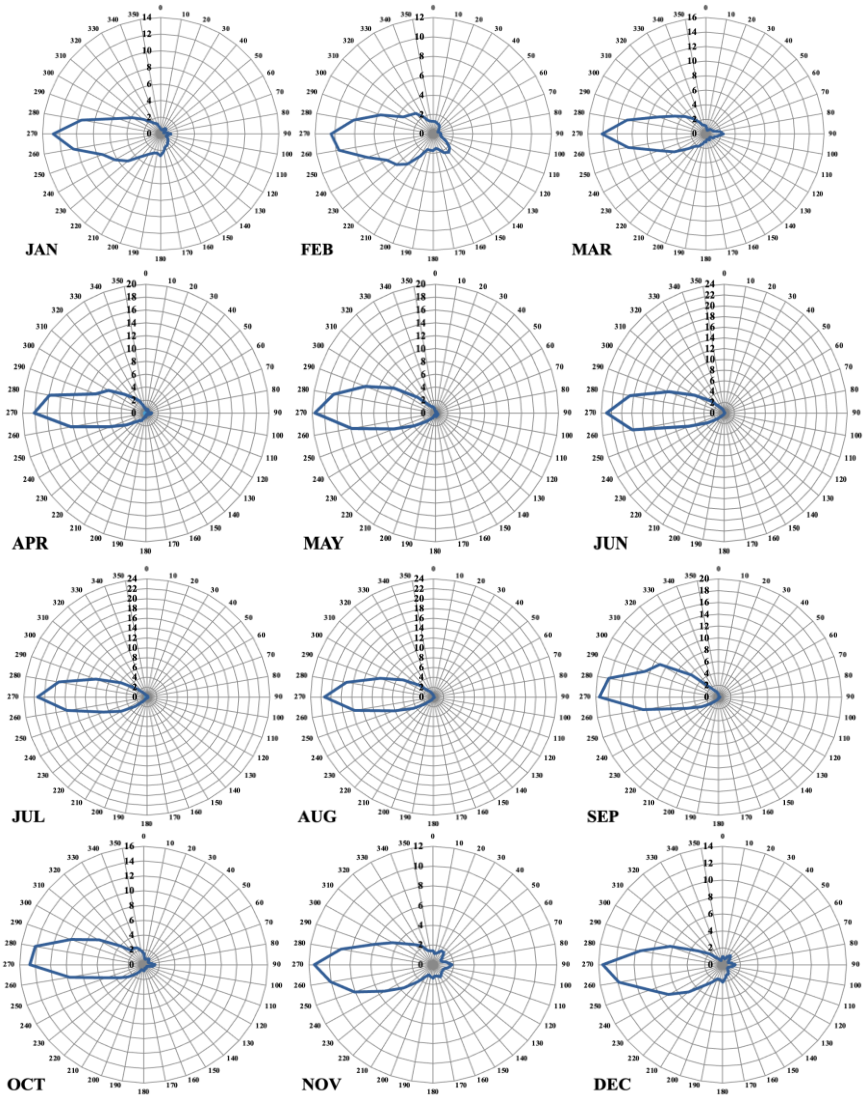


Figure 5. Wind directions of ash-containing clouds for the period September 1999 to July 2026, distributed by months. The graphs indicate the combined data of the five Ecuadorian volcanoes, which have been active in this time period. Information based on the data base of the Global Forecast System / North American Model of the National Oceanic and Atmospheric Administration (NOAA, 2026)

RESULTS AND DISCUSSION

Geochronology

Geochronological data based on charcoal separated from the prominent ash layer at the Papayita geosite yielded an age

of 3530 ±30 years (Páez-Barrera et al., 2024), being identical to the 3560 ±70 years BP, 3540 ±30 years BP and 3549 ±30 years BP ages of previous studies of the same deposit in different sites throughout the Ecuadorian area, being originated from the activity of the Pichincha Volcanic Complex (Zeidler, 1994, 2016; Robin et al., 2008, 2010). This age has been also revealed in tephra layers preserved in marine sediments reaching an age of 3516 years BP (Bablon et al., 2022). This was realized within the KAT18 core as the so-called ATAC-51 tephra, which was sampled just 75 km NW of the Papayita geosite without being associated with the same major event of the Pichincha Volcanic Complex.

Archeology

Upon examination in the field, it was clear that the area impacted by the backhoe exposed part of a larger site that was previously unknown in the Cerro Hojas-Jaboncillo archaeological area. The 15 m long by 2 m deep machine cut had revealed a stratigraphic sequence that indicated the existence of a cultural deposit, completely sealed off by other layers and capped by the contemporary surface which was being worked as a family-owned farming plot (Figure 6).

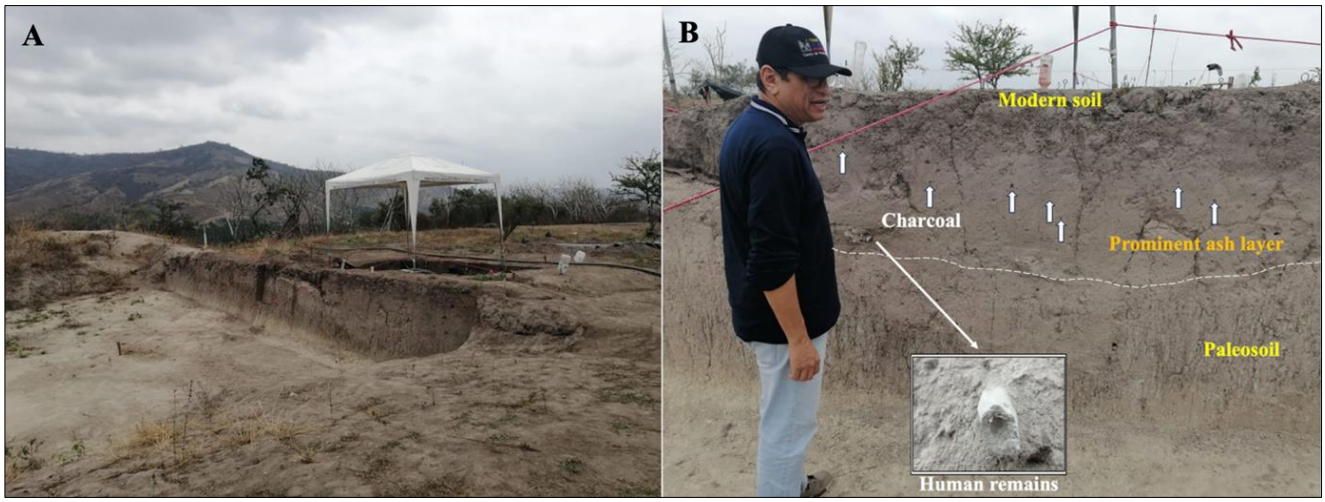


Figure 6. A: Initial excavation site at Papayita; B: Representative outcrop, with some fundamental parts of the excavation site; Both pictures were taken by Theofilos Toulkeridis on August 6, 2022

Since the backhoe cut provided a quite clear window into the stratigraphic configuration of the site, it was decided to clean this profile and then combine with narrow trenches to isolate a 4x4 m block that we would then remove using the different stratigraphic units as vertical guides. On the horizontal plane, we used as guides carefully delineated rectangular excavation sampling geometry units that ranged from 50 by 50 cm to 100 x 50 cm to carefully control the provenance of features and artifacts. This excavation process was carefully followed until each stratigraphic unit or context was extracted since it became apparent that we were excavating what appeared to be a domestic cultural context the encompassed different activity areas in evidence. From the very beginning of the findings, it was obvious that the ceramic material that the backhoe disturbed, and that we later examined on the field, pertained to a very late Valdivia component that suggested that it was best associated with the known data from Valdivia 7 and 8 phases. Once we started the excavation process and completed a few of the excavation units it became clear that we were dealing with a single component site.

The archaeological “living floor” had the artifacts within its context. This living floor was located on top of what appeared to be a paleosoil which in turn was preceded by a parent material. In other words, the Valdivia activity had taken place on virgin soil that had not been disturbed before the Valdivia settlement itself.

Excavated materials and features were varied although not very numerous. Among the recovered artifacts were utilitarian ceramics, some chipped stone tools, lithic debitage, animal bones (probably deer) and a small number of mollusk shells of marine origin. The features included a hearth, two possible offerings or ceremonial activity indications, one posthole, remains of what could be basketry artifacts or some organic material and two burials. In terms of the features which suggested activity areas the most obvious one was the hearth which contained some fragments of marine shells, as well as small fragments of charcoal and very few ceramic sherds. The base of the hearth was directly on the living floor context. Very near that hearth we found two lithic artifacts, one being a fragment of a cylindrical Mano (grinding stone) in a vertical position under rectangular brick-shaped lithic artifact with rectilinear incisions that may or may not have been some sort of abstract figurine. This latter artifact was placed horizontally on the top end of the vertically positioned Mano. The far end of the mano was resting on the living floor surface. Also on the living surface, a retouched flake tool with beaked/spurred working end, being likely for a graver/gouge function was found (Figure 7). The function of this configuration of artifacts, the cylindrical mano, and the brick like object, is not clear (Figure 7). They were obviously placed one on top of the other and they don’t seem to have been buried into the ash, rather they were buried by the ash while being on the living floor. A similar situation can be stated for the hearth which was clearly resting on the living floor. It was covered by the ashfall. Indeed, all the features and findings were essentially on the living floor, and they all appear to have been covered by the general ashfall event. The only feature that seems to have cut into the ash layer was Burial #1.

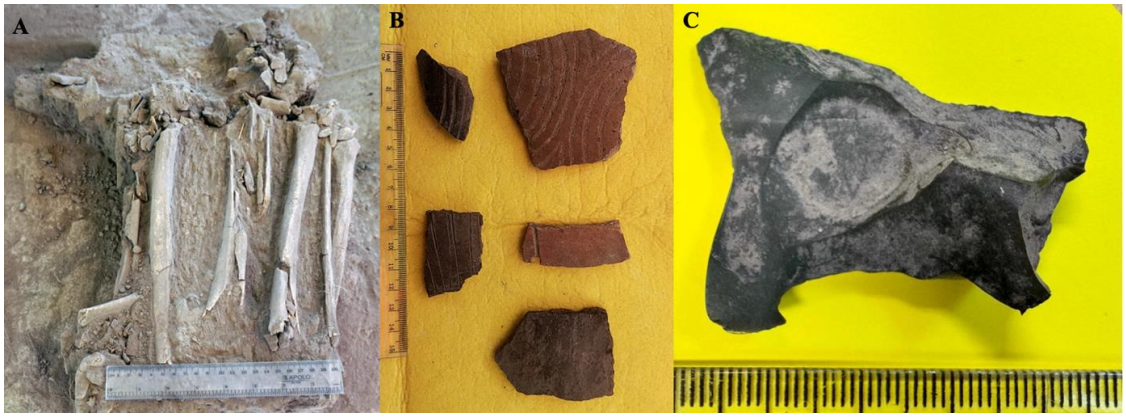


Figure 7. Excavated items of Papayita from the Valdivia culture: (A) Burial 1 exposed; (B) Valdivia Phase 8 ceramic sherds, mostly utilitarian ware; (C) cutting tool (knife) All pictures taken by Juan José Ortiz-Aguilú in December 2022

Burial #1 consists of human long-bone shafts arranged in a tight, sub-parallel cluster buried into the volcanic ash matrix, with little to no representation of axial elements (cranium, vertebrae, ribs) or pelvic components within the excavated block (Figure 7). The bone types represented and their spatial patterning are mainly robust limb long bones, in a mainly disarticulated position, and lacking anatomical continuity at the hip/pelvic region. Such content and configuration match well-documented indications of a reduced or secondary deposition, in which selected elements (often long bones) are intentionally collected and reinterred after decomposition elsewhere, rather than remaining in full articulation as in a primary burial (Bass, 2005; Buikstra & Ubelaker, 1994; Ubelaker, 1999). From a forensic standpoint, a configuration of long bones with absent or underrepresented axial/pelvic elements is repeatedly treated as a strong indicator of secondary mortuary handling, including bundle-type or redeposited remains (Rhodes et al., 2016; Ubelaker, 1999). While digging the *albarrada*, mechanical truncation appears to have removed the upper portion of the burial. The surviving long-bone–dominant pattern and the lack of clear hip articulation or pelvic concentration in situ are most consistent with a reduced/secondary long-bone deposit, pending confirmation through block excavation and inventory/MNI assessment.

As previously mentioned, sample of charcoal fragments contained in the burial matrix were submitted for C14 measurement for chronometric purposes, yielding a result of 3530 +/− 30 BP (ICA-14C-7129). This date aligns favorably with the current chronology for Late Valdivia. Therefore, Burial # 1 pit's context presents an interesting situation. Aside from the human remains described above, the burial soil content is indistinguishable from the pit's matrix. In other words, there is no contrast in texture, color, or particle size for example, between the soil inside the burial pit and the soil into which the pit was dug. They are both volcanic ash. That situation suggests that the burial pit was dug shortly after the ashfall and very likely at a moment where no pedogenesis had occurred and hence no dark topsoil existed. The absence of fill–matrix contrast is then consistent with a relatively short interval between ashfall and burial.

The analytical lens of Disaster Archaeology posits that sudden, high-magnitude natural events are primary drivers that can fundamentally alter the trajectory of civilizations. This perspective challenges the gradualist view of cultural change, emphasizing instead punctuated equilibrium—a concept borrowed from evolutionary biology by Eldredge & Gould (1972) and applied to social systems to explain abrupt "beginnings and endings" in the archaeological record (Torrence & Grattan, 2002). A disaster is not defined solely by the physical event, but by the social context in which it occurs. Hoffman & Oliver-Smith (2002) argue that disasters are "socially produced," occurring when a natural hazard meets a vulnerable population. The global archaeological record offers key parallels: Bawden & Reycraft (2000) have documented how the Moche state in Peru collapsed due to extreme El Niño (ENSO) events, while Payson Sheets (1992, 2002) illustrated at Joya de Cerén how volcanic eruptions can instantly entomb entire populations, creating a "time capsule" of domestic life interrupted by disaster. Even in modern times, events like the 1985 Armero tragedy in Colombia demonstrate how volcanism acts as a cultural "reset," altering landscapes and social memory permanently (Zeiderman, 2016). Studying these cataclysms allows archaeologists to measure "cultural resilience" (Redman, 2005) seeking to understand why some societies adapt to such abrupt changes, while others, facing a threshold of environmental stress, vanish.

Sealed deposits preserve short-term activity residues better than open stratified sequences. In the case of Papayita we have a scientifically exceptional site because it offers a closed Late Valdivia cultural system sealed by a geologically instantaneous ashfall, creating a rare opportunity to reconstruct behavior, chronology, and human–environment dynamics at unusually high resolution. It is, indeed, a near perfect stratigraphically integrated catastrophe-and-society case study.

Geochemistry and provenance analysis

Geochemical data of major elements of the sampled ash layer of the Papayita geosite may allow confirm its source to be the Pichincha Volcanic Complex or, however, to identify a different source by revealing a thorough provenance analysis involving other potential sources. Therefore, samples of ashes of a several volcanoes were taken, of which activities were expected to have occurred close the given timeframe some 3,5 ka ago. Those chosen volcanoes should have had also recorded volcanic events which may have been superior to a volcanic explosivity index (VEI) of 4, as this degree or higher, represents very strong impacts of pyroclastic material in even remote areas. This case is given in the Papayita geosite,

which in respect to the distance to any of the volcanoes of the Ecuadorian Andes is yielding that a very strong eruption was capable to deposit such quantities of ashes in this spot. Subsequently, the samples were taken from the Cuicocha, Pululahua, Niñahuilca, Quilotoa, Cotopaxi and Chalupas volcanoes. Furthermore, special emphasis was given on further samples for reason of comparisons of the Pichincha Volcanic Complex such as young, historic known layers, ashes of the 3,5 ka event of the volcano found on its western rim, ashes slightly older to the 3,5 ka event and much older ashes of the Rucu Pichincha sector of the Pichincha Volcanic Complex. Based on the chosen samples of the identified source and other potential sources, provenance analysis in form of ternary diagrams were realized. Provenance analysis may be realized with mineralogical assemblages, lithic compositions, isotopic pairs or geochemical data in combination of major, trace or rare earth elements (Toulkeridis et al., 1999; Toulkeridis et al., 2015; Toulkeridis et al., 1998; Toulkeridis et al., 2010; Seelos et al., 2021; Bryant et al., 2006; Willmes et al., 2018; Alvarado-Induni et al., 2026; Rollinson, 2014). In the current research, this occurred with the combination of the oxides of major elements of the more mafic constellation of SiO_2-((Na_2O-K_2O)*5)-Al_2O_3 (Figure 8a and 8b) The ternary diagrams were subdivided in the potential sources of the different, age-related ashes of the different volcanoes and to the different ashes of the Pichincha Volcanic Complex. Hereby, a very nice correlation was observed within the given ternary diagrams. There, clear distances revealed that the ash samples of the Papayita geosite were identical to the pyroclasts taken of the 3,5 ka event site, west of the Pichincha Volcanic Complex (Figure 8b). Furthermore, the other potential sources are quite distinct to the geochemical affinity of the sampled ashes of the Papayita geosite (Figure 8a).

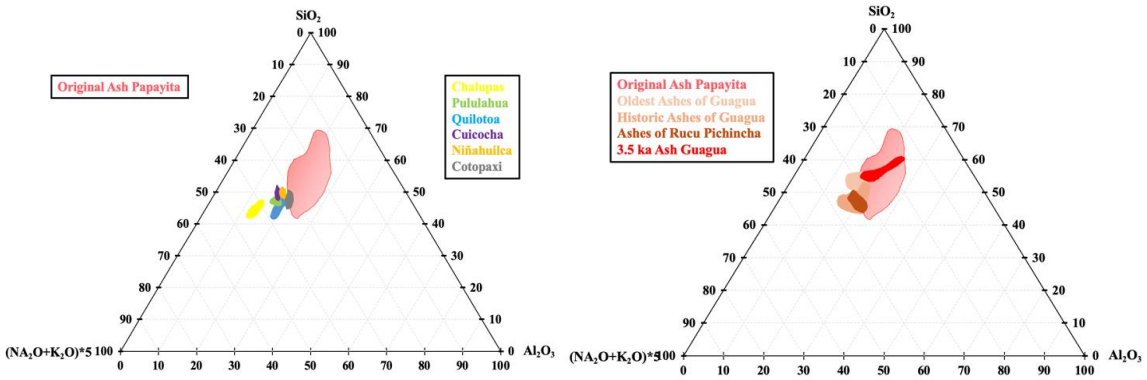


Figure 8a (left) and 8b (right). Ternary diagrams about the provenance analysis of the potential source of the studied prominent ash layer (explanation see text)

Wind direction of the ashes and magnitude of corresponding eruption

Based on the findings in several sites of the coastal area, where the prominent ash layer has been encountered, the determined thicknesses of the ash layer may reveal that the explosive event which occurred some 3,5 ky ago and distributed the mentioned tephra, resulted to have been directed towards the west to southwest direction of the Pichincha Volcanic Complex. This would most likely have occurred in the early months of the year, meaning around January to February, as these are the months where the ash-carrying eruptive clouds direction points to such course. Up to date, the extension of the magnitude of the eruptive cloud and the corresponding ash volume was not well documented, as only very few and mostly very thin layers were considered to calculate the resulting VEI of this catastrophic event. The method for calculating the minimum volume of tephra was based on the formula of Legros (2000), which calculated the volume based on a single isopach with the equation (Legros, 2000):

$$V_{min} = 3.69\ TA$$

where V_{min} is the minimum volume, T is the thickness (cm) of the isopach and A is the area (km^2) of the isopach. The data used have been of about 0.03 cm for T and $15*10^9$ for A. Unfortunately, these preliminary findings gave a way to incomplete idea of the extension of the disaster 3,5 ky ago as its calculation was demonstrating just a VEI of 4 (Vallejo Vargas, 2011). In order to compare such an event of modern times, a VEI of 4 occurred in Ecuador on November 3, 2002, when the El Reventador volcano erupted, some 90 km east of Quito (Ridolfi et al., 2008; Toulkeridis et al., 2022). Then, the westwards directing ash cloud precipitated some 2 mm of ash in Quito. The Papayita geosite is situated some 225 km southwest of the Pichincha Volcanic Complex and the prominent ash layer does have a thickness of at least 85 cm (Figure 9). This prominent ash layer has been found in many remote places within Ecuador, including Jama, Coaque, Julcuy, Mana besides many other sites and always having considerable thicknesses, being much higher in average than those reported in Vallejo Vargas (2011). Nonetheless, with the new findings, especially based on the thicknesses of the prominent ash layers at the Papayita geosite and also elsewhere, as mentioned previously, the newly calculated VEI is almost exponentially higher than that previously reported, as it yielded a VEI of 6, making this recorded event to one of the most devastating of the Ecuadorian active volcanism in the Holocene so far. Previously to the present study, it was documented that a massive volcanic eruption emanating from the Ecuadorian highlands blanketed a large swath of the western lowlands with a tephra mantle so thick that Early Formative lifeways were completely devastated and resident populations of northern Manabí were forced to either migrate or succumb to asphyxiation and/or famine (Zeidler & Isaacson, 2003). The footprint of this eruption was not well understood, but its effects have been well documented in the Jama Valley of northern Manabí, where the Piquigua Phase peoples abruptly disappeared and the valley was abandoned for over 600 years (Zeidler, 1994; Zeidler et al., 1998; Zeidler & Isaacson, 2003).

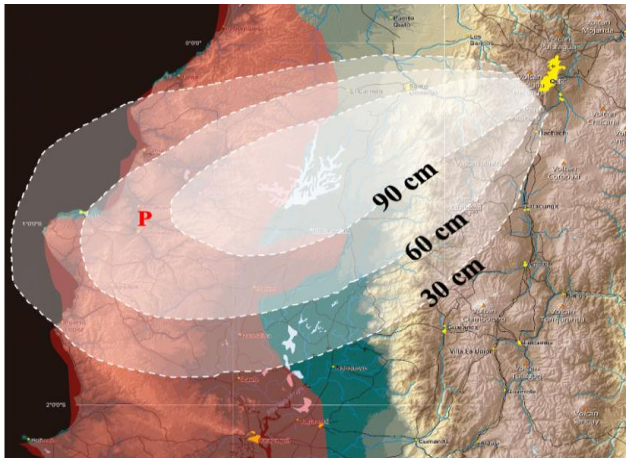


Figure 9. The morphological map of Ecuador with the potential ash distribution and corresponding isopachs of 30, 60 and 90 cm of the eruptive event of the Pichincha Volcanic Complex some 3,5 ka years ago (Páez-Barrera et al., 2024); The known distribution of the Valdivian culture in coastal Ecuador is illustrated in reddish color, while "P" points the study area of the Papayita geosite, based on Meggers & Evans, 1977; Meggers et al., 1965; Map of the Military Geographical Institute (IGM) of Ecuador



Figure 10a-b. Hypothetical, illustrative reconstruction of the triple mega-event in the Ecuadorian coast some 3,5 ka ago; Explanation see text. All images were generated by Artificial Intelligence

Reconstruction of the 3,5 ka mega-event, which destroyed the Valdivia culture

The new geo-archaeological discoveries in the Papayita geosite may allow to reconstruct and or reveal a triple mega-event that ended the flourishing of the Valdivia culture in the Manabí and Guayas area of coastal Ecuador. Close or on beach areas of Ecuador, several paleotsunami deposits have been encountered, which indicate the existence of severe marine quakes in the past, a behavior very well-known up to present day as demonstrated previously. These very strong seismic events have occurred in the recorded past along the south American continental margin, very magnitudes have reached up to 9.5 Mw on the Richter scale, destroying vast areas close to the epicenters due to the resulting long-lasting movements and due to the corresponding associated generation of devastating tsunamis (Cisternas et al., 2005; McCaffrey, 2008).

In the case of Ecuador, a new discovery includes a paleotsunami deposit in the San Pablo area in the Province of Santa Elena, some 120 km south of the Papayita geosite. There, a 18cm thick paleotsunami deposit dated an OSL age of 3,500±30 years, being identical to the charcoal separated from the ash deposit on the Papayita geosite (López Cadavid et al., 2019). This implies, that a strong earthquake occurred, which may have frightened some of the public of the Valdivia culture, without provoking major concerns, as at the ancient times more than a few landslides may be not to be expected in the coastal area of Ecuador. Landslides as well as liquefaction as result of earthquakes in the coastal morphology are quite common, as demonstrated in 2016 due to the 7.8 Mw earthquake, but these phenomena most likely lacked to provoke an extended harm as it did in present society with unprepared or less seismic resistant modern edifices with a high number of fatalities (Toulkeridis et al., 2017; Ortiz-Hernández et al., 2022a; 2022b; Avilés-Campoverde et al., 2020; Sennson & Beck, 1996).

Nonetheless, we simply speculate that shortly after the shaking due to the marine earthquake, an incoming wave certainly impacted the people who were elaborating fishing and other beach activities of the Valdivia culture (Figure 10a) bringing death and devastation close, on the beaches and sometime towards inland based on channeled rivers, deltas and estuaries. Volcanic activity of the Ecuadorian highlands may have been perceived and accompanied the Valdivian culture from time to time where some strong explosions may have been heard and some less amounts of ashes may have been precipitated upon the Valdivian villages (Figure 10b). It may be pure speculative but also potentially true, that such strong seismic movement, as previously explained, along the Ecuadorian coast may have triggered the volcanic activity of the Pichincha volcanic complex to generate an enormous eruptive power, leading to a VEI of 6, which precipitated rather quickly enormous amounts if fine-grained volcanic material towards the settlements of the Valdivian culture. Such active eruptive phase may have very fast not only covered a huge amount of land destroying in the agricultural sector the growing crops, the associated livestock and

related tasks. However, even worse, such amounts of ashes were leading to death by asphyxiation to animals and humans alike, as almost no opportunities existed to escape this deadly volcanic hazard as demonstrated in our study.

The surviving public migrated to other lands to escape the deadly ash-covered areas and for certainly many years unproductive lands. It may be pure coincidence, but exactly along this time, 3,5 ky ago, indigenous people entered Amazonian caves such as the Tayos cave may as a potential shelter of the described mega-triple event (earthquake-tsunami-volcanic explosion), as evidenced by archeological findings (Judson, 1976; Toulkeridis et al., 2025). Such "triple" mega-events are not unusual in human history as shown in the Greek Island of Santorini 3,6 ky ago, where (volcanic) earthquakes have led to the escape of the public from the volcanic island, which later erupted to form an enormous caldera, and shortly later to generate a deadly tsunami along the Aegean Sea (Bruins et al., 2009).

CONCLUSIONS

The multidisciplinary research that has been conducted at the Papayita site provides fundamental information about the abrupt termination of the Valdivia tradition in the central and north-central Manabí province. This study, by integrating archaeology, geochemistry, and volcanology, finds important conclusions. The analysis of the geochemical provenance links the ash deposits at Papayita site to the Pichincha Volcanic Complex. The stratigraphic profile identifies a tephra layer of approximately 85 cm, which, according to new calculations based on isopach distribution, can correspond to a VEI of 6.

This number puts this event as one of the most devastating within the Holocene. Simultaneously, geochronological data found within the tephra (3530 ±30 years BP, uncalibrated) indicates a direct temporal link between the Guagua Pichincha eruption and the terminal phase of the Valdivia Phase 8 culture (ca. 1600–1500 BC). The archaeological evidence at Papayita, specifically hearths and ceremonial offerings encased in ash, proves that the eruption occurred during active domestic occupation, when occurred immediate and permanent abandonment of the site.This study demonstrates an observed regional variation in human response to the disaster. While southern populations exhibited resilience through a gradual transition into the Machalilla phase, the central coast of Manabí suffered a total societal collapse followed by a 600-year hiatus of abandonment. This period of depopulation, lasting until the arrival of the Chorrera tradition, highlights that the magnitude of the ashfall rendered the structured agricultural systems of the Valdivia untenable in this specific region. This, however, can be related to the impact of the ash in the areas. Perhaps in Southern coast, the effect was a minimal to any, and thus, we can observe a steady transition between Valdivia and Machalilla traditions.

Investigations which information is presented here suggests in a purely speculative form, that this volcanic event may have been part of a larger compound disaster, potentially triggered by a high-magnitude earthquake and tsunami. Such geodynamic interaction is characteristic if the extreme vulnerability of the Ecuadorian coast, mainly due to the subduction and collision of the Nazca Plate with the continent. Finally, the Papayita area is established as an extraordinary archeological geosite of global importance. It is and works as a "time capsule" preserving a high-resolution record of the intersection between catastrophic natural hazards and social vulnerability. Hereby, it also serves as an indicator of a warning to modern society towards the recurrence of future catastrophic events with little to no warning.

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Conflicts of Interest: The authors declare no conflict of interest.

Use of Generative AI: AI was exclusively used for the generation of Figure 10 a and 10b. No AI was used for data processing, edition of the text or any other research-related activities.

Abbreviations: USGS: United States Geological Survey; NEIC: National Earthquake Information Center; IGM: Military Geographical Institute of Ecuador; NOAA: National Oceanic and Atmospheric Administration

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INTEGRATION OF GEOPHYSICAL AND HYDROGEOCHEMICAL METHODS TO REVEAL THE KARST AQUIFER SYSTEM IN GEOTOURISM AREAS, LO AND BANGI CAVES, SOUTH MALANG, INDONESIA

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Abstract: Karst areas have complex hydrogeological systems resulting from the dissolution of carbonate rocks, fracture networks, and the presence of underground rivers. Lo Cave and Bangi Cave, in South Malang, are located in the Wonosari Formation and are known as active underground river sites with potential for the development of karst geotourism, speleology, and water resources. However, to date, no study has combined geophysical and hydrochemical methods to provide information on underground river connectivity, karstification levels, and groundwater vulnerability at these sites. This study aims to understand the subsurface structure, flow patterns, and geochemical processes as a basis for geotourism development. This study was conducted in Kedungsalam Village, South Malang, Indonesia. This study used Self-Potential (SP), Induced Polarization (IP), and Hydrochemical analyses. SP data showed negative anomalies consistent with underground flow paths connecting the two caves. IP data identified loading zones at Lines 4, 6, and 7, which are suspected to be active cavities and water-filled channels. Hydrochemistry analysis showed that all samples had low mineralization (TDS 31-63 mg/L), neutral to slightly alkaline pH, and were dominated by Ca^{2+}–Mg^{2+}–HCO_3^- ions. Similar hydrochemical facies confirm that all water sources originate from a single, interconnected karst aquifer system. Integration of geophysical and hydrochemical methods reveals that Lo Cave and Bangi Cave form a hydrogeological system, with active channels and flow controlled by carbonate dissolution.

Keywords: carbonate rocks, cave, dissolution karst, geotourism development, geosite, hydrochemistry, induced polarization, karst aquifers, self potential, underground river

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INTRODUCTION

Karst areas are unique and complex landscapes due to the close relationship between geomorphology, geology, and (Cao et al., 2024; Faizal et al., 2025a; Ford & Williams, 2013). Karst hydrochemistry is a highly dynamic and heterogeneous system due to interactions between water and rocks (Pambudi et al., 2024; Tian et al., 2025). The main characteristic of karst areas is the dominance of carbonate rocks such as limestone and dolomite, which are readily soluble in water (Deng et al., 2022). The longterm dissolution process forms distinctive morphologies such as caves, dolines, sinkholes, and complex underground river networks. These structures make karst systems vital for storing and distributing groundwater, while also

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making them vulnerable to environmental changes and human activities (Faizal et al., 2017; Jones & White, 2019). Groundwater dynamics in karst areas differ from those in aquifers in ordinary rocks. Groundwater movement is controlled by subsurface fractures, channels, and cavities that serve as primary flow pathways (Ma et al., 2022; Yang et al., 2024).

This makes groundwater flow patterns in karst areas highly complex and difficult to predict (Zhao et al., 2023). Consequently, karst groundwater systems are highly sensitive to hydrological changes, both natural and anthropogenic (Yang et al., 2026), such as water exploitation, land-use changes, and seawater intrusion in coastal areas. The Lo Cave and Bangi Cave complexes are part of a karst system that developed in southern Malang, East Java, Indonesia. This area was formed in the carbonate rock of the Wonosari Formation, which underwent intensive dissolution, resulting in distinctive cave, doline, and underground drainage systems related to local aquifer activity (Susanti et al., 2025; Utomo & Siregar, 2018). Based on previous research (Faizal et al., 2025) and field observations, these two caves have underground river flows that can meet domestic and agricultural water needs in the area. However, to date, scientific information explaining the geochemical processes, the direction of underground flow, and potential groundwater contamination in this area remains very limited.

Understanding the dynamics of karst aquifers at the research site requires integrating subsurface conditions and geochemical information. Hydrochemistry analysis is an important approach in tracing the dissolution process of carbonate rocks and the characteristics of groundwater evolution. Measuring major ions such as calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^{+}), potassium (K^{+}), bicarbonate (HCO_3^{-}), sulfate (SO_4^{2-}), and chloride (Cl^{-}), it is possible to determine the extent to which carbonate dissolution dominates the chemical composition of groundwater and the importance of external influences such as anthropogenic activity or seawater intrusion (Alemdağ et al., 2025; Féraud et al., 2009; Zhao et al., 2023). The chemical composition of groundwater reflects the complex interactions between water, rocks, and the atmosphere, which are influenced by the depth of the aquifer, the water residence time, and local Hydrochemistry conditions (Liang et al., 2018; Ryzhenko & Sidkina, 2017). Riyanto & Cahyadi (2023) investigated the carbonate dissolution process in the Gunung Sewu karst springs, which are also located in the Wonosari formation, and found that the dominant ions in the springs are calcium ($Ca^{2+)}$ and bicarbonate, derived from bicarbonate limestone.

On the other hand, geophysical methods can provide information on karst subsurface features, such as cavities, fractures, and groundwater flow paths (Hussain et al., 2020; Wang, 2026; Zhou et al., 2002), and are non-intrusive and cost effective (Massinai et al., 2023). Various geophysical techniques have been used to support karst Hydrochemistry research, including Self Potential (SP) and Induced Polarisation (IP). The SP method is sensitive to the movement of conductive fluids and natural potential gradients, making it effective for detecting patterns and directions of underground water flow (Ammar et al., 2023; Boimau et al., 2023; Revil et al., 2004). In the Malang karst area, the SP and resistivity methods were used to map underground river flow, showing a good correlation between SP anomalies and water flow paths (Susilo et al., 2017). The study by Boimau et al. (2018) also showed that low potential values in SP data can be used to identify underground river paths in the karst area of South Malang. Meanwhile, the IP method can map chargeability zones indicative of carbonate rock dissolution or water-saturated zones (Lubang et al., 2023; Yang et al., 2023).

Research conducted by Wahid et al. (2022) using the IP method at Sendang Biru Beach, Malang Regency, successfully identified zones with high chargeability, which are generally associated with cavities or fractures filled with water.

Although several studies using Hydrochemistry or geophysical methods have been conducted in the karst area of South Malang, the results have not provided a comprehensive picture because they have used only a single approach. Integrated research using Hydrochemistry, SP, and IP methods has never been conducted, especially in the South Malang region. Therefore, this study combines these three methods to analyse the relationship between carbonate dissolution processes and groundwater characteristics around Lo Cave and Bangi Cave. The integration of the results from these three methods provides a more comprehensive understanding of the dynamics of karst aquifers and a scientific basis for water resource management and geotourism development in the South Malang region, Indonesia.

MATERIALS AND METHODS

Study area

This research was conducted in the Gua Lo and Bangi areas, Kedungsalam Village, Donomulyo District, Malang Regency, East Java Province. Geographically, it is located at coordinates 112.426°–112.427° East Longitude and 8.342°–8.345° South Latitude. The research area is located in the Wonosari Formation (Figure 1), which comprises carbonate rocks such as coral limestone, clay limestone, tuff limestone, and sandy limestone (Faizal et al., 2025; Labib et al., 2019; Susanti et al., 2025). Based on the results of research conducted by Sholichin & Prayogo (2019), the subsurface conditions around the research location consist of layers of sand, mud, clay, tuff, limestone, and andesite, which determine the storage capacity and quality of groundwater in the South Malang area. The dissolution process in these carbonate rocks produces a complex karst system both on the surface and below the surface, including dolines, karst hills, and horizontal and vertical cave networks, which often contain underground spaces (Labib et al., 2019; Sahrina et al., 2022).

Geophysical Methods

The geophysical methods used in this study were SP and IP. These two methods complement each other in identifying groundwater flow patterns, conductive zones, and karst rock characteristics that can form cavities or fractures beneath the surface. Data collection was conducted using eight lines adapted to the field topography, with a line length of 180 meters and electrode spacing of 10 meters (Figure 2).

The dipole-dipole configuration used was a resistivity instrument manufactured by PASI SRL, Turin, Italy.

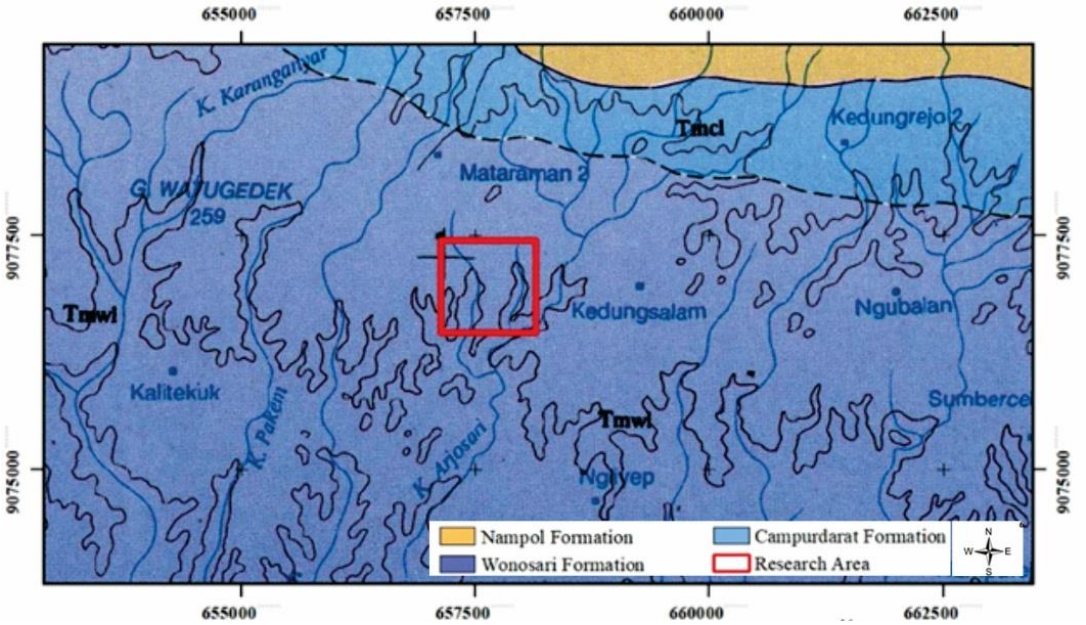


Figure 1. Geological map of the research area (Source: Developed by the authors, 2025)

SP measurements were conducted to detect natural potential variations arising from differences in electrokinetic gradients in the groundwater flow system. The obtained data were then processed using 2D inversion with a smoothness-constrained least-squares approach, and the results were plotted to display the distribution of potential contours.

The negative potential anomaly pattern was interpreted as a natural conduit or water-saturated zone, indicating the direction of underground river flow in the karst areas of Lo Cave and Bangi Cave. Meanwhile, the IP method was applied to analyse the electrical properties of subsurface rocks associated with cavities, fractures, and water-saturated zones.

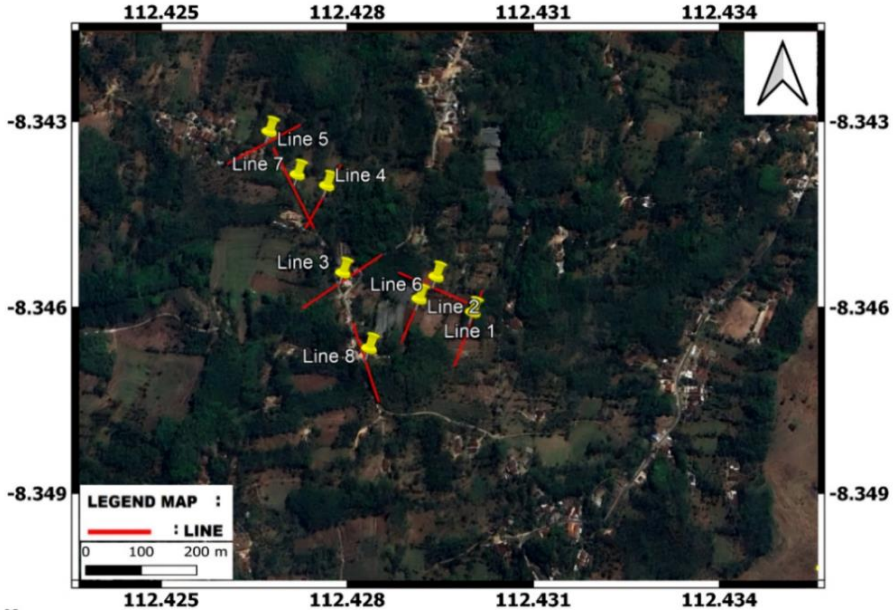


Figure 2. Research Location and Groundwater Sampling Points in the Lo Cave and Bangi Bangi Karst Areas, Kedungsalam Village, Malang Regency (Source: Developed by the authors, 2025)

Measurements were conducted in the time domain by injecting an electric current through a current electrode and observing the remaining potential difference after the current was turned off. The configuration used was a dipole-dipole with a resistivity meter. The main parameter analysed was chargeability. High chargeability values indicate a strong polarisation effect, which is generally associated with dissolved-carbonate rocks or groundwater-rich zones.

Hydrochemistry Method

Hydrochemistry methods were used to analyse the chemical characteristics of water reflecting the dissolution processes, flow dynamics, and aquifer types in the Lo Cave and Bangi Cave karst systems. Purposive sampling was used at strategic points, including the river flow within the caves and surface water sources around the Lo Cave and Bangi Cave areas (Figure 3).

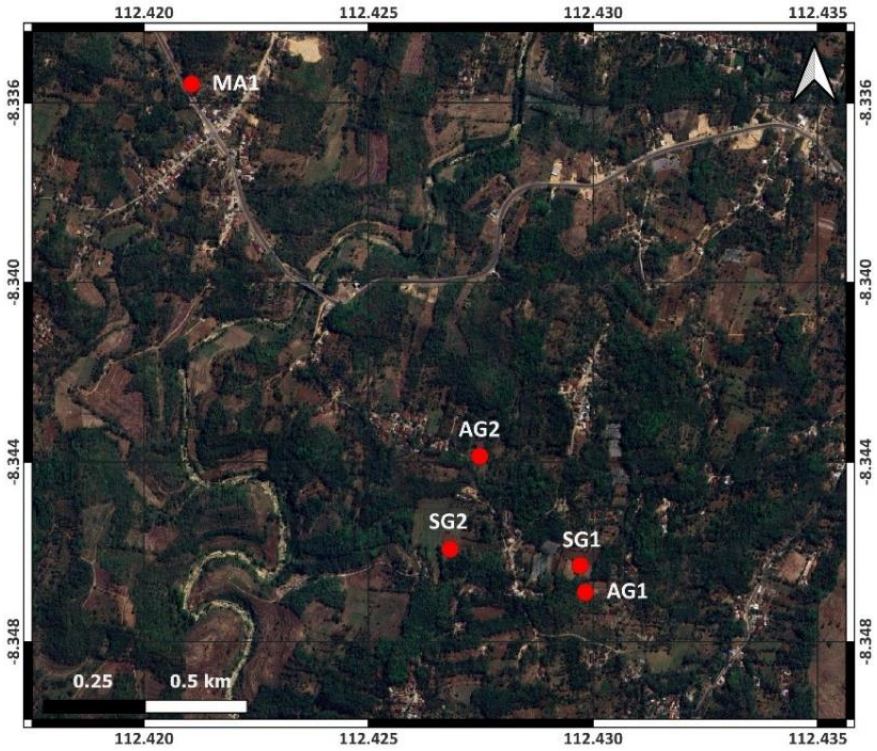


Figure 3. Groundwater Sampling Points in the Lo Cave and Bangi Cave Karst Areas, Kedungsalam Village, Malang Regency (Source: Developed by the authors, 2025)

The selection of chemical parameters was based on their relevance to the carbonate rock dissolution process and the possibility of external contributions, both from anthropogenic activities and seawater intrusion. The Hydrochemistry parameters analysed included the concentrations of major ions, namely calcium (Ca^{2+}), magnesium (Mg^{2+}), bicarbonate (HCO_3^-), sodium (Na^+), potassium (K^+), chloride (Cl^-), and total dissolved solids (TDS). The laboratory analysis data were then processed to determine the concentration of each ion and the total dissolved content. Ion balance analysis was performed on the main elements, namely Mg, Na, K, Ca, Cl, SO_4, CO_3, and HCO_3. Theoretically, the ion content of groundwater should be balanced between positive and negative ions (Atkinson, 2024; Lu et al., 2020; Megha et al., 2025; Sajil Kumar & James, 2019). This principle is the basis for hydrochemical evaluation by calculating the Charge Balance Error (CBE) of the main ion concentrations from laboratory analyses using Equation 1 (Domenico & Schwartz, 1997).

$$\text{CBE (\%)} = \frac{\sum \text{kation} - \sum \text{anion}}{\sum \text{kation} + \sum \text{anion}} \text{ x } 100 \qquad (1)$$

The calculation of the Charge Balance Error (CBE) is carried out by converting the ion concentration, both the ∑ cation component, which represents the total positively charged ions, and the ∑ anion component, which shows the total negatively charged ions, from milligrams per liter (mg/L) to milliequivalents per liter (meq/L).

The hydrochemical data are then plotted on a Piper diagram (Piper, 1944) to determine groundwater type and to interpret relationships among sources based on the dominance of their major cations and anions.

The geophysical interpretation results are integrated with hydrochemical analysis to provide a more complete picture of the subsurface structural characteristics, groundwater flow patterns, and geochemical processes controlling the aquifer system.

RESULTS

Results of the self potential method in the Lo Cave and Bangi Cave karst area

Figure 4 shows a contour map of SP anomalies in the Gua Lo and Gua Bangi karst areas. Negative potential values indicate conductive zones, while positive values characterize resistive zones. Negative SP anomalies, shown in blue to dark purple, are thought to represent groundwater flow pathways or active recharge zones. These zones are characterized by dissolution features, such as cracks, sinkholes, and epikarst development. SP values down to approximately -0.15 mV indicate high fluid movement intensity in the study area. The distribution of negative anomalies in the Lo Cave and Bangi Cave areas follows the morphological orientation of the karst hills, indicating that rainwater falling on the hilltops infiltrates and then flows through the fracture system to the lower zones. The presence of these negative anomalies also reflects ongoing speleogenesis, in which carbonate rock dissolution occurs continuously as water flows, carrying dissolved ions. The zone with strong negative anomalies in the central and southeastern parts of the map is thought to indicate an underground water channel connecting Lo Cave and Bangi Cave. The existence of this channel is not only crucial for understanding groundwater dynamics but also indicates ongoing active geological processes, such as carbonate rock dissolution and underground cavity formation. Meanwhile, positive SP anomalies, indicated by yellow to red colors (values

> 0.15 mV to > 0.75 mV) as more resistive areas, are thought to be related to relatively higher or drier topography that serves as a recharge area, as well as the presence of impermeable lithologies such as marl or carbonate mudstone.

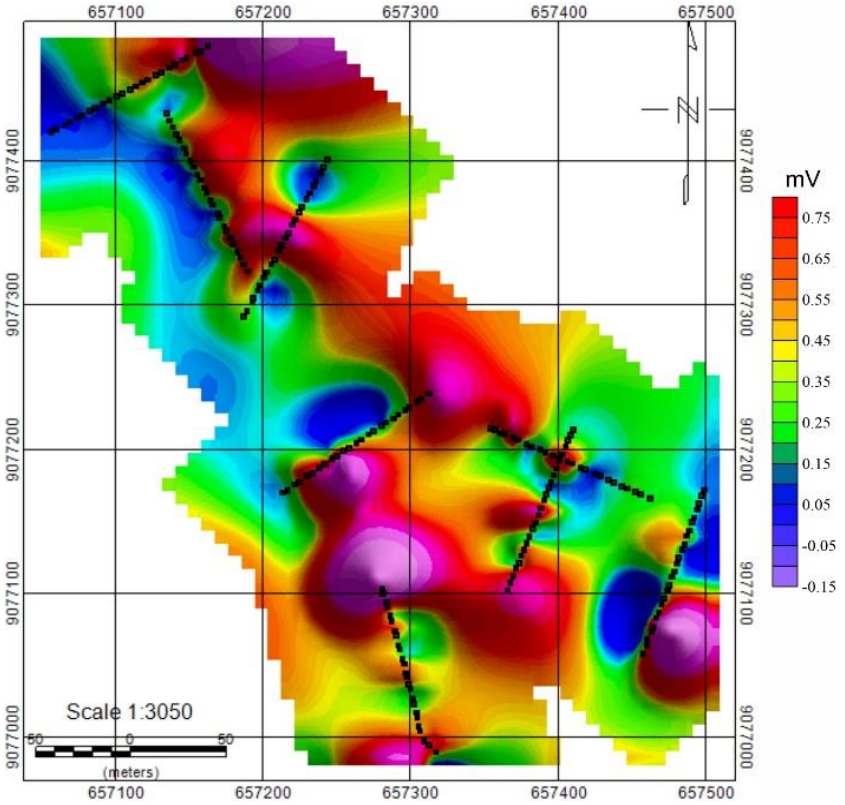


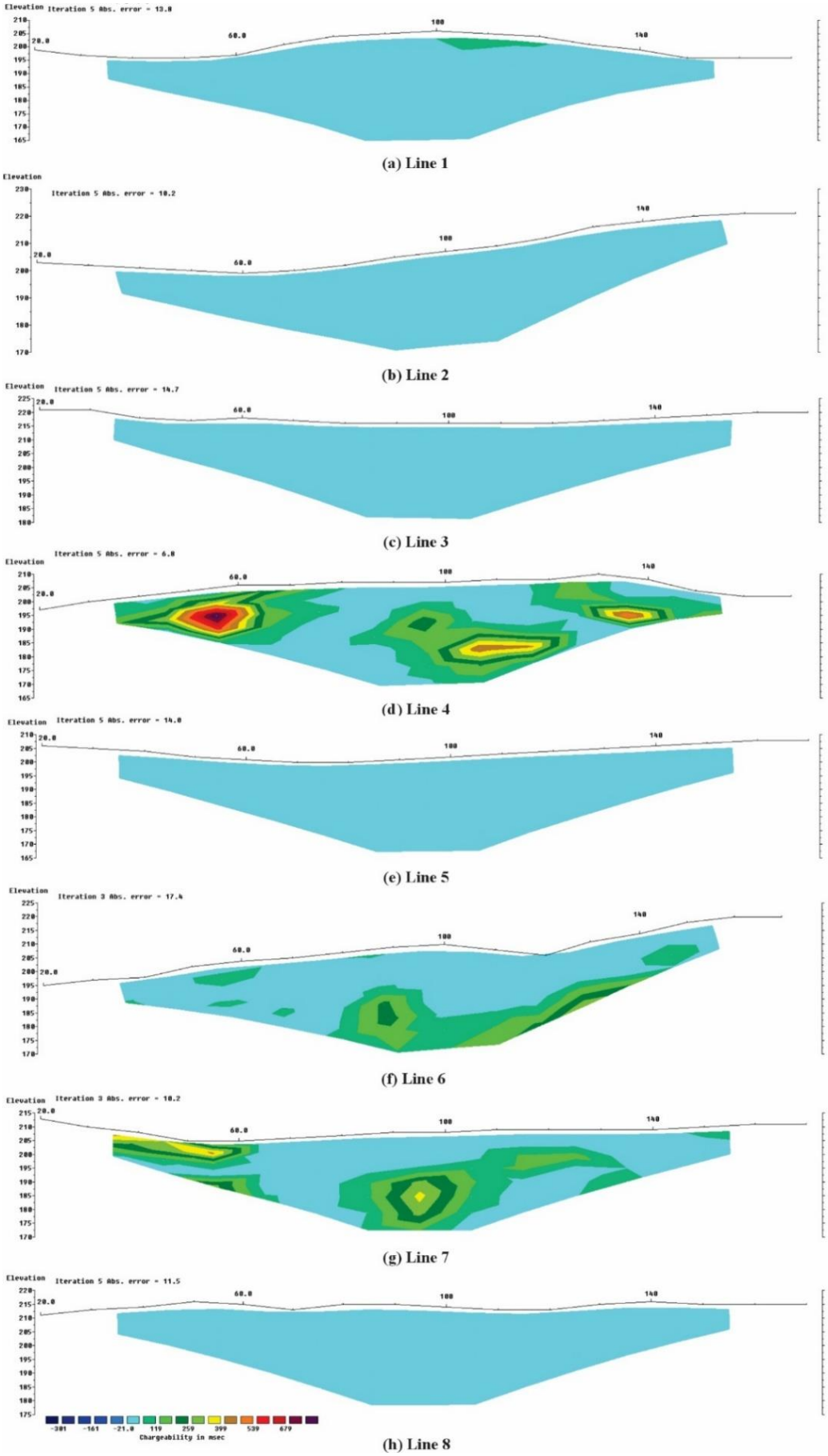
Figure 4. Contour map of Self Potential anomalies in the Lo Cave and Bangi Cave karst areas (Source: Developed by the authors, 2025)

Results of the induced polarization method in the Lo Cave and Bangi Cave karst areas

Figure 5 shows the results of 2D Induced Polarization modeling for eight lines (lines 1-8). The colors, from dark blue (low charge) to red (high charge), provide subsurface information on lithological conditions, dissolution rates, and the presence of conductive fluids. Line 1 (Figure 5a) shows a zone dominated by low to moderate values, with one green anomaly (~60-120 ms) at a depth of approximately 5-8 meters. The presence of moderately charged material is thought to be related to carbonate rocks that have undergone alteration or initial dissolution, which have not yet been filled with clay or water. This condition indicates the presence of shallow infiltration pathways (epikarst) that serve as initial channels for surface water movement into the subsurface. Based on field observations, a ponor serves as the primary entry point for surface water into the underground hydrological system at this location (Figure 6). The presence of this ponor is consistent with the IP anomaly in Line 1 and the SP pattern (Figure 4), both of which indicate active infiltration pathways.

Lines 2, 3, 5, and 8 (Figure 5) show low charge values (<40 ms) throughout most of the cross-section. This pattern indicates that these four lines are located within compact carbonate units with low dissolution rates. Therefore, these lines can be interpreted as part of a stable rock, as shown in the figure, or an anticline zone with little dissolution or fluid recharge at these depths. Line 4 (Figure 5d) shows a very prominent chargeability anomaly, characterized by a red to purple zone (>300 ms) on the left side of the cross-section. This zone indicates the presence of water-filled karst cavities or residual clay deposits trapped within dissolution channels. This high-value anomaly suggests intense hydrogeological activity, with fluid flow focused in the area. This pattern is consistent with SP results at the exact location, which identified laterally elongated underground flow paths. Thus, Line 4 can be considered the area with the most active karst aquifer dynamics in the study area. Line 4 (Figure 5d) shows the presence of a red to purple zone (>300 ms) on the left side of the line, indicating the presence of water-filled karst cavities or residual clay deposits trapped within dissolution channels. This anomaly indicates hydrogeological activity with focused fluid flow in the area. This pattern is consistent with SP results at the same location, which identified laterally extending underground flow paths. Lines 6 and 7 (Figures 5f and 5g) show several zones with moderate to high chargeability values at intermediate depths. Zones with chargeability values of 120–180 ms indicate the presence of cavities or conductive materials such as clay, and are surrounded by weathered carbonate rocks. Anomalies on both lines indicate isolated zones, characteristic of tropical karst systems in massive carbonate rocks. This pattern is consistent across Lines 6 and 7 and also suggests possible connectivity between cavities around Bangi Cave.

IP modeling results for lines 2, 3, 5, and 8 indicate resistive zones with low chargeability values, representing compact carbonate rocks with minimal dissolution activity. In contrast, Lines 4, 6, and 7 have zones with high chargeability values, indicating areas of intense dissolution, water-filled karst cavities, and accumulation of conductive materials. Overall, this pattern demonstrates subsurface heterogeneity in the Lo Cave and Bangi Cave karst systems.



(a) Line 1

(b) Line 2

(c) Line 3

(d) Line 4

(e) Line 5

(f) Line 6

(g) Line 7

(h) Line 8

Figure 5. 2D induced polarization modeling (line 1–8) showing variations in chargeability values in the Lo Cave and Bangi Cave karst areas (Source: Authors, 2025)



Figure 6. Location of active ponor as surface water entry point to the karst system
(Source: Authors field survey, Kedungsalam Village, September 27–28, 2025)

Hydrochemistry facies analysis based on the Piper diagram

The results of groundwater sample analysis around Lo Cave and Bangi Cave show variations in the concentrations of major ions and differences in chemical characteristics between locations (Table 1). Sodium (Na) concentrations ranged from 9.87 to 21.83 meq/L, with the highest value in SG2 and the lowest in AG1. Potassium (K) content was relatively low in all samples, ranging from 0.13 to 0.23 meq/L. Calcium (Ca) was approximately between 1.25 and 1.79 meq/L, while magnesium (Mg) ranged from 0.54 to 1.34 meq/L. Bicarbonate (HCO_3^-) ranged from 1.53 to 2.74 meq/L, with the highest value in SG2 and the lowest in MA1. Chloride (Cl^-) content is very low, namely 0.0045–0.0062 meq/L, while sulfate (SO_4^{2-}) is between 0.62–0.85 meq/L, with the highest value in MA1. The pH value shows neutral to slightly alkaline conditions (6.8–7.8). Total dissolved solids (TDS) with values between 31–63 meq/L, with the highest value in MA1 and the lowest in AG2. In general, the analysis results show that groundwater in the study area has low mineralization, with Na^+, Ca^{2+}, and HCO_3^- ions dominating the hydrochemical system. The Charge Balance Error (CBE) for the 5 groundwater samples analyzed is below 10%, indicating that all samples are valid and can be used in further analysis.

Table 1. Physical and chemical parameters of groundwater in the Lo Cave and Bangi
Cave karst systems, Kedungsalam Village, Donomulyo District, Malang Regency (Source: Authors, 2025)

Sampel	Na (meq/L)	K (meq/L)	Ca (meq/L)	Mg (meq/L)	HCO3 (meq/L)	Cl (meq/L)	SO4 (meq/L)	pH	TDS
SG-1	14.33	0.21	1.79	0.80	2.42	0.0045	0.62	7.8	37
AG 1	9.87	0.13	1.60	1.07	2.47	0.0045	0.77	7.2	43
AG 2	12.26	0.20	1.25	0.81	2.25	0.0054	0.69	6.8	31
SG 2	21.83	0.15	1.29	1.34	2.74	0.0054	0.62	7.8	47
MA 1	12.89	0.23	1.32	0.54	1.53	0.0062	0.85	7.5	63

Figure 7 shows the hydrogeochemical facies classification using the Piper Diagram for five water samples around Lo Cave and Bangi Cave (SG1, SG2, AG1, AG2, MA1). In the cation triangle, all points are clustered in the area of relative Na^++K^+ dominance, with significant contributions from Ca^{2+} and Mg^{2+}. This pattern indicates a mixture of carbonate dissolution and ion exchange processes in the shallow aquifer. SG1, SG2, AG1, and AG2 occupy almost identical positions, suggesting that they originated from the same flow system. MA1 is slightly shifted towards Ca-Mg, which may reflect a longer water residence time and more intense water-rock interactions. The dominance of HCO_3^-+CO_3^{2-} across all samples is characteristic of limestone dissolution in tropical karst systems. MA1 is slightly shifted from the central cluster but remains within the HCO_3 domain, indicating no significant SO_4^{2-} or Cl^- presence.

This suggests that carbonation reactions are the primary chemical process controlling groundwater composition, despite the influence of surface water. Cave waters (AG1 and AG2) and well waters (SG1 and SG2) remain within the same cluster, reinforcing the interpretation that the karst system has high surface-subsurface connectivity. The combined dominance of Na^++K^+ (cation) and HCO_3^- (anion) maps all samples to the Na-HCO_3 zone in the centre of the diamond, indicating that all samples originate from the same hydrogeological system. The similarity of facies between the wells, cave waters, and springs suggests that the karst system in this area is hydrologically connected. Water flows through fractures and dissolution channels, resulting in similar chemical characteristics across all samples. None of the samples exhibited significant evaporite influence, seawater intrusion, or anthropogenic contamination. This consistent pattern aligns with the results of geophysical modelling (SP and IP), which identified a network of subsurface cavities and channels still actively conducting water.

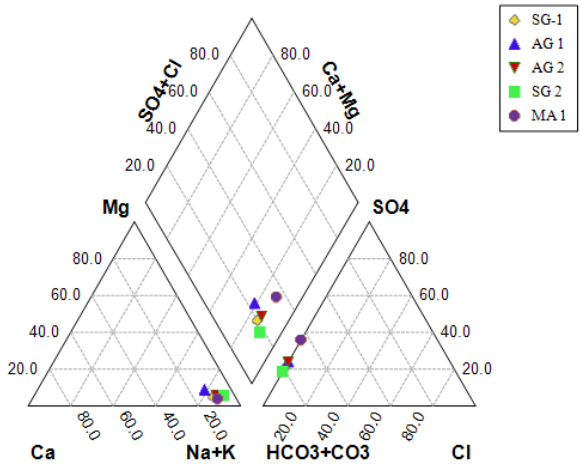


Figure 7. Piper diagram for hydrochemistry facies classification of groundwater around Lo Cave and Bangi Cave (Source: Authors, 2025)

DISCUSSION

The integrated SP, IP, and Hydrochemistry methods indicate that the karst aquifers around Lo Cave and Bangi Cave are connected. Hydrochemistry data confirm that the system is dominated by carbonate dissolution, producing $CaMgHCO_3$ water with low mineralization (TDS 31–63 meq/L) and a neutral to alkaline pH. According to the Piper diagram (Figure 7), the concentration of major ions and the position of all samples within the Na–HCO3 facies indicate that the groundwater is still in its natural state. The similarity in chemical properties of the well, cave water, and spring samples indicates that interconnected flow paths supply all of these locations. These conditions indicate rapid infiltration and short water residence times, characteristic of tropical karst aquifers. This interpretation is consistent with research by Hoaghia et al. (2021), Liu et al. (2022), and Gao et al. (2023), which states that young karst systems are generally controlled by the dissolution of calcite and dolomite, resulting in a dominance of Ca^{2+}–Mg^{2+}–HCO_3^- ions. At this study site, the very low Cl^- and SO_4^{2-} contents confirm the absence of saltwater intrusion, despite the area's coastal location.

This indicates that the coastal karst aquifer in South Malang remains Hydrochemistryly stable and has not been affected by external factors such as marine intrusion or anthropogenic activity. From the geophysical results, the elongated negative SP anomaly indicates an active underground flow path that serves as the main conduit for the karst system. This finding is reinforced by the high chargeability zones (>300 ms) in the IP results on Tracks 4, 6, and 7, which indicate the presence of water-filled cavities and fractures. The agreement between SP and IP patterns, and the uniform Hydrochemistry results, demonstrates that fluid flow through a network of interconnected dissolution channels results in the homogenization of water's chemical properties. This relationship aligns with the classical speleogenesis model, which explains that the development of karst conduits is controlled by the flow of calcium and bicarbonate-rich water (Ford & Williams, 2007).

One important finding is the high Na^+ concentration in SG2 and the highest TDS value in MA1. These small variations may result from localized flow with longer residence times or from interactions with non-carbonate lithologies surrounding the spring. The absence of elevated Cl- or SO42- concentrations suggests that these variations are caused by natural processes within the aquifer system rather than human contamination or seawater intrusion. Microscale ion exchange, common in shallow karst aquifers connected to residual clays, is another possibility. With good water quality and low contaminant levels, it is likely suitable for domestic use. However, open fractures in the aquifer make it vulnerable to land-use changes and to the intrusion of pollutants. The integration of geochemical and geophysical data provides new insights into the hydrogeological structure of karst that cannot be obtained from either method alone. The uniformity of Hydrochemistry facies in wells, cave water, and springs, in line with SP and IP results showing interconnected subsurface flow pathways, suggests that the Lo Cave and Bangi Cave aquifers form a single hydrogeological system.

Overall, this study improves our understanding of carbonate dissolution mechanisms and subsurface flow patterns in coastal tropical karst and provides a scientific basis for water resources management, mitigation of potential geological hazards, and sustainable geotourism development in the Gua Lo and Gua Bangi areas.

CONCLUSION

Based on SP, IP, and hydrochemical analysis data, it is known that the karst aquifer system in Gua Lo and Gua Bangi is influenced by carbonate dissolution processes and subsurface connectivity, with a Ca-Mg-HCO_3 facies and low mineralization, suggesting that the groundwater originates from a natural system relatively unaffected by marine intrusion or anthropogenic activity. Similarities in primary ion composition in dug wells, cave water, and springs indicate a single, connected flow system with rapid infiltration and short water residence times. The elongated negative SP anomaly and high-charge zone in the IP confirm the presence of an active underground river network.

While this study provides information that can inform geotourism planning and development in Gua Lo and Gua Bangi, it still has several limitations. The number of hydrochemical samples was limited, and data were collected only during one season. From a geophysical perspective, the limited number of lines does not provide extensive subsurface spatial information. Therefore, further research is needed, including geophysical surveys, such as ERT, to improve the resolution

in detecting subsurface cavities and fractures. In addition, to determine the response of karst systems to seasonal changes and anthropogenic influences, long-term hydrochemical and hydrological monitoring is required.

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Use of Generative AI: Not applicable.

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THE ROLE OF DIGITAL LEADERSHIP IN SHAPING EMPLOYEES' DIGITAL MINDSET, AGILITY, AND ADAPTIVE PERFORMANCE IN HOTEL ENTERPRISES

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Abstract: The rapid digital transformation of the hospitality industry has intensified the need for leadership approaches that foster employees' adaptability and digital capabilities. In digitally intensive hotel environments, employees must continuously adjust their behaviors, adopt new technologies, and respond to evolving service demands. Drawing on Social Cognitive Theory (SCT), this study examines how digital leadership influences employees' adaptive performance by shaping two key mechanisms: digital mindset and digital agility. Specifically, the study aims to investigate the direct effects of digital leadership on adaptive performance, digital mindset, and digital agility, as well as the mediating roles of digital mindset and digital agility in the relationship between digital leadership and adaptive performance. Data were collected from 428 full-time employees working in five-star hotels in Egypt. The study employed a structured questionnaire using previously validated measurement scales. The proposed research model was tested using Partial Least Squares Structural Equation Modeling (PLS-SEM) with WarpPLS software to evaluate both measurement and structural relationships among the constructs. The findings reveal that digital leadership has significant positive effects on employees' adaptive performance, digital mindset, and digital agility. Furthermore, both digital mindset and digital agility positively influence adaptive performance. Mediation analysis indicates that digital mindset and digital agility partially mediate the relationship between digital leadership and adaptive performance, suggesting that digital leaders enhance employee adaptability not only directly but also by cultivating cognitive openness to digital technologies and the capability to respond quickly to technological change. These findings highlight the critical role of digital leadership in developing a digitally agile workforce capable of sustaining performance in rapidly evolving hospitality environments.

Keywords: digital leadership, digital mindset, digital agility, adaptive performance, hotel enterprises

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INTRODUCTION

The rapid digitalization of the tourism and hospitality industry has fundamentally reshaped how hotel enterprises operate, compete, and deliver value (Al-Romeedy, 2026; Salama et al., 2025; Zeqiri, 2024). Advances in digital platforms, data-driven decision-making, and service automation have intensified environmental uncertainty while simultaneously raising expectations for responsiveness, personalization, and operational flexibility (Ghobakhloo et al., 2026). Within this evolving landscape, leadership has emerged as a decisive factor in determining whether digital technologies function merely as operational tools or as catalysts for sustained organizational adaptability (Khairy et al., 2026; Razzak et al., 2025). Digital leadership, in particular, has gained prominence as a form of leadership that transcends technical oversight by actively shaping how individuals perceive, interpret, and respond to digital transformation initiatives (Salih, 2024).

In hotel enterprises, where service encounters are dynamic and customer demands fluctuate continuously, adaptive performance has become a critical indicator of organizational effectiveness (Khairy & Salama, 2026; Elshaer & Saad, 2022). Employees are increasingly required to adjust their behaviors, learn new digital routines, and respond constructively to unexpected challenges (Hasanein & Metwally, 2025; Al-Shyyab et al., 2026). Digital leaders play a pivotal role in this process by establishing norms, role-modelling digital behaviors, and fostering environments that encourage experimentation and continuous learning (Zhu et al., 2025). Through these mechanisms, digital leadership is expected to exert a direct influence on employees' adaptive performance, while also shaping the psychological and behavioral foundations that enable adaptation in digitally intensive work settings (Salih, 2024; Ayad & Hasanein, 2025).

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Beyond its direct influence on performance outcomes, digital leadership is instrumental in cultivating employees' digital mindset and digital agility (Pandey et al., 2023; Shen et al., 2025). A digital mindset reflects an individual's cognitive orientation toward digital technologies, encompassing openness to change, confidence in using digital tools, and a positive evaluation of technology-enabled work practices (Goldmann et al., 2025). Digital agility, in contrast, represents the behavioral manifestation of this mindset, capturing employees' capacity to rapidly apply digital knowledge, adjust work processes, and respond effectively to evolving technological demands (Goraya et al., 2026). Leaders who actively support digital learning, communicate a compelling digital vision, and legitimize adaptive experimentation are likely to strengthen both the cognitive readiness and the behavioral flexibility of their employees (Shahzad, 2024). The link between digital mindset, digital agility, and adaptive performance is particularly salient in hospitality contexts characterized by real-time service delivery and high levels of interpersonal interaction (Seraj et al., 2025; Li et al., 2024). Employees who possess a strong digital mindset are more inclined to interpret technological change as an opportunity rather than a disruption, which enhances their willingness to engage in adaptive behaviors (Solberg et al., 2020). When this mindset is coupled with digital agility, employees are better equipped to translate cognitive readiness into effective action, allowing them to modify routines, integrate new digital tools, and maintain service quality under changing conditions (Aldhi et al., 2025). Adaptive performance, therefore, emerges not as a spontaneous outcome, but as the result of an underlying cognitive–behavioral process shaped by leadership and enacted through digital capabilities (Jundt & Shoss, 2023). This study is theoretically anchored in Social Cognitive Theory, which emphasizes the reciprocal interaction between environmental influences, cognitive processes, and behavioral capabilities in shaping individual performance (Schunk & DiBenedetto, 2020). From this perspective, digital leadership constitutes a salient environmental stimulus that signals expected behaviors and acceptable norms within the organization (Salih, 2024).

Employees internalize these signals through the development of a digital mindset, which influences their self-efficacy, expectations, and interpretations of digital work demands (Liu & Kamioka, 2025). Digital agility, in turn, represents the behavioral capability through which cognitive orientations are enacted, ultimately enabling adaptive performance (Seraj et al., 2025). By adopting this lens, the study moves beyond deterministic views of technology adoption and highlights the human-centered mechanisms through which leadership drives adaptation in digital service environments.

Despite the growing scholarly attention to digital leadership within tourism and hospitality research, several important gaps remain in understanding how leadership-driven digital transformation translates into employees' adaptive behaviors. Previous studies have primarily examined digital leadership in relation to general innovation outcomes, organizational performance indicators, or technological adoption, often overlooking adaptive performance as a dynamic capability that reflects employees' ability to adjust behaviors, learn new approaches, and respond effectively to continuous technological change (Razzak et al., 2025; Palmucci et al., 2025). In service-intensive sectors such as hospitality, where operational environments are highly dynamic and customer expectations evolve rapidly, adaptive performance represents a critical dimension of organizational effectiveness that has received relatively limited attention in digital leadership research. A second limitation concerns the level of analysis adopted in prior studies. Much of the existing literature conceptualizes digital capabilities as organizational resources or technological infrastructures, emphasizing firm-level digital transformation while providing limited explanation of the individual-level mechanisms through which employees interpret leadership signals and translate them into adaptive behaviors (e.g., Held et al., 2025). This perspective leaves insufficient understanding of the cognitive and behavioral processes that shape how employees respond to digitally oriented leadership in daily work settings. Third, although concepts such as digital mindset and digital agility have emerged as important elements in contemporary digital transformation literature, these constructs have often been examined separately and rarely integrated within a unified theoretical framework that explains their mediating roles between leadership and employee outcomes. In particular, little empirical research has investigated how digital leadership fosters employees' digital mindset and agility, and how these factors subsequently enhance adaptive performance within hospitality organizations, where continuous learning, rapid problem-solving, and behavioral flexibility are essential for service delivery. To date, no empirical study has simultaneously examined how digital leadership shapes adaptive performance through both cognitive and behavioral mechanisms within a unified Social Cognitive Theory framework in hotel enterprises.

These gaps highlight the need for a more comprehensive framework that explains not only whether digital leadership influences employee performance, but also how and through which psychological and behavioral mechanisms such influence occurs. Addressing these limitations, the present study adopts Social Cognitive Theory as a theoretical lens to explain how leadership shapes employees' cognitive orientations and behavioral capabilities in digital work environments. Accordingly, the study pursues three main objectives. First, it examines the direct influence of digital leadership on adaptive performance, digital mindset, and digital agility within hotel enterprises. Second, it investigates the effects of digital mindset and digital agility on employees' adaptive performance. Third, it explores the mediating roles of digital mindset and digital agility in explaining how digital leadership translates into adaptive performance, thereby illuminating the cognitive–behavioral pathways through which leadership influences employee adaptability.

This study makes several theoretical and practical contributions. Theoretically, it extends the digital leadership literature by positioning adaptive performance as a key outcome of leadership-driven digital transformation in hospitality organizations. By integrating digital mindset and digital agility within a social cognitive framework, the study provides a deeper understanding of the micro-level mechanisms through which leadership influence is translated into adaptive employee behaviors. Empirically, the research contributes evidence from hotel enterprises, a context that remains relatively underexplored in digital leadership research despite its strong dependence on human adaptability and service innovation. Practically, the findings offer valuable insights for hotel managers and hospitality organizations by emphasizing the importance of cultivating employees' digital mindset and agility, rather than relying solely on technological investments, as essential drivers of adaptive performance in increasingly digitalized service environments.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Digital leadership and adaptive performance

Adaptive performance has become increasingly important in digitally intensive hotel environments where employees must continuously adjust their behaviors, learn new digital practices, and respond to evolving service demands (Goraya et al., 2026; Huu, 2023). In such contexts, leadership plays a critical role in shaping how employees interpret and respond to technological change (Yin & Hoang, 2026). Digital leaders guide employees through digital transformation by clarifying expectations, modelling adaptive behaviors, and encouraging experimentation with digital tools (Imran et al., 2021; Chen & Zhao, 2024). From the perspective of Social Cognitive Theory, leadership behaviors function as environmental cues that influence how employees regulate their actions and respond to new challenges (Schunk & DiBenedetto, 2020). When leaders reinforce flexibility, learning, and proactive problem-solving, employees are more likely to adjust their work practices and develop stronger adaptive responses to changing service conditions (Breit et al., 2021; Razzak et al., 2025). Accordingly, digital leadership is expected to strengthen employees' adaptive performance in digitally evolving hotel enterprises. Accordingly, the following hypothesis is proposed:

H1: Digital leadership positively influences employees' adaptive performance.

Digital leadership and digital mindset

Employees' digital mindset reflects their cognitive orientation toward digital technologies, including their openness to technological change and confidence in using digital tools (Hamouche et al., 2026). The development of this mindset is strongly influenced by leadership signals that shape how employees interpret digital transformation within the organization. Digital leaders communicate the strategic importance of digitalization, demonstrate engagement with digital tools, and encourage employees to explore new technological solutions (Shahzad, 2024; Chowdhury, 2025). Within a social cognitive perspective, such leadership behaviors influence employees' beliefs, expectations, and perceived capabilities in digital work environments (Albannai et al., 2025). As employees observe and internalize these signals, they become more likely to view digital technologies as opportunities for learning and innovation rather than sources of uncertainty (Seraj et al., 2025). Consequently, digital leadership is expected to foster the development of employees' digital mindset. Based on this reasoning, the following hypothesis is advanced:

H2: Digital leadership positively influences employees' digital mindset.

Digital leadership and digital agility

Digital agility refers to employees' ability to respond quickly and effectively to technological changes by adapting digital work processes and service routines (Varshney, 2020). In hotel enterprises characterized by dynamic service environments, such agility enables employees to adjust digital tools and processes while maintaining service quality (Busulwa, 2020). Digital leadership contributes to the development of this capability by fostering work environments that support flexibility, decentralized decision-making, and experimentation with digital solutions (Zia et al., 2025; Wenten, 2025). According to Social Cognitive Theory, leadership behaviors influence employees' behavioral capabilities by shaping opportunities for action and reinforcing adaptive responses (Schunk & DiBenedetto, 2020). When leaders encourage initiative and support real-time problem solving, employees become more confident in modifying digital practices and responding effectively to changing operational demands (Busse & Weidner, 2020; Razzak et al., 2025). Therefore, digital leadership is expected to enhance employees' digital agility. Accordingly, the following hypothesis is proposed:

H3: Digital leadership positively influences employees' digital agility.

Digital mindset and adaptive performance

Employees' ability to perform adaptively in hotel settings is closely tied to how they interpret and mentally engage with digital change (Hasanein et al., 2026). When employees approach technology with curiosity rather than resistance, and with confidence rather than apprehension, they are better positioned to adjust their behavior as work demands evolve (Khanfar et al., 2026). A digital mindset shapes this interpretive process by influencing how employees evaluate new tools, assess situational challenges, and decide whether adaptation is necessary or worthwhile (Neeley & Leonardi, 2022). In practice, employees who possess a strong digital mindset tend to view unexpected service situations as manageable rather than disruptive. This orientation encourages proactive learning, experimentation, and cognitive flexibility, all of which are essential for modifying work practices in real time (Solberg et al., 2020; Smith & Beretta, 2021). Rather than relying on established routines, such employees are more inclined to reconsider existing approaches and identify digitally enabled alternatives that align with changing operational requirements (Salmela et al., 2022; Baiyere et al., 2020). Over time, this pattern of thinking translates into consistent adaptive performance. Employees who remain mentally receptive to digital innovation are more likely to recalibrate their responses, acquire new competencies, and maintain effectiveness under shifting conditions (Li & Long, 2025; Manroop et al., 2025). In dynamic hospitality environments, where adaptability is a continuous expectation rather than an occasional requirement, a digital mindset functions as a key psychological driver of sustained adaptive behavior (Meng et al., 2025; Al-Romeedy, 2026). Based on these arguments, the following hypothesis is proposed:

H4: Digital mindset positively influences employees' adaptive performance.

Digital agility and adaptive performance

Adaptive performance in hotel enterprises is ultimately realized through employees' capacity to adjust their actions as conditions change (Luo et al., 2021). While cognitive openness toward digital tools provides a foundation for adaptation, effective performance under dynamic circumstances depends on employees' ability to translate understanding into timely and

appropriate action (Jasim et al., 2024). Digital agility captures this action-oriented capability by reflecting how quickly and effectively employees can modify digital work processes, reconfigure tools, and respond to situational demands (Wiraeus & Creelman, 2019). Employees who demonstrate high levels of digital agility are better equipped to cope with operational disruptions, technology updates, and shifting service expectations. They can navigate multiple digital systems simultaneously, adjust service delivery methods on the spot, and implement alternative solutions when standard procedures become insufficient (Goraya et al., 2026; Kirjavainen & Jalonen, 2025). This behavioral flexibility allows them to maintain performance continuity even when faced with uncertainty, making adaptability an operational outcome rather than a reactive response (Karman, 2020). As digital work becomes increasingly embedded in hotel operations, agile behavior enables employees to sustain effectiveness across diverse and unpredictable service scenarios (Liu, 2025). The capacity to act swiftly, recalibrate workflows, and integrate digital resources as situations unfold enhances employees' ability to meet performance expectations under changing conditions (Omachi & Ajewumi, 2024). Consequently, digital agility serves as a critical driver of adaptive performance in digitally enabled hospitality environments. Accordingly, the following hypothesis is proposed:

H5: Digital agility positively influences employees' adaptive performance.

The mediation role of digital mindset

The influence of digital leadership on adaptive performance is unlikely to operate as an immediate or automatic effect, particularly in complex hotel environments where employees must interpret change before acting upon it (Jasim et al., 2024). Leadership initiatives related to digital transformation are first processed cognitively, as employees assess their relevance, feasibility, and implications for daily work (Trenerry et al., 2021). This interpretive stage plays a decisive role in determining whether leadership signals translate into adaptive behavior or remain superficial directives with limited behavioral impact (Enang et al., 2025; Al-Romeedy, 2026). Digital mindset represents the cognitive mechanism through which leadership influence is filtered and internalized. When digital leaders consistently frame technology as an enabler of effectiveness and professional growth, employees are more likely to develop a mindset that supports experimentation, learning, and flexibility (Shen et al., 2025; Brunner et al., 2023). This cognitive orientation shapes how employees perceive uncertainty, evaluate new digital demands, and decide whether to engage in adaptive responses (Yadav & Dhar, 2025). Without such a mindset, leadership-driven digital initiatives may fail to alter behavior, as employees may comply superficially while resisting deeper adaptation (Salih, 2024; Khairy et al., 2025). As employees' digital mindset strengthens, adaptive performance becomes more sustainable and self-reinforcing. A cognitively receptive orientation toward digital change allows employees to recalibrate their behavior proactively, learn from digitally mediated experiences, and respond constructively to evolving service conditions (Seraj et al., 2025). In this sense, digital mindset functions as the internal conduit through which digital leadership exerts its influence on adaptive performance, transforming external leadership cues into meaningful behavioral outcomes (Shen et al., 2025; Razzak et al., 2025). Accordingly, the following hypothesis is proposed:

H6: Digital mindset mediates the relationship between digital leadership and adaptive performance.

The mediation role of digital agility

In digitally enabled hotel operations, leadership influence becomes consequential only when employees can execute change under time pressure and service variability (Brunner et al., 2023). Digital leadership may introduce new systems, redefine workflows, or raise expectations for technology-mediated service delivery, yet these signals do not improve adaptive performance unless employees can respond with fast, situationally appropriate adjustments (Al-Romeedy, 2024). The practical bottleneck is rarely the strategic intent; it is the employee's ability to reconfigure digital work while the service is still unfolding (Salih, 2024). Digital agility offers that execution capacity. It is reflected in how employees switch between platforms, improvise alternatives when a system fails, adjust procedures to match updated digital requirements, and keep the guest experience stable while internal routines are being recalibrated (Salmela et al., 2022; Busulwa, 2020). When digital leaders grant discretion, remove procedural friction, and reinforce rapid problem resolution, employees are more likely to develop the kind of digitally fluent responsiveness that turns managerial direction into real-time adaptive behavior (Kupiek, 2021). Under these conditions, the effect of digital leadership on adaptive performance is expected to be transmitted through employees' digital agility. Leadership shapes the readiness to act; agility determines whether that action is feasible at the moment it is needed (Jasim et al., 2024; Wenten, 2025). Accordingly, the following hypothesis is proposed:

H7: Digital agility mediates the relationship between digital leadership and adaptive performance.

The theoretical framework of the study is illustrated below in Figure 1.

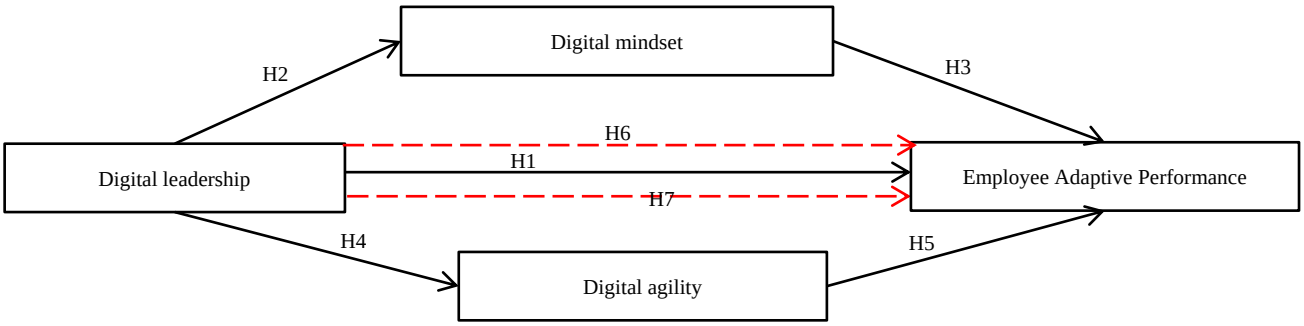


Figure 1. The theoretical framework of the study

METHODOLOGY

Survey Instrument and Measures

This study employed a structured questionnaire divided into two sections. The first section assessed the study's latent constructs using 42 measurement items (see Appendix A), while the second section collected demographic information, including gender, age, and educational attainment. All constructs were measured using previously validated scales adapted from the literature.

- Digital Leadership: Evaluated using a 7-item scale adapted from Claassen et al. (2021).
- Employee Adaptive Performance (EAP): Measured with ten items adapted from Hartline & Ferrell (1996).
- Digital Agility: Assessed via a 10-item scale adapted from Srivastava et al. (2023).
- Digital Mindset (DM): Captured using a 15-item scale derived from Valta et al. (2024).

All items employed a five-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree"). To ensure linguistic accuracy and conceptual equivalence, the questionnaire underwent a rigorous back-translation process. Additionally, academic scholars and hotel industry practitioners reviewed the instrument to confirm clarity, cultural relevance, and practical applicability prior to data collection.

Sampling and Data Collection

The study targeted full-time employees in five-star hotels located in Greater Cairo, Egypt. A judgmental sampling approach identified suitable hotels, while convenience sampling was used to select individual participants. This strategy was deemed appropriate given practical constraints, including access, time, and organizational approvals.

Data collection was conducted on-site following formal approval from hotel management and HR departments. Participation was voluntary, and respondents were informed of the study's objectives. Confidentiality and anonymity were emphasized to encourage candid responses, and all data were reported in aggregated form. A total of 600 questionnaires were distributed, with 428 returned and deemed usable, yielding a response rate of 71.3%. According to Hair et al. (2010), who recommend a minimum of 10 respondents per observed variable, the required sample size for 42 measurement items was 420, indicating that the final sample was sufficient for statistical analysis. Only employees with at least one year of work experience were included to ensure familiarity with organizational processes and culture (Morrison, 1993).

Analytical Strategy

Data were analyzed using Partial Least Squares Structural Equation Modelling (PLS-SEM) via WarpPLS version 8.0 (Kock, 2021). PLS-SEM is a robust multivariate technique suitable for testing complex models with multiple latent constructs, particularly when data may deviate from normality and sample sizes are small to medium (Hair et al., 2017; Ali et al., 2018).

The analysis proceeded in two stages:

1. Measurement model assessment – evaluated construct reliability, convergent validity, and discriminant validity.
2. Structural model assessment – tested the hypothesized relationships among the variables. This two-stage approach ensured both the robustness and validity of the results while accommodating exploratory and confirmatory objectives.

Assessment of Common Method Bias

Potential common method variance (CMV) was addressed using both procedural and statistical remedies. Procedurally, participants were assured of confidentiality and anonymity to minimize social desirability bias. Additionally, items measuring independent, mediating, and dependent variables were placed in separate sections of the questionnaire to reduce context and priming effects. Statistical analyses confirmed the absence of significant CMV. Harman's single-factor test indicated that no single factor accounted for more than 50% of the total variance. Moreover, Variance Inflation Factor (VIF) values for all constructs were below 3.3 (Table 2), further supporting the conclusion that CMV was unlikely to affect the study's findings.

RESULTS

Participants' profile

Table 1 presents the demographic characteristics of the 428 hotel employees who participated in the study. In terms of gender, the sample is predominantly male, with 264 respondents (61.68%), while females account for 164 participants (38.32%). This indicates a higher representation of male employees within the surveyed hotels.

Table 1. Participant's profile (N=428 hotel employees)

Demographics	Category	Frequency	Percent
Gender	Male	264	61.68
	Female	164	38.32
Age	18< 30 years	184	4.28
	30:<45 years	174	40.65
	45:60 years	70	16.36
Education	High school or below	84	19.63
	Undergraduate degree	282	65.89
	Postgraduate degree or above	62	14.49

Regarding age distribution, most participants fall within the 18 to below 30 years and 30 to below 45 years categories, with 184 (43.0%) and 174 (40.65%) respondents respectively, showing that the workforce is largely composed of young to

middle-aged adults. A smaller proportion of employees, 70 individuals (16.36%), are aged between 45 and 60 years, suggesting fewer older employees in the sample. With respect to educational attainment, the majority of respondents hold an undergraduate degree, representing 282 employees (65.89%). Those with a high school education or lower comprise 84 participants (19.63%), while 62 employees (14.49%) have obtained a postgraduate degree or higher. Overall, the table illustrates that the surveyed hotel employees are mostly male, relatively young, and generally well educated.

Table 2. Results of psychometric properties

Construct	Indicators	Loading	CR	CA	AVE	VIF	Construct	Indicators	Loading	CR	CA	AVE	VIF
Digital leadership (DL)	DL1	0.633	0.911	0.885	0.597	3.027	Employee adaptive performance (EAP)	EAP.1	0.833	0.919	0.893	0.609	2.017
	DL2	0.787						EAP.2	0.743				
	DL3	0.838						EAP.3	0.791				
	DL4	0.808						EAP.4	0.748				
	DL5	0.845						EAP.5	0.844				
	DL6	0.717						EAP.6	0.774				
	DL7	0.758						EAP.7	0.823				
Digital mindset (DM)	**DM1**	0.715	0.921	0.908	0.514	2.073		EAP.8	0.802				
	DM2	0.702						EAP.9	0.737				
	DM3	0.726						EAP.10	0.701				
	DM4	0.713					Digital agility (DA)	DA1	0.830	0.918	0.900	0.529	3.142
	DM5	0.698						DA2	0.783				
	DM6	0.753						DA3	0.783				
	DM7	0.721						DA4	0.766				
	DM8	0.729						DA5	0.734				
	DM9	0.713						DA6	0.676				
	DM10	0.718						DA7	0.636				
	DM11	0.728						DA8	0.659				
	DM12	0.712						DA9	0.662				
	DM13	0.703						DA10	0.721				
	DM14	0.713											
	DM15	0.709											

Measurement model

Table 2 reports the psychometric evaluation of the study constructs, including indicator loadings, reliability measures, convergent validity, and collinearity diagnostics. Overall, the results demonstrate that all constructs meet the recommended thresholds, confirming the adequacy of the measurement model. For digital leadership, the indicator loadings range from 0.633 to 0.845, indicating acceptable to strong item contributions. The construct shows high internal consistency, with a composite reliability (CR) of 0.911 and Cronbach's alpha (CA) of 0.885. The average variance extracted (AVE) value of 0.597 exceeds the minimum recommended level of 0.50, supporting convergent validity. In addition, the variance inflation factor (VIF) of 3.027 remains within acceptable limits, suggesting no multicollinearity concerns. The employee adaptive performance construct demonstrates strong psychometric properties, with factor loadings between 0.701 and 0.844. Reliability is well established, as reflected by a CR of 0.919 and a CA of 0.893. The AVE value of 0.609 indicates that the construct explains a substantial portion of variance in its indicators. The VIF value of 2.017 further confirms that collinearity is not an issue for this construct. For digital agility, indicator loadings range from 0.636 to 0.830, which are generally acceptable. The construct exhibits high reliability, with a CR of 0.918 and a CA of 0.900. Although the AVE value is slightly lower at 0.529, it still exceeds the recommended threshold, supporting convergent validity. The VIF value of 3.142 is below the critical limit, indicating acceptable levels of collinearity. Finally, the digital mindset construct includes a larger number of indicators, with loadings ranging from 0.698 to 0.753. The reliability indices are strong, with a CR of 0.921 and a CA of 0.908, reflecting excellent internal consistency. The AVE value of 0.514 meets the minimum criterion for convergent validity, while the VIF value of 2.073 suggests that multicollinearity does not pose a concern. Although a small number of indicator loadings are slightly above the lower acceptable threshold (e.g., 0.633 and 0.636), they were retained because loadings above 0.60 are considered acceptable in PLS-SEM when composite reliability and AVE meet recommended criteria (Hair et al., 2017). In this study, all constructs demonstrate strong reliability and convergent validity, supporting the retention of these indicators to preserve the theoretical content validity of the measurement scales.

Table 3 presents the correlations among the latent variables along with the square roots of the average variance extracted (AVE) on the diagonal, in accordance with the Fornell–Larcker criterion. The diagonal values—0.772 for digital leadership, 0.780 for employee adaptive performance, 0.728 for digital agility, and 0.717 for digital mindset—represent the square roots of the AVEs for each construct. In all cases, these values are higher than the corresponding inter-construct correlation coefficients. The correlation results indicate moderate positive relationships among the constructs. Digital leadership is positively associated with employee adaptive performance (0.565), digital agility (0.621), and digital mindset (0.582). Employee adaptive performance also shows notable correlations with digital agility (0.527) and digital mindset (0.676), suggesting meaningful relationships among these variables. Additionally, digital agility and digital mindset are moderately correlated (0.537). Importantly, since the square root of each construct's AVE exceeds its correlations with other constructs, the results satisfy the Fornell–Larcker criterion. This confirms adequate discriminant validity, indicating that each construct is empirically distinct and captures a unique aspect of the conceptual model.

Table 3. Correlations among latent variables with the square root of AVEs

Construct	DL	EAP	DA	DM
Digital leadership (DL)	0.772			
Employee adaptive performance (EAP)	0.565	0.780		
Digital agility (DA)	0.621	0.527	0.728	
Digital mindset (DM)	0.582	0.676	0.537	0.717

Table 4 reports the results of discriminant validity assessment using the Heterotrait–Monotrait (HTMT) ratio of correlations. The HTMT values are evaluated against the recommended thresholds, where values below 0.90 indicate acceptable discriminant validity and values below 0.85 suggest a more stringent criterion. Overall, the results confirm that discriminant validity is well established for all constructs, as none of the HTMT ratios approach the critical cutoff values. This suggests that each construct measures a conceptually unique dimension within the research model.

Table 4. Discriminant validity (HTMT)

HTMT ratios (good if < 0.90, best if < 0.85)				
Construct	DL	EAP	DA	DM
Digital leadership (DL)				
Employee adaptive performance (EAP)	0.629			
Digital agility (DA)	0.706	0.582		
Digital mindset (DM)	0.657	0.742	0.590	

Model Fit

Appendix B summarizes the model fit and quality indices used to evaluate the robustness and adequacy of the proposed structural model. Overall, the results indicate that the model demonstrates a strong and acceptable fit according to the criteria suggested by Kock (2021). The average path coefficient (APC) is 0.455 and statistically significant at $p < 0.001$, confirming that the relationships specified in the model are meaningful. Similarly, the average R-squared (ARS) and average adjusted R-squared (AARS) values are 0.540 and 0.538 respectively, both significant at $p < 0.001$, indicating that the model explains a substantial proportion of variance in the endogenous constructs. Collinearity diagnostics further support the quality of the model. The average block variance inflation factor (AVIF) and the average full collinearity variance inflation factor (AFVIF) are 2.877 and 2.564 respectively, both well below the acceptable threshold of 5 and close to the ideal value of 3.3. These findings suggest that multicollinearity is not a concern in the model. In addition, the Tenenhaus goodness-of-fit (GoF) index is 0.536, which exceeds the benchmark for a large effect size, reflecting strong overall explanatory power. The remaining quality indices also meet or exceed recommended standards. The Sympson's paradox ratio (SPR), R-squared contribution ratio (RSCR), statistical suppression ratio (SSR), and nonlinear bivariate causality direction ratio (NLBCDR) all equal 1.000, which represents the ideal value for each criterion. Collectively, these results confirm that the model is statistically sound, free from major estimation issues, and suitable for hypothesis testing.

Structural model and hypotheses testing

Table 5 and Figure 2 present the results of the direct effects analysis, including path coefficients, significance levels, effect sizes, and hypothesis testing outcomes. The findings indicate that all hypothesized relationships are statistically significant and supported, highlighting the strength of the proposed structural model.

Table 5. Direct effects

H	Structural Paths	Path Coefficient (β)	P-values	Effect Size (f^2)	Result
H1	DL →EAP	0.19	<0.01	0.110	Supported
H2	DL →DM	0.61	<0.01	0.370	Supported
H3	DL →DA	0.85	<0.01	0.731	Supported
H4	DM →EAP	0.52	<0.01	0.352	Supported
H5	DA →EAP	0.10	<0.01	0.057	Supported
DM $R^{2:}$ = 0.37, DA $R^{2:}$ = 0.73, EAP $R^{2:}$ = 0.52					

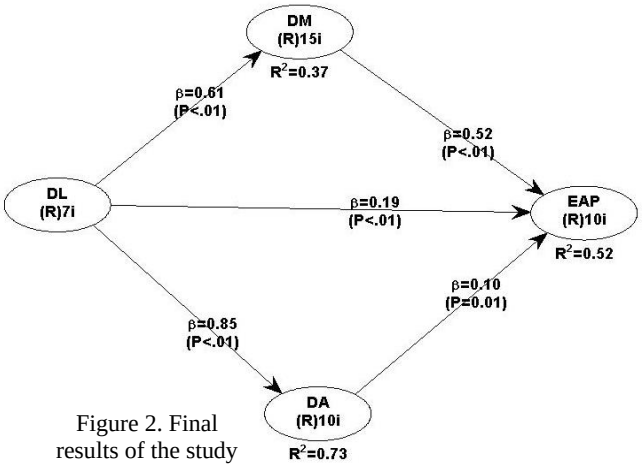


Figure 2. Final results of the study

Digital leadership has a positive and significant effect on employee adaptive performance ($\beta = 0.19$, $p < 0.01$), with a small to moderate effect size ($f^2 = 0.110$), supporting Hypothesis 1. In addition, digital leadership strongly influences digital mindset ($\beta = 0.61$, $p < 0.01$), exhibiting a large effect size ($f^2 = 0.370$), which confirms Hypothesis 2. The strongest relationship is observed between digital leadership and digital agility ($\beta = 0.85$, $p < 0.01$), with a very large

effect size ($f^2 = 0.731$), providing strong support for Hypothesis 3. Furthermore, digital mindset shows a substantial positive impact on employee adaptive performance ($\beta = 0.52$, $p < 0.01$), with a large effect size ($f^2 = 0.352$), supporting Hypothesis 4. Digital agility also has a positive and statistically significant influence on employee adaptive performance ($\beta = 0.10$, $p < 0.01$); however, its effect size is relatively small ($f^2 = 0.057$), which nonetheless supports Hypothesis 5.

Regarding the model's explanatory power, digital leadership accounts for 37% of the variance in digital mindset ($R^2 = 0.37$) and 73% of the variance in digital agility ($R^2 = 0.73$). Collectively, digital leadership, digital mindset, and digital agility explain 52% of the variance in employee adaptive performance ($R^2 = 0.52$). These results indicate that the model has strong predictive capability and that the proposed relationships meaningfully explain employee adaptive performance.

Table 6 presents the results of the mediation analysis using the bootstrapping approach recommended by Preacher & Hayes (2008). The analysis examines whether digital mindset and digital agility mediate the relationship between digital leadership and employee adaptive performance. Mediation is assessed based on the significance of indirect effects and the exclusion of zero from the 95% bootstrapped confidence intervals.

For Hypothesis 6, digital mindset is found to significantly mediate the relationship between digital leadership and employee adaptive performance. The indirect effect is 0.317, with a standard error of 0.033 and a t-value of 9.612, indicating strong statistical significance. The corresponding 95% bootstrapped confidence interval ranges from 0.253 to 0.382, which does not include zero, confirming the presence of partial mediation. This suggests that digital leadership enhances employee adaptive performance in part by fostering a stronger digital mindset among employees.

Similarly, Hypothesis 7 examines the mediating role of digital agility in the relationship between digital leadership and employee adaptive performance. The indirect effect is 0.085, with a standard error of 0.033 and a t-value of 2.576. The 95% bootstrapped confidence interval spans from 0.020 to 0.150, again excluding zero, thereby supporting the partial mediating effect. Although the magnitude of this indirect effect is smaller compared to that of digital mindset, it still indicates that digital leadership contributes to employee adaptive performance through improved digital agility.

Overall, the mediation analysis confirms that both digital mindset and digital agility serve as significant mediators between digital leadership and employee adaptive performance. These findings highlight the importance of internal cognitive and capability-based mechanisms in translating digital leadership into enhanced adaptive performance outcomes.

Table 6. Mediation analysis' Bootstrapped Confidence Interval

Hypo.	Indirect Path	Path a	Path b	Indirect Effect	SE	t-value	Bootstrapped Confidence Interval		Mediation
							95% LL	95% UL	
H6	DL→DM→EAP	0.610	0.520	0.317	0.033	9.612	0.253	0.382	Yes
H7	DL→DA →EAP	0.850	0.100	0.085	0.033	2.576	0.020	0.150	Yes

DISCUSSION

The findings of this study reinforce and extend emerging evidence on the pivotal role of digital leadership in shaping employee outcomes within dynamic work environments. Supporting Hypotheses H1–H3, digital leadership demonstrated significant positive effects on employees' adaptive performance, digital mindset, and digital agility. These results underscore that leaders with strong digital competencies are instrumental in enabling employees to navigate change and adopt new technologies—a conclusion echoed in hospitality research showing that digital leadership enhances operational performance through employee engagement and technology integration in five-star hotels (Hussein et al., 2024). Moreover, the observed impact of digital leadership on digital mindset and agility aligns with prior studies suggesting that digitally competent leaders cultivate a learning-oriented culture and promote adaptability, thereby strengthening staff readiness to meet evolving service demands (Hamouche et al., 2026). The positive relationships between digital mindset and adaptive performance (H4), and between digital agility and adaptive performance (H5), highlight the importance of employees' internal readiness and capability for effective adjustment to digital transformation. Contemporary research emphasizes that a growth-oriented mindset enhances digital self-efficacy, supporting performance in technology-intensive contexts (Liu & Kamioka, 2025).

Similarly, both organizational and individual agility underpin performance resilience in turbulent environments, particularly as digital strategies become central to service delivery (Alakaş, 2024). Together, these findings illustrate that employees' cognitive and behavioral adaptations are key mechanisms linking digital leadership to adaptive outcomes.

Although digital agility significantly influences adaptive performance, its effect size is smaller than that of digital mindset. This difference suggests that cognitive readiness toward digital technologies may play a more foundational role in shaping adaptive behavior. In other words, employees who possess a strong digital mindset are more likely to interpret technological change positively and engage in adaptive behaviors consistently, whereas digital agility reflects the situational execution of these behaviors during specific operational challenges. Mediation analyses (H6 and H7) further demonstrate that digital mindset and digital agility serve as psychological and capability-based pathways through which digital leadership influences adaptive performance. This mediating role aligns with recent theoretical developments emphasizing internal cognitive and behavioral processes as critical in explaining how leadership fosters performance amid digital disruption (Yang et al., 2025).

By revealing both direct and indirect effects, the results suggest a layered influence process: digital leaders not only provide strategic direction but also cultivate the internal capacities that enable employees to adapt, innovate, and excel.

The findings collectively underscore that digital leadership enhances employee adaptability through multiple mechanisms. Leaders influence organizational priorities and employee attitudes toward digital innovation, creating contexts in which staff feel empowered to experiment with new tools and processes—conditions that nurture agility and an open mindset, essential for thriving in dynamic service sectors (Sacavém et al., 2025). Consistent with Social Cognitive Theory, these outcomes reflect

active psychological and behavioral adaptations shaped by leadership cues (Al-Romeedy, 2026). By empirically linking digital mindset and agility to performance, the study extends prior work showing that employees' attitudes and capabilities enable them to manage uncertainty, innovate service delivery, and maintain high performance—insights particularly relevant to hospitality, where responsiveness and customization are paramount (Hasanein et al., 2026; Hussein et al., 2024).

Finally, the mediation results indicate that the effects of digital leadership on adaptive performance are not solely direct but also operate by enhancing employees' internal capacities (Albannai et al., 2026). This mechanism resonates with contemporary digital transformation literature, highlighting that leaders influence performance not only through strategic guidance but also by fostering learning and adaptive processes, emphasizing the interplay between leadership practices and individual dynamic capabilities (Wang et al., 2024).Overall, the results illustrate the multifaceted role of digital leadership in enabling workforce adaptability during digital transformation. By fostering a progressive digital mindset and strengthening agility, leaders empower employees to engage in adaptive behaviors essential in today's volatile, technology-driven hospitality landscape. This integrated perspective advances both theory and practice by identifying the cognitive and capability-based pathways through which leadership drives performance in digital contexts, offering actionable insights for managers aiming to cultivate resilient, adaptive, and high-performing teams.

THEORITICAL IMPLICATIONS

This study makes several substantive theoretical contributions by extending Social Cognitive Theory into the domain of digital leadership and adaptive performance within hospitality contexts. While Social Cognitive Theory has traditionally been employed to explain learning, self-regulation, and behavior in relatively stable environments, this research advances the theory by situating it within digitally volatile service settings characterized by constant technological change and operational uncertainty. By doing so, the study demonstrates that the theory remains highly relevant for explaining behavior under conditions of continuous digital disruption, rather than episodic change.

A key theoretical contribution lies in explicating the distinct yet complementary roles of cognitive orientation and behavioral capability in the leadership–performance relationship. Prior applications of Social Cognitive Theory have often emphasized either cognitive mechanisms or behavioral outcomes in isolation. This study advances the theory by empirically distinguishing digital mindset as a cognitive interpretive mechanism and digital agility as a behavioral enactment mechanism, thereby clarifying how leadership influence is cognitively internalized and behaviorally executed. This separation refines the theory's explanatory power by showing that cognition and behavior operate as sequential, rather than interchangeable, processes in digitally intensive work environments. Furthermore, the study extends Social Cognitive Theory by repositioning leadership as a dynamic environmental stimulus rather than a static contextual factor.

In this framework, digital leadership is not merely a background condition shaping behavior indirectly; it actively structures employees' sensemaking processes and action possibilities as digital conditions evolve. This perspective enriches the theory by highlighting leadership's role in continuously recalibrating cognitive expectations and behavioral repertoires, offering a more dynamic view of environmental influence aligned with modern digital work realities. Another important theoretical contribution concerns the conceptualization of adaptive performance. Rather than treating adaptive performance as a general or dispositional outcome, the study embeds it within a social cognitive process in which adaptation emerges from repeated cycles of interpretation and action. This reframing advances Social Cognitive Theory by demonstrating how adaptive performance can be understood as a cumulative behavioral outcome grounded in leadership-shaped cognition and agility-driven execution. As such, the study shifts adaptive performance from being an abstract capability to a socially constructed and theoretically traceable outcome. By empirically validating both direct and mediated pathways, the study also strengthens the internal coherence of Social Cognitive Theory in organizational research. The findings confirm that leadership influence does not dissipate when cognitive and behavioral mechanisms are introduced; instead, it operates through them. This reinforces the theory's core proposition that environmental, cognitive, and behavioral elements function interdependently rather than hierarchically. In doing so, the study provides robust empirical support for applying Social Cognitive Theory to complex organizational phenomena involving leadership, digital transformation, and performance adaptation.

Finally, the hospitality context itself contributes to theoretical enrichment. Much of the existing social cognitive literature has been developed in manufacturing, education, or generalized organizational settings. By demonstrating the theory's applicability within hotel enterprises—where service immediacy, emotional labor, and technological mediation intersect—the study broadens the contextual boundaries of Social Cognitive Theory. This extension underscores the theory's versatility and opens new avenues for its application in service-dominant and digitally enabled industries.

PRACTICAL IMPLICATIONS

The findings of this study provide clear execution-oriented implications for hotel organizations seeking to enhance adaptive performance in digitally dynamic environments. Given the confirmed direct effect of digital leadership on adaptive performance, hotel executives should reconceptualize digital leadership as a core operational capability rather than a support function. Practically, this can be implemented by incorporating digital leadership competencies into leadership development programs, including digital adaptation indicators in managerial performance appraisal systems, and requiring department managers to lead periodic digital problem-solving meetings during operational briefings. This requires embedding digital leadership responsibilities into managerial roles, performance evaluations, and daily supervisory practices, ensuring that leaders consistently demonstrate adaptive responses to digital disruptions rather than merely endorsing digital initiatives at a strategic level. The positive effects of digital leadership on employees' digital mindset and digital agility indicate that leadership influence must be enacted simultaneously at cognitive and behavioral levels. From an execution standpoint, hotel

managers should deliberately structure leadership interactions to shape how employees think about digital change while enabling immediate action. For example, managers can integrate short digital learning discussions into daily shift briefings, assign employees rotating responsibility for resolving minor digital service disruptions, and encourage supervisors to openly analyze digital challenges encountered during operations. This can be operationalized by integrating digital decision-making responsibilities into frontline roles, encouraging leaders to openly discuss digital challenges during operations, and legitimizing on-the-spot adjustments to digital workflows when service conditions require rapid adaptation.

The direct influence of digital mindset on adaptive performance suggests that managing digital transformation as a mindset-shaping process is critical. Practically, hotel organizations should move beyond technology-centered training and introduce structured reflection mechanisms that allow employees to reinterpret digital challenges as solvable and manageable. This can be implemented through brief "digital reflection sessions" incorporated into shift handovers, where employees discuss recent digital service issues and identify alternative responses for similar future situations. Embedding brief digital debriefings into shift handovers or post-service reviews can systematically reinforce constructive digital interpretations, strengthening employees' readiness to adapt when conditions change.

Similarly, the confirmed effect of digital agility on adaptive performance underscores the importance of redesigning work systems to support rapid execution. Hotel managers should critically assess procedural rigidity, approval layers, and digital task dependencies that slow adaptive responses. In practice, organizations can establish simplified digital escalation protocols, empower frontline employees to resolve routine digital service disruptions without managerial approval, and implement quick-response guidelines for handling technology-related service interruptions. Reducing bureaucratic constraints, granting situational autonomy in digitally mediated service tasks, and simplifying escalation protocols enable employees to translate leadership intent into immediate adaptive action during live service encounters.

The mediating roles of digital mindset and digital agility further imply that leadership-driven improvements in adaptive performance unfold through identifiable internal mechanisms rather than instant outcomes. For practitioners, this means that the success of digital leadership initiatives should be evaluated not only through performance indicators but also through intermediate signals such as changes in employees' digital attitudes and responsiveness. Organizations can operationalize this monitoring process by incorporating short internal surveys measuring digital confidence and agility into quarterly employee assessments, allowing managers to track cognitive and behavioral readiness for digital adaptation. Regular monitoring of these indicators allows organizations to adjust leadership practices before performance consequences fully materialize.

Finally, the results highlight the need for alignment across human resource systems. Recruitment criteria, leadership development programs, and performance appraisal frameworks should explicitly prioritize cognitive openness to digital change and behavioral responsiveness in digital contexts. To support implementation, hotel organizations can include digital adaptability scenarios in recruitment interviews, introduce leadership workshops focused on managing digital change in service environments, and integrate digital agility metrics into employee performance reviews. Training programs should emphasize scenario-based simulations that require employees to adapt digital tools under realistic service pressures, reinforcing the link between leadership influence, agile execution, and adaptive performance. Such alignment ensures that digital leadership is institutionalized as a driver of sustained adaptability rather than dependent on individual managerial discretion.

CONCLUSION

This study examined the influence of digital leadership on employees' adaptive performance in hotel enterprises through the mediating roles of digital mindset and digital agility, drawing on Social Cognitive Theory. The findings demonstrate that digital leadership directly enhances employees' adaptive performance while simultaneously fostering a stronger digital mindset and greater digital agility. Furthermore, both digital mindset and digital agility positively influence adaptive performance and partially mediate the relationship between digital leadership and adaptive performance, confirming that leadership promotes employee adaptability through both cognitive and behavioral mechanisms.

The study contributes to the digital leadership literature by providing an integrated Social Cognitive Theory framework that explains how leadership translates into adaptive employee behaviors in digitally intensive hospitality environments.

By distinguishing digital mindset as a cognitive mechanism and digital agility as a behavioral capability, the research offers a more comprehensive understanding of the processes through which digital leadership enhances workforce adaptability. These findings also emphasize that successful digital transformation depends not only on technological investments but also on leadership practices that cultivate employees' digital readiness and responsiveness.

From a managerial perspective, the results suggest that hotel organizations should invest in developing digitally competent leaders who encourage continuous learning, strengthen employees' digital mindset, and create work environments that support agile responses to technological change. Such efforts are likely to improve employees' adaptive performance and enhance organizational resilience in increasingly dynamic hospitality settings. Overall, this study provides robust empirical evidence that digital leadership is a critical driver of adaptive performance and highlights the importance of developing employees' cognitive and behavioral capabilities to achieve sustainable success during digital transformation.

Limitations and Future Research

Despite its contributions, this study entails several limitations that warrant consideration and offer meaningful directions for future research. First, the cross-sectional nature of the research design limits the ability to capture the temporal processes through which digital leadership shapes employees' cognitive orientations and behavioral capabilities. Adaptive performance in digitally intensive environments is inherently dynamic, suggesting that longitudinal or time-lagged designs could provide richer insights into how digital mindset and digital agility develop and interact over time as leadership

practices and technological conditions evolve. Second, the empirical focus on hotel enterprises, while theoretically appropriate, suggests caution in generalizing the findings to other service sectors with different operational characteristics. The hospitality context is distinguished by high levels of customer interaction, real-time service delivery, and emotional labor, which may amplify the influence of digital leadership on adaptive behavior. Future research could test the proposed framework across other digitally enabled service sectors, such as healthcare, logistics, or financial services, to assess the robustness of the identified mechanisms under different organizational and task environments.

Third, the reliance on self-reported data introduces the potential for perceptual bias and common method variance, despite the use of validated measurement instruments and rigorous analytical procedures. Employees' evaluations of leadership behavior, mindset, and performance may be shaped by subjective interpretations or situational factors beyond the scope of the current model. Subsequent studies could enhance empirical rigor by incorporating multi-source data, including supervisor assessments or objective indicators of digitally adaptive behavior, to strengthen causal inference and measurement validity.

Additionally, the study models digital mindset and digital agility as mediators operating independently between digital leadership and adaptive performance. While this approach clarifies their distinct explanatory roles, future research may benefit from exploring more complex process configurations. For example, reciprocal or reinforcing relationships between mindset and agility could be examined to determine whether adaptive behavior feeds back into cognitive readiness over time, thereby capturing adaptation as an iterative rather than linear phenomenon. Finally, although the theoretical framework is grounded in Social Cognitive Theory, future research could extend the explanatory scope by integrating complementary perspectives. The incorporation of theories related to role identity, job demands and resources, or paradox management may further illuminate how employees navigate competing expectations and technological pressures in digitally transformed service environments. Such extensions would not detract from the social cognitive foundation established in this study, but rather deepen understanding of adaptive performance as a multifaceted organizational outcome.

Appendix (A) measurement scales

Digital leadership (DL)	DL1	I am involved in decisions that affect my work and my digital work environment
	DL2	My digital literacy is encouraged by my manager.
	DL3	When there is a need for questions about digitalization, I receive support from my manager.
	DL4	I get regular feedback on the quality of my digital work.
	DL5	I get all the information I need to do my digital job.
	DL6	I am supported by my manager to better understand and use digital applications.
	DL7	In my department, digital working methods are encouraged.
Employee Adaptive performance (EAP)	EAP.1	I knows that every customer requires a unique approach
	EAP.2	I can easily change to another approach when he or she feels that his or her approach is not working
	EAP.3	I like to experiment with different approaches
	EAP.4	I do not change his or her approach from one customer to another (–)
	EAP.5	I is very sensitive to the needs of his or her customers
	EAP.6	I find it difficult to adapt his or her style to certain customers (–)*
	EAP.7	I varies his or her approach from situation to situation
	EAP.8	I try to understand how one customer differs from another
	EAP.9	I feel confident that he or she can effectively change his or her approach when necessary
	EAP.10	I treat all customers pretty much the same (–)
Digital agility (DA)	DA1	I can quickly adapt and respond to the changing digital landscape
	DA2	I can leverage digital tools and technologies to automate manual tasks
	DA3	I can leverage digital tools and technologies to enable collaboration across teams
	DA4	I can quickly learn and adapt to new technologies, processes, and best practices
	DA5	I can support institutions to remain competitive and enhance student experiences
	DA6	I can quickly shift to online or hybrid learning models
	DA7	I can experiment with new technologies and teaching methods
	DA8	I take the shortest possible time to develop my skills, adjust to new environment, and collect information
	DA9	I take a personal interest in collecting information about my organization and other related organization
	DA10	I have the potential to transform the way we teach and learn
Digital Minset (DM)	DM1	I am aware of the high growth potential of IT
	DM2	I always think of the future growth of IT as an exponential curve
	DM3	I always have the long-term exponential growth projections of IT in mind
	DM4	When using IT, I always think about what else I could use it for besides its intended functions
	DM5	I always see potential new use cases for IT that go beyond the intended use
	DM6	I enjoy developing or using IT that is generic and versatile
	DM7	If I developed IT, I would always provide possibilities for alternative use cases
	DM8	I often think about how IT can be combined in a way similar to a modular IT
	DM9	I enjoy recombining IT from existing components of a variety of technology fields to create new things
	DM10	I always notice that digital products consist of different (digital) components
	DM11	I always think about combining different IT when solving problems
	DM12	I always see potential for digital products or services to transform entire markets
	DM13	I always recognize how IT could replace established solutions
	DM14	I always see potentials for existing business models being replaced by disruptive IT
	DM15	I regularly think about how the business model of my company/employer could be replaced by a more effective unexpected IT

Appendix (B): Model fit and quality indices (Kock, 2021)

	Assessment	Criterion	Mark
Average path coefficient (APC)	0.455, P<0.001	P<0.05	√
Average R-squared (ARS)	0.540, P<0.001	P<0.05	√
Average adjusted R-squared (AARS)	0.538, P<0.001	P<0.05	√
Average block VIF (AVIF)	2.877	acceptable if ≤ 5, ideally ≤ 3.3	√
Average full collinearity VIF (AFVIF)	2.564	acceptable if ≤ 5, ideally ≤ 3.3	√
Tenenhaus GoF (GoF)	0.536	small ≥ 0.1, medium ≥ 0.25, large ≥ 0.36	√
Sympson's paradox ratio (SPR)	1.000	acceptable if ≥ 0.7, ideally = 1	√
R-squared contribution ratio (RSCR)	1.000	acceptable if ≥ 0.9, ideally = 1	√
Statistical suppression ratio (SSR)	1.000	acceptable if ≥ 0.7	√
Nonlinear bivariate causality direction ratio (NLBCDR)	1.000	acceptable if ≥ 0.7	√

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POSSIBILITIES AND LIMITATIONS OF ACCESS TO SPA TREATMENTS IN HEALTH TOURISM IN THE NORTHERN GREAT PLAIN IN HUNGARY

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Abstract: Spa treatments in Hungary are covered by social security; however, actual utilization of these services is influenced not only by formal financing frameworks but also by social, economic, and regional factors. The aim of the research was to explore the socio-demographic characteristics of patients receiving spa treatments covered by social security in the Northern Great Plain region, as well as the attitudes, financial, and time constraints associated with the use of these services. The study was based on primary, questionnaire-based data collection, which took place between June and December 2025 at eight thermal spas in the Northern Great Plain region. A total of 405 patients receiving balneotherapy treatments covered by social security participated in the study. The data were analyzed using IBM SPSS Statistics. During the analysis, we employed descriptive statistics, the chi-square test, the Kruskal–Wallis test, and ordinal logistic regression to identify correlations and regional differences. Based on the results, the majority of respondents were women, belonged to an older age group, and had a secondary or higher education. A significant correlation was found between educational attainment and the subjective assessment of financial status: a higher proportion of those with lower educational attainment reported a sense of financial constraint. In terms of regional breakdown, financial and time constraints were more pronounced in Szabolcs-Szatmár-Bereg and Jász-Nagykun-Szolnok counties, while more favorable access conditions were identified in Hajdú-Bihar county. The results suggest that formal access provided by social security alone does not eliminate regional and social inequalities in access to balneotherapy services in health tourism in the Northern Great Plain in Hungary.

Keywords: balneotherapy, medicinal spas, health tourism, territorial inequalities, access

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INTRODUCTION

Medicinal activities associated with spas constitute an integral part of the healthcare system in numerous European countries (Oliveira et al., 2023; Walczak & Kowalska, 2025). Accordingly, in several European countries—such as France, Italy, Spain, Turkey, and Hungary—the number of scientific studies related to balneotherapy has increased significantly in recent decades (Protano et al., 2023; Protano et al., 2024), especially research analyzing the results of balneotherapy procedures used in the treatment of chronic diseases (Gutenbrunner et al., 2010; Varga et al., 2019).

Numerous empirical studies have confirmed that balneotherapy has a beneficial effect on various health conditions, especially when used in the treatment of chronic diseases (Pittler et al., 2006; Santos et al., 2016; Antonelli et al., 2018; Antonelli & Donelli, 2018). In Hungary, balneotherapy – linked to physiotherapy and rehabilitation services – is institutionalized and embedded in the social security-funded healthcare system (Géher, 2013; Hojcska, 2022). In Hungary, some spa treatments are covered by health insurance, typically on medical grounds, which reinforces the interpretation of these services as healthcare (Bender, 2014; Hinek et al., 2019; Hojcska, 2019).

According to data from the National Health Insurance Fund Administration of Hungary (Hungarian acronym: NEAK), there were a total of 200 healthcare providers with valid contracts for social security reimbursement in Hungary in 2022 (Table 1). From a territorial perspective, the distribution of service providers shows substantial disparities: the highest number operated in Hajdú-Bihar County (20), while only two were located in Nógrád County. In the Northern Great Plain region, a total of 42 providers financed by the NEAK were available, representing more than one-fifth of the total national capacity. The number of service providers and the size of the population are not always proportional: while Budapest and Pest County have a particularly high population, the number of service providers is more moderate, whereas in some counties – such as Heves or Jász-Nagykun-Szolnok – the presence of service providers is more favorable in relation to the population.

The use of subsidized balneotherapy services in Hungary has been declining in recent years (HCSO, 2024), but at the same time, in line with findings in the international literature, marked regional differences can be identified in terms of both the number of treatments and the distribution of social security subsidies (Helmeczi & Láczay, 2025). Analyses based on

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the NEAK financing database provide an opportunity to empirically explore these spatial inequalities and to interpret access conditions and the fairness of the healthcare system. According to an analysis by Varga et al. (2020), the number of spa treatments subsidized by social security showed a downward trend between 2009 and 2016, reaching its highest value in 2009 and its lowest in 2012. In territorial terms, the amount of support per 10,000 inhabitants was highest in Csongrád, Hajdú-Bihar, and Győr-Moson-Sopron counties, while it was lowest in Nógrád, Zala, and Szabolcs-Szatmár-Bereg counties. Usage increases in the 60–69 age group, then declines. Furthermore, women over the age of 40 used treatments at a higher rate than men in all age groups. Jóna & Fedor (2025) similarly explained differences in access to healthcare services by the impact of spatial inequalities as well as gender differences in health behavior.

Table 1. Regional distribution of healthcare providers financed by social security and population size in Hungary (Source: NEAK, 2022; HCSO, 2024)

County[1]	**Number of service providers (NEAK, 2022)**	**Population, 2024 (HCSO, 2024)**
Baranya	12	353 331
Bács-Kiskun	14	491 632
Békés	8	310 912
Borsod-Abaúj-Zemplén	16	617 800
Budapest	13	1 686 222
Pest	11	1 333 257
Csongrád-Csanád	11	389 411
Fejér	5	419 490
Győr-Moson-Sopron	10	473 246
Hajdú-Bihar	20	520 550
Heves	13	285 058
Jász-Nagykun-Szolnok	16	353 511
Komárom-Esztergom	7	301 834
Nógrád	2	180 469
Somogy	14	292 691
Szabolcs-Szatmár-Bereg	6	524 513
Tolna	5	206 398
Vas	7	248 199
Veszprém	5	335 979
Zala	5	260 124
Total	**200**	**9 584 627**

The literature highlights that the function and social significance of medicinal spa use vary considerably across regions. While in Western Europe medicinal spas primarily appear within the framework of wellness and recreational tourism (Csirmaz & Pető, 2015), in Central and Eastern Europe—especially in countries where balneotherapeutic treatments are available with social insurance support—spas are more closely integrated into the healthcare system (Dryglas & Salamaga, 2017; Woźniak-Holecka, 2017; Derco et al., 2020).

Owing to its geographical endowments, Hungary has gained international recognition for its natural healing factors—particularly its medicinal waters—which interdisciplinarily link the fields of geography, balneology, and tourism, and, alongside the growing emphasis on health, play an increasingly prominent role within health tourism, especially in the context of therapeutic tourism trips aimed at health preservation (Hojcska & Szabó, 2021; Kővári-Tóth et al., 2024).

In addition to their health benefits, more and more research is emphasizing the tourism and spatial dimensions of balneotherapy services. Spas are not only health institutions, but also complex service locations that simultaneously fulfill therapeutic, recreational, and tourism functions (Smith & Puczkó, 2014; Widawski, 2017; Diekmann, 2020; Walczak, & Kowalska, 2025; Smith, 2025). This dual role – in health and tourism – makes spa tourism particularly suitable for examining social inequalities, access barriers, and regional differences.

In recent years, research on balneotherapy and health tourism has increasingly moved beyond traditional clinical efficacy studies and shifted toward spatial, social, and health policy dimensions. Among these approaches, spatial studies have become particularly prominent, analyzing the geographical distribution of natural therapeutic factors and the services built upon them, as well as inequalities in access to care. In Hungary, significant differences can be observed in this regard: the geographical concentration of institutions and natural resources based on thermal water influences not only the availability of services but also their utilization (Hojcska, 2021; Szabó, 2023).

The social dimension of research is also receiving increasing attention. Köbli (2021) points out that the development of Hungarian spa towns is closely linked to the implementation of sustainability and ecological considerations. According to his findings, environmental sustainability and the active involvement of the local community and economy play a key role in the long-term competitiveness of spa towns, which aligns well with a complex, systemic understanding of health tourism.

An examination of health policy dimensions further nuances this picture. Research by Ádám Ruszinkó and colleagues (2024) highlights that the macroeconomic environment and health insurance financing mechanisms play a decisive role in the accessibility and sustainability of medical treatments. Financing structures and policy decisions thus have a direct impact on the operation and development potential of medical tourism services.

[1] NUTS 3 level administrative unit in Hungary

MATERIALS AND METHODS

The aim of this research was to explore the characteristics of patients receiving spa treatments covered by social security benefits and their experiences with the service in a primary questionnaire survey.

The primary data collection took place in the Northern Great Plain region of Hungary, which includes Hajdú-Bihar, Jász-Nagykun-Szolnok, and Szabolcs-Szatmár-Bereg counties. The research took place at eight thermal spas offering balneotherapy treatments covered by social security between June and December 2025. Figure 1 shows the geographical location of the study sites within Hungary and broken down by county.

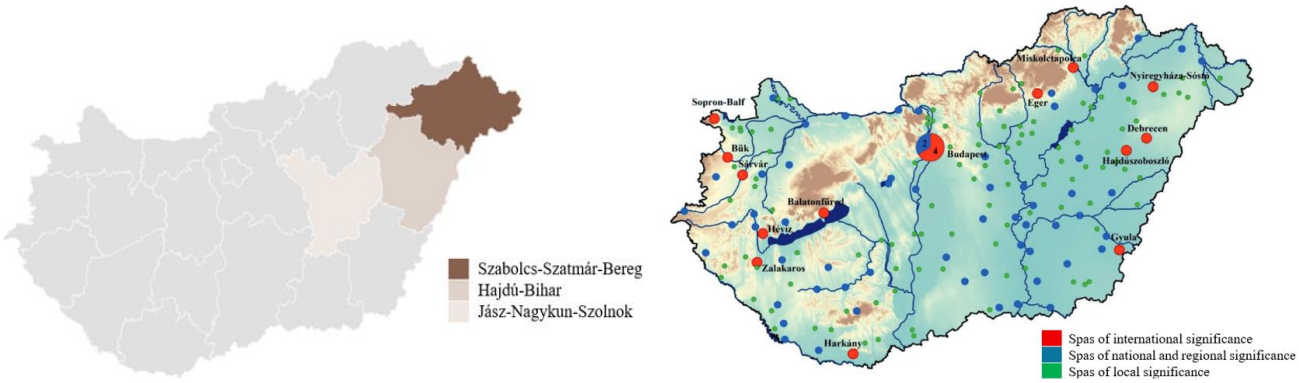


Figure 1. Research location and the classification and location of spas in Hungary (Source: Own compilation; Köbli, 2021)

Following the review of the literature, data collection was carried out using a structured questionnaire designed by the authors during the primary research. The target group of the study consisted of patients receiving spa treatments covered by Hungarian social security, who were available at the spas during the treatment period. Accordingly, data collection was carried out in person using paper-based questionnaires at eight spas in the Northern Great Plain Region. Data collection took place between June and December 2025, during which a total of 405 people participated in the research and completed the questionnaire (Figure 2). The sample cannot be considered representative, as respondents participated in the survey on a voluntary basis and completed the questionnaire while undergoing balneotherapy treatments. As a result, the findings cannot be generalized to the entire population, but they do reflect trends and correlations within the target group studied.

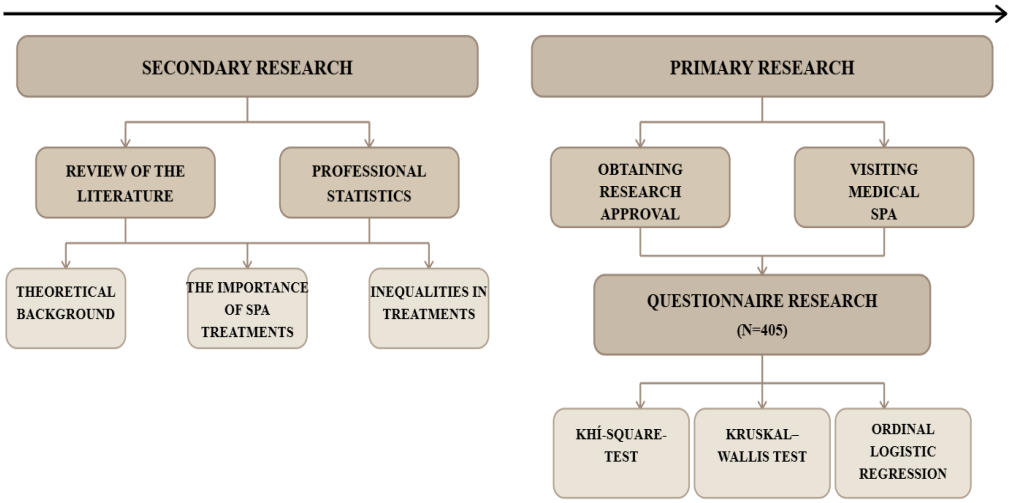


Figure 2. Research process (Source: Own compilation)

Applied Research Methods

Among the applied methods, this study draws on insights obtained from secondary sources, including the analysis of data from the HCSO, the NEAK, and providers of balneological treatments, examined both at the national level and by regional breakdown. The coding, cleaning, and statistical analysis of the primary research data was performed using the IBM SPSS Statistics software package. The analyses were conducted in several steps, in line with the research questions and the measurement levels of the variables. We used descriptive statistics to present the socio-demographic characteristics of the respondents, in the form of absolute and relative frequencies (number of persons, %).

We used a chi-square test to examine the correlations between socio-demographic factors and subjective assessments of financial status, interpreting the strength of the correlations using Cramer's V index. We also used a chi-square test to analyze the subjective financial burden of using balneotherapy services by region.

Attitudes toward health tourism based on medicinal waters and the use of spa treatments were measured using six statements on a five-point Likert scale (1 = strongly disagree; 5 = strongly agree). The questions concerned the need for

relaxation, financial and time constraints, the tourist nature of spa tourism, the requirement for a doctor's recommendation, and visiting new spas. We used the Kruskal–Wallis test to reveal differences between counties.

To explain the significant regional differences, we estimated ordinal logistic regression models, in which county, gender, educational attainment, economic activity status, and age were included as explanatory variables. Hajdú-Bihar county, female gender, higher education, and active status were defined as reference categories.

In the analyses, we considered a 5% significance level to be relevant ($p < 0.05$).

Description of the Questionnaire Content

The questionnaire was compiled by integrating several sources in order to ensure that the measurement tool was well-founded in terms of both content and methodology. The questions were developed using relevant elements from partially standardized, validated measurement tools, questions used in previous empirical research, and items developed in-house.

The measurement tools used included relevant elements of the SF-36 quality of life questionnaire, questions from the European Health Interview Survey (EHIS), and adapted questions from previous PhD research (Hojcska, 2022; Szabó, 2015). These were supplemented by questions developed in-house and tailored to the objectives of the research and the specific characteristics of balneotherapy treatments. Prior to finalizing the questions, professional consultations were held with a specialist working at a spa and a spa manager, which contributed to the professional soundness and comprehensibility of the questions and their suitability for spa medical practice. The consent of the spas concerned and the approval of the Regional Research Ethics Committee were required to carry out the research.

RESULTS

Socio-demographic characteristics of respondents

Table 2 summarizes the socio-demographic characteristics of the respondents participating in the survey by gender, age, educational attainment, place of residence, and subjective income status.

Table 2. Socio-demographic characteristics of respondents (Source: Own compilation)

Characteristics of respondents		Person	%
Gender	Male	124	30.6%
	Female	281	69.4%
Classification by age	18-24	5	1.2%
	25-34	15	3.7%
	35-44	35	8.6%
	45-54	76	18.8%
	55-64	84	20.7%
	65-74	135	33.3%
	75+	55	13.6%
Classification by educational attainment	Low (Less than 8 years of elementary school; 8 years of elementary school; Vocational school, vocational training	72	17.8%
	Secondary (with vocational secondary school leaving certificate; high school; secondary school leaving certificate, technical college)	165	40.7%
	Higher education (college, university)	168	41.5%
Classification by place of residence	Capital	16	4.0%
	County seat	124	30.6%
	City	167	41.2%
	Village	98	24.2%
Income distribution	No, because I live comfortably and am able to save regularly	89	22.0%
	No, because I live on my income and am rarely able to save	189	46.7%
	Yes, because my income just covers my expenses	103	25.4%
	Yes, I often have financial difficulties	18	4.4%
	I do not have my own income	6	1.5%

Based on the socio-demographic characteristics of the 405 participants in the study, it can be concluded that the gender composition of the sample was heavily skewed towards women: 69.4% of respondents were women, while 30.6% were men. This ratio is consistent with the gender distribution characteristic of the population using balneotherapy treatments.

Looking at the age structure, it can be seen that the majority of the sample consisted of older age groups (Figure 3). 67.6% of respondents were over 55 years of age, with the largest proportion being those aged 65–74 (33.3%). The proportion of age groups under 45 is low, which can be explained by the more frequent occurrence of musculoskeletal complaints with age. In terms of educational attainment, the vast majority of respondents had secondary or higher education (82.2% in total). The proportion of those with higher education (41.5%) slightly exceeded that of those with secondary education (40.7%), while the proportion of those with low educational attainment was 17.8%. The results suggest that the more educated social groups are overrepresented among those who use balneotherapy treatments (Figure 3).

Based on the distribution by place of residence, the sample is typically urban. Of the respondents, 41.2% lived in cities, 30.6% in county seats, while the proportion of those living in villages and farms was 24.2%. The proportion of those living in the capital is low (4.0%), which is consistent with the geographical location of the region under study.

Based on their subjective assessment of their income situation, nearly half of respondents (46.7%) said that they could live on their income, but were rarely able to save (Table 1). Twenty-two point zero percent reported a stable financial situation and regular savings opportunities. At the same time, more than a quarter of the sample (25.4%) indicated that their income barely covers their expenses, while 4.4% experience regular financial difficulties. The proportion of respondents without independent income is low (1.5%) (Figure 4).

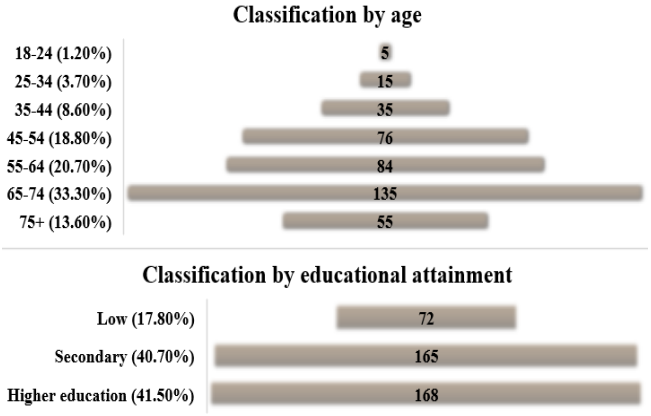


Figure 3. Classification by age and educational attainment (N=405) (Source: Own compilation)

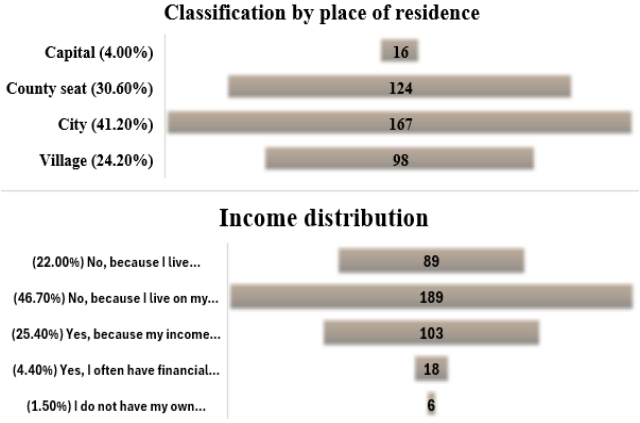


Figure 4. Classification by place of residence and income distribution (N=405) (Source: Own compilation)

Relationships between financial situation and socio-demographic factors

Table 3 shows the distribution between educational attainment and subjective assessment of financial situation, which indicates that higher educational attainment is associated with a more favorable assessment of financial situation.

Table 3. Respondents' educational attainment and subjective assessment of their financial situation (number of respondents, %) (Source: Own compilation)

	Is it difficult for you to use services in your situation?					Total
School education	**No, because I live comfortably and am able to save regularly**	**No, because I live on my income and am rarely able to save**	**Yes, because my income just covers my expenses**	**Yes, I often have financial difficulties**	**I do not have my own income**	
Low	7	30	31	3	1	72
	9.7%	41.7%	43.1%	4.2%	1.4%	100.0%
Secondary school education	24	80	45	13	3	165
	14.5%	48.5%	27.3%	7.9%	1.8%	100.0%
Higher education	58	79	27	2	2	168
	34.5%	47.0%	16.1%	1.2%	1.2%	100.0%
Total	89	189	103	18	6	405
	22.0%	46.7%	25.4%	4.4%	1.5%	100.0%

We used a chi-square test to explore the correlations between the socio-demographic characteristics of respondents and their subjective assessment of their financial situation. A statistically significant correlation was found between educational attainment and respondents' subjective assessment of their financial situation ($\chi^2 = 45.03$; df = 8; $p < 0.001$). The Cramer's V value indicating the strength of the relationship was 0.236, which indicates a small to medium effect size. Respondents with lower levels of education were more likely to report financial difficulties, while those with higher education were more likely to assess their financial situation as favorable. Table 4 shows the subjective financial burden of using balneotherapy services broken down by county among respondents.

Table 4. Financial burden of using balneotherapy services broken down by region (Source: Own compilation)

	Is it difficult for you to use services in your situation?					Total
	No, because I live comfortably and am able to save regularly	**No, because I live on my income and am rarely able to save**	**Yes, because my income just covers my expenses**	**Yes, I often have financial difficulties**	**I do not have my own income**	
Szabolcs-Szatmár-Bereg	52	82	46	6	5	191
	27.2%	42.9%	24.1%	3.1%	2.6%	100.0%
Jász-Nagykun-Szolnok	12	41	37	10	0	100
	12.0%	41.0%	37.0%	10.0%	0.0%	100.0%
Hajdú-Bihar	25	66	20	2	1	114
	21.9%	57.9%	17.5%	1.8%	0.9%	100.0%
Total	89	189	103	18	6	405
	22.0%	46.7%	25.4%	4.4%	1.5%	100.0%

A statistically significant correlation was found between the location (county) where spa treatments were used and the respondents' subjective assessment of their financial situation ($\chi^2 = 32.41$; df = 8; $p < 0.001$).

The Cramer's V value indicating the strength of the relationship was 0.200, which indicates a small to medium effect size. The proportion of patients who considered their income to be financially limited was highest in the spas of Jász-Nagykun-Szolnok County (47.0%), while respondents reporting a stable financial situation were overrepresented in Hajdú-Bihar County (79.8%). In the spas of Szabolcs-Szatmár-Bereg County, the proportion of responses indicating financial constraints (27.2%) fell between the values of the other two counties.

Attitudes towards health tourism based on medicinal waters

Attitudes toward health tourism based on medicinal waters and the use of balneotherapy treatments were examined in a separate set of questions. Respondents could express their level of agreement with each statement on a five-point Likert scale (1 = strongly disagree; 5 = strongly agree). With regard to the ordinal measurement level, we used the Kruskal–Wallis test to reveal differences between counties (Table 5). Based on the results of the analysis, statistically significant differences were found between counties for several of the statements examined.

A significant difference was found for the statement “I don’t have enough money to use spa services as often as I would like” (H = 14.372; p = 0.001), while a particularly strong regional difference was observed in the case of the statement "I am unable to take long trips or vacations due to my work" (H = 64.297; p < 0.001).

Table 5. Examination of attitudes related to the use of spa services by county (Kruskal–Wallis H test) (Source: Own compilation)

Test Statistics[a] (Kruskal Wallis Test),b (Grouping Variable: Vármegye)						
	Due to our hectic lives, it is often necessary to relax.	I don't have enough money to use spa services as often as I would like to.	Due to my job, I don't have the opportunity to travel for long periods of time or relax.	I try to combine spa treatments with getting to know a particular region.	I only use spa services on medical advice.	I always try to visit new spas.
Kruskal-Wallis H	1.359	14.372	64.297	7.661	6.478	0.520
df	2	2	2	2	2	2
Asymp. Sig.	0.507	**<0.001**	**<0.001**	**0.022**	**0.039**	0.771

There was also a significant difference in the assessment of the tourist nature of spa treatments (H = 7.661; p = 0.022) and in terms of the requirement for a doctor's recommendation (H = 6.478; p = 0.039). The results suggest that the assessment of financial, time and attitude factors related to balneotherapy treatments varies regionally among patients receiving treatment at spas in the Northern Great Plain region. We used ordinal logistic regression to identify the explanatory factors for the regional differences revealed by the Kruskal–Wallis test (Table 6). In the models, Hajdú-Bihar county, female gender, higher education, and active status served as reference categories.

Table 6. Significant results of ordinal logistic regression models of attitudes toward spa use (Source: Own compilation)

Variable	**Reference category**	Due to our hectic lives, it is often necessary to relax.	I don't have enough money to use spa services as often as I would like to.	Due to my job, I don't have the opportunity to travel for long periods of time or relax.	I try to combine spa treatments with getting to know a particular region.	I only use spa services on medical advice.	I always try to visit new spas.
SzSzB	HB	–	β = 0.838 p<0.001	β = 0.927; p < 0.001	–	β = 0.819 p <0.001	–
JNSz	HB	–	β = 0.989 p<0.001	β = 0.970; p = 0.001	–	β = 0.762 p =0.006	–
Male	Female	–	–	–	–	–	–
Low level of education	Higher education	β = −0.781 p = 0.020	β = 0.799 p=0.005	–	–	β = 0.750 p =0.008	–
Secondary school education	Higher education	β = −0.855 p = 0.001	β = 0.699 p=0.001	–	β = 0.447 p = 0.038	–	β = 0.545 p =0.012
Inactive (Retired, unemployed)	Active worker	–	–	β =−1.716. p < 0.001	–	–	–
Age	–	–	–	–	–	–	–

Based on the results, respondents in Szabolcs-Szatmár-Bereg and Jász-Nagykun-Szolnok counties were significantly more likely to indicate financial constraints and lack of time as barriers to using balneotherapy services. Educational attainment also proved to be a decisive factor: those with lower and secondary education were more likely to feel financially constrained and less likely to view spa treatments as recreational activities.

Inactive respondents were significantly less likely to perceive lack of time as a limiting factor. Gender and age did not have a significant effect on any of the attitudes examined. The results of the ordinal logistic regression analysis

confirm that attitudes and constraints related to the use of balneotherapy services are not determined solely by individual demographic characteristics, but are also significantly influenced by regional and structural factors.

Based on the results of the model, financial constraints and lack of time are more likely to appear in the perceptions of respondents in Szabolcs-Szatmár-Bereg and Jász-Nagykun-Szolnok counties, even when the analysis controls for educational attainment, economic activity, gender, and age. This suggests that social security support alone cannot compensate for regional inequalities in access to spa treatments.

Presumably, we can speak of a complex, multifactorial mechanism of effects in which the factors mutually influence one another, and where the utilization of services is simultaneously shaped by individual characteristics as well as the social and physical environment (Moravcsik-Kornyicki & Fedor, 2021). The impact of educational attainment also shows a consistent and interpretable pattern. Respondents with lower and intermediate levels of education were more likely to report feeling financially constrained and less likely to view spa treatments as a form of recreation or relaxation. This result is consistent with approaches that suggest that the use of health and health tourism services is influenced not only by formal access to care, but also by individuals' socioeconomic resources and interpretive frameworks. In this sense, spa tourism is not merely a therapeutic service, but an experience with different meanings for different social groups.

The impact of economic activity status—particularly in terms of perceived lack of time—further reinforces the structural interpretation. Inactive respondents were significantly less likely to cite lack of time as a limiting factor, which logically follows from their lack of time constraints related to work. This result highlights that the use of spa treatments is significantly influenced not only by financial conditions but also by time resources related to labor market position.

It is noteworthy that neither gender nor age had a significant effect on individual attitudes. This suggests that the differences examined are not primarily linked to biological or demographic characteristics, but rather stem from differences in the functioning of territorial and socio-economic structures. Overall, the results of the model suggest that, even with formal access provided by social security support, there remain "hidden" financial and time constraints that differentially affect actual access to and interpretation of balneotherapy services.

DISCUSSION

The results of this study confirm that attitudes toward and barriers to accessing balneotherapy services are complex, with individual socio-demographic characteristics and regional characteristics both playing a decisive role. The differences identified among patients treated in spas in the Northern Great Plain region with social security support and on medical grounds indicate that, even with formal access provided by funding, financial and time constraints remain that influence the actual use of services.

Based on an analysis of regional differences, financial constraints and lack of time were significantly more common in Szabolcs-Szatmár-Bereg and Jász-Nagykun-Szolnok counties than in Hajdú-Bihar county. This result is consistent with previous analyses of NEAK's financing and service provider capacities, which suggest that the spatial distribution of service providers and regional socio-economic conditions together shape access conditions (Varga, 2019; Hojcska, 2022). The results of the regression models show that these regional differences remain even when individual demographic factors are taken into account in the analysis. The effect of educational attainment showed a consistent pattern in both the assessment of financial constraints and the interpretation of the therapeutic, recreational, and tourist role of spa treatments. Respondents with lower and intermediate levels of education were more likely to report feeling financially burdened and less likely to view spa treatments as a form of recreation and relaxation. This result is consistent with approaches that suggest that the use of health and health tourism services is influenced not only by formal access to care, but also by individuals' socioeconomic resources, cultural capital, and interpretive frameworks (Rezapour et al., 2024).

The impact of economic activity status—particularly in terms of perceived lack of time—further complicates the interpretation of access barriers. Inactive (retired, unemployed) respondents were less likely to cite lack of time as a limiting factor, which is logical given their lack of work-related time constraints. This result highlights that the use of spa treatments is significantly influenced not only by financial conditions but also by time resources related to labor market position (Andersen, 1995). It is noteworthy that neither gender nor age had a significant effect on the attitudes examined. This suggests that the differences identified are not primarily related to biological or age characteristics, but rather stem from differences in the functioning of territorial and socio-economic structures. In this context, spa treatment is not only a form of healthcare, but also a socially embedded service with different meanings.

The limitations of the research include the fact that the sample is not representative and that data collection was conducted exclusively among patients who actually used balneotherapy treatments. Nevertheless, the results provide valuable empirical insight into regional patterns of attitudes and access barriers related to spa services covered by social security, and lay the foundation for further studies based on extended data collection.

CONCLUSIONS

Based on the results of the research, it can be concluded that access to spa treatments covered by social security benefits cannot be considered homogeneous in the Northern Great Plain Region. Despite the existence of formal financing frameworks, significant regional, social, and structural differences influence the actual interpretation of services.

The analyses showed that in Szabolcs-Szatmár-Bereg and Jász-Nagykun-Szolnok counties, financial and time constraints are more strongly reflected in patients' perceptions than in Hajdú-Bihar county, even when controlling for individual socio-demographic factors. Educational attainment and economic activity also play a decisive role in shaping attitudes, while gender and age were found to have no significant effect. The results of the research suggest that inequalities

in access to spa treatments cannot be interpreted solely as a health policy or financing issue, but are closely linked to regional socio-economic characteristics and individual resources. In this sense, spas fulfill both a health and health tourism function, the interpretation and utilization of which varies from one social group to another.

The study contributes to expanding the empirical basis for research on balneotherapy and health tourism, and highlights that regional and social inequalities should be taken into account when developing spas and planning services.

One of the methodological limitations of the research is that the primary data collection covered only those patients who personally participated in balneotherapy treatment during the data collection period, so the sample does not represent the entire range of potential users. As a result, the study primarily reflects the experiences and perceptions of patients currently receiving care. In order to expand the scope of the study, supplementary online data collection will also be launched, based on the basic structure of the questionnaire, using a database built on snowball sampling techniques via social media. This data collection provides an opportunity to include in the analysis the opinions and experiences of people who are unfamiliar with balneotherapy treatments, have used them in the past, or plan to use them in the future.

The data from the external sample can later serve as a control group, the inclusion of which can contribute to confirming the results of the present study and to a more nuanced interpretation of those results, with particular regard to the correlations between health status, financial situation, and regional access.

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THE EFFECT OF ONLINE DESTINATION BRAND EXPERIENCE ON BEHAVIOURAL INTENTIONS: THE MEDIATING ROLE OF DESTINATION BRAND AUTHENTICITY

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Abstract: This study examines the effects of online destination brand experience on destination brand authenticity, affective commitment, and behavioural intention within the context of cultural tourism destinations. As digital interactions increasingly shape tourists' destination perceptions before and during their travel experiences, understanding the role of online brand experiences has become essential for destination marketing research. Accordingly, this study contributes to the destination branding literature by investigating the mediating role of destination brand authenticity in the relationship between online destination brand experience and affective commitment. The study population consists of visitors who experienced the cultural tourism destinations of Zeugma and Gaziantep in Türkiye. Quantitative data were collected using a structured questionnaire administered to destination visitors, and the proposed conceptual model was analysed through Partial Least Squares Structural Equation Modelling (PLS-SEM) using SmartPLS. The empirical findings demonstrate that online destination brand experience has significant positive effects on destination brand authenticity, affective commitment, and behavioural intention. Furthermore, destination brand authenticity significantly mediates the relationship between online destination brand experience and affective commitment, indicating that authentic brand perceptions strengthen tourists' emotional attachment to the destination. These findings provide both theoretical and practical implications by emphasising the strategic importance of creating engaging and authentic online destination experiences to enhance tourists' emotional bonds and encourage favourable behavioural intentions. The study also offers valuable insights for destination marketing organisations seeking to strengthen destination competitiveness through effective digital branding strategies.

Keywords: online destination brand experience, destination brand authenticity, affective commitment, behavioural intentions, Zeugma

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INTRODUCTION

The perception of a destination as a brand is shaped by a set of associations and values that distinguish it from competitors and promise visitors unique and memorable experiences (Srivastava et al., 2022). Destination brand experience, in a physical context, emerges through tourists' direct visits to the destination (Candrea et al., 2025). However, when tourists interact with a destination through online channels such as official destination websites prior to travel, an online destination brand experience is formed, constituting a key component of the destination's experiential simulation process (Lin et al., 2024). In today's digitalized tourism market, destination marketing organizations (DMOs) increasingly use internet technologies to engage target audiences and promote their brands. Accordingly, online destination brand experience (ODBE) refers to the internal and subjective responses that arise during tourists' interactions with platforms such as official destination websites. These online experiences play a critical role in shaping perceptions of destination brand authenticity (DBA) (Khan & Fatma, 2021; Lalicic et al., 2020; Jimenez-Barreto et al., 2020; Napoli et al., 2016).

Many destinations emphasize authenticity and employ technologies such as virtual reality to establish stronger connections with tourists (Chen et al., 2020; Dağ et al., 2024). Immersive technologies, including AR and VR, are reported to enhance tourists' perceptions of destination brand authenticity by offering engaging and exciting experiences that exceed expectations (Gao et al., 2022). Consequently, destination brand authenticity has become a critical factor in tourism decision-making, as authenticity positively influences tourism experiences and related emotions (Chen et al., 2021). In this sense, perceiving a destination as authentic significantly affects destination choice and tourists' behavioral intentions (Zhou et al., 2023; Genc & Genc, 2023). Tourists' desire to escape the technological complexity and artificiality of everyday life further increases their demand for genuine and authentic experiences (Chen et al., 2020).

As a result, the search for authentic experiences has positioned destination brand authenticity (DBA) at the center of visitors' decision-making processes. DBA reflects the extent to which a destination is perceived as honest, value-driven, and supportive of visitors' self-expression. In this process, destination websites function as experiential simulations in the pre-visit stage by virtually presenting cultural and promotional elements, thereby playing a critical role in

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constructing authenticity perceptions (Khan & Fatma, 2021). Understanding how the relationship between ODBE and DBA influences behavioral intention is therefore essential. Prior studies demonstrate that unique experiences delivered through online interactions and multimedia content enhance authenticity perceptions, which in turn strengthen tourists' intentions to visit and recommend destinations (Khan & Fatma, 2021; Chen et al., 2020; Jimenez-Barreto et al., 2020).

CONCEPTUAL FRAMEWORK

Online Destination Brand Experience (ODBE)

Representing a preliminary stage, unlike traditional offline experiences, where tourists gather information and increase their motivation before making a decision, ODBE is expressed as the internal and subjective responses that occur during a tourist's interaction with a destination's official website or other digital platforms (Kumar & Kaushik, 2018; Choi et al., 2018; Zhang et al., 2018; Khan et al., 2016). ODBE, as a whole of sensory, emotional, cognitive, and behavioral responses, arises as a result of visitors' interaction with the destination brand in the digital realm (Lonardi et al., 2024; Grosso et al., 2024). This whole set of responses actually represents an experience that potential visitors have remotely lived through and formed in their minds via digital content before visiting the destination (Candrea et al., 2025). This digitally represented experience is considered a significant factor in decision-making and planning stages, positively influencing physical visits and behavioral intentions (Jimenez-Barreto et al., 2020).

Destination Brand Authenticity (DBA)

The increasing demand for authenticity in the tourism industry is considered important within the technological complexity of modern societies and is treated as a fundamental understanding for a genuine experience (Shi et al., 2022; Kososki & Prado, 2017; Yeh et al., 2025). DBA becomes an important structure at this point, responding to tourists' search for authentic experiences and representing a fundamental role with increasing importance in destination marketing. DBA is defined as the degree to which tourists perceive how honest a destination brand is in fulfilling its promises, and how "authentically" it represents its values and origins (Kumail et al., 2022). Therefore, authenticity includes elements such as the destination brand being honest with the tourist, being responsible, and helping the tourist find their own identity. Essentially, DBA is considered a subjective judgment about the authenticity and accuracy of a brand's image (Beverland & Farrelly, 2010; Newman & Dhar, 2014; Khan & Fatma, 2021; Can et al., 2025).

Affective Commitment (AC)

Affective commitment, reflecting visitors' desire to maintain a long-term relationship with a business or brand and their strong emotional responses to the destination brand, manifests itself through positive emotions and carries personal meaning. Affective commitment is a consumer's or tourist's emotional attachment to a brand and a sense of belonging based on identification with that brand (Iglesias et al., 2019; Brakus et al., 2009). Therefore, for visitors, this emotional commitment is more than just a rational choice for that destination; it carries a strong personal meaning (Zhong et al., 2017). This emotional commitment manifests itself through the happiness, pride, and strong positive emotions visitors feel while experiencing the destination. In other words, it is considered a strong sense of belonging to the destination and the destination having a personal meaning (Yew, 2008; Tang et al., 2021).

Behavioural Intentions (BI)

Behavioral intention is referenced to better understand marketing efforts and to provide a focal point for tourism managers in decision-making. Behavioral intention is considered a critical variable that determines the potential of a tourism experience to translate into future actions. Behavioral intention is defined as an individual's conscious and planned inclination or willingness to engage in future behaviors. In other words, it provides insight into the tourist's future interactions with the destination (Wong et al., 2020; Yeh et al., 2025). Behavioral intentions always focus on the expected outcome in future behavior and comparison with overt behavior, enabling tourism managers to better understand how to improve marketing efforts to create an attractive image for the destination and maximize resource utilization (Matiza & Kruger, 2021; Zatori et al., 2018).

THEORETICAL FRAMEWORK

Online Destination Brand Experience and Destination Brand Authenticity

Tourists, influenced by multiple visual and auditory stimuli, transform the experiences they perceive through these online platforms into lasting impressions. The function of destination websites is to present the cultural and promotional features of a destination to tourists before their visit, creating a perception that the destination is real and authentic. This is because tourists, overwhelmed by the complex routines of modern life, increasingly desire more interactive, value-oriented, and self-respecting experiences (Jimenez-Barreto et al., 2020; Mura et al., 2017). This desired authenticity is formed as a result of the internal and subjective interactions that visitors have with various experiences and stimuli. Therefore, the sensory and cognitive processes triggered during interaction with a website form a judgment about the authenticity of that destination brand (Moulard et al., 2016). Online experiences, especially those with a high level of emotional intensity, lead tourists to perceive the destination as more authentic and genuine (Jim´enez-Barreto et al., 2020). Consequently, online destination brand experience is considered a fundamental antecedent that constructs tourists' perception of destination authenticity (Khan & Fatma, 2021; Jimenez-Barreto et al., 2020; Chen et al., 2022; Jin et al., 2020). Based on this information, the following hypothesis is proposed:

H1. Online destination brand experience positively influences destination brand authenticity.

Online Destination Brand Experience and Behavioural Intentions

Online experiences offered by destinations through their official websites positively influence tourists' intentions to visit and recommend them to others. Sensory, cognitive, and emotional stimuli offered on these platforms create a positive destination image in the minds of tourists, strengthening behavioral intentions and encouraging digital interactions to translate into physical visits (Jimenez-Barreto et al., 2020). The enhancement of authenticity perception by online brand experience also has significant effects on destination selection and future behavioral intentions (Chen et al., 2022; Zhu et al., 2023). Previous studies have shown that a positive online experience directly increases visit intention and recommendation behavior (Bilgihan et al., 2016; Illouz & Illouz, 2017; Li et al., 2023; Wang et al., 2023; Candrea et al., 2025). Accordingly, the following hypothesis is proposed:

H2. Online destination brand experience positively influences behavioral intention.

Online Destination Brand Experience and Affective Commitment

Experiences delivered through online and interactive brand content generate strong emotional responses among tourists, thereby strengthening affective commitment and a sense of belonging toward the brand (Brakus et al., 2009; Iglesias et al., 2019). Interactive and value-laden digital experiences offered by destinations address not only visitors' rational needs but also their emotional needs, which enhances commitment (Li et al., 2023). In this context, stimuli presented through platforms such as destination websites (e.g., multimedia content) are reported to have significant effects on affective commitment. Prior studies consistently demonstrate that online destination brand experience (ODBE) has a direct and positive effect on tourists' affective commitment (Khan & Fatma, 2021). Accordingly, the following hypothesis is proposed:

H3. Online destination brand experience positively affects affective commitment.

Destination Brand Authenticity and Affective Commitment

When tourists perceive a destination brand's promises as honest, genuine, and faithful to its core values, destination brand authenticity (DBA) reinforces perceptions of strong values and originality, thereby increasing tourists' tendency to develop a strong affective commitment toward the brand (Sallaku & Vigolo, 2024; Yin & Dai, 2021). Moreover, DBA functions as a bridging mechanism in the relationship between online experiences and affective commitment, exerting a positive influence on tourists' emotional attachment to the destination (Manthiou et al., 2018; Kim & Song, 2020; Khan & Fatma, 2021). Accordingly, the following hypothesis is proposed:

H4. Destination brand authenticity positively affects affective commitment.

Affective Commitment and Behavioural Intentions

Affective commitment toward a destination brand positively influences tourists' behavioural intentions. Tourists who develop a strong emotional bond are more likely to recommend the destination, provide positive feedback, and exhibit brand loyalty (Brakus et al., 2009; Jimenez-Barreto et al., 2020; Donthu & Gustafsson, 2020; Khan & Fatma, 2021). Experiences delivered through digital environments and destination websites foster affective commitment, thereby strengthening long-term behavioural intentions (Hosany & Gilbert, 2010; Khan & Fatma, 2021). In this context, interactive and high-quality digital experiences enhance visit intentions and encourage positive online behavioural outcomes, such as favourable reviews and recommendations (Lalicic et al., 2020; Choi et al., 2018). Accordingly, the following hypothesis is proposed:

H5. Affective commitment positively affects behavioural intention.

The Mediating Role of Destination Brand Authenticity

DBA plays a strategic bridging role in tourism marketing by functioning as a critical mediator between various marketing stimuli and destination brand experience, acting as both an influencing and an influenced construct. In particular, destination brand authenticity has been confirmed to exert direct positive effects on revisit and recommendation intentions, thereby strengthening the link between brand experience and commitment (Zhou et al., 2023; Chen et al., 2020). In the relationship between ODBE and tourists' attitudes toward the destination, DBA occupies a central position. Its mediating role is especially grounded in tourists' efforts to reduce information asymmetry and make sense of virtual experiences, thereby serving an important interpretive function (Jimenez-Barreto et al., 2020). Prior studies indicate that destinations perceived as authentic foster positive emotions during brand interactions and increase tourists' likelihood of recommending the destination when their need for authenticity is fulfilled (Gilmore & Pine, 2007; Eggers et al., 2013; Schallehn et al., 2014). Moreover, brand authenticity positively influences tourists' affective commitment, brand engagement, and satisfaction, which ultimately shape behavioural outcomes (Carreira et al., 2022; Chen et al., 2022).

Sensory experiences generated by online multimedia content are considered sufficient to form judgments about destination authenticity, and such perceptions enhance affective commitment and subsequently strengthen behavioural intention (Khan & Fatma, 2021; Sallaku & Vigolo, 2024). Authenticity deepens tourists' interest in destination-related activities and reinforces their affective commitment (Yeh et al., 2025). In this process, DBA is described as a psychological bridge that enables marketing stimuli to resonate with tourists' minds and emotions (Can et al., 2025). While authenticity can directly influence visitor behaviour, it may also exert indirect effects through commitment (Meng & Luo, 2024), indicating that authenticity can generate multiple behavioural outcomes (Fu, 2019; Chen et al., 2020). Empirical findings further confirm the mediating role of DBA in the relationship between ODBE and affective commitment (Khan & Fatma, 2021; Can et al., 2025; You et al., 2015; Hasanein et al.,2026). Accordingly, the following hypothesis is proposed:

H6. Destination brand authenticity mediates the relationship between online destination brand experience and affective commitment.

MATERIALS AND METHODS

Data were collected from participants using a survey-based approach and an appropriate participant sample. The questionnaire was administered face-to-face in September 2025 and was completed by consumers who used the platform. Prior to responding to the survey, participants were asked to browse Zeugma's (Gaziantep) official online promotional platform(https://zeugma.org.tr/sanal-muze/). Accordingly, data were obtained from a sample of 515 users who had visited the cultural tourism destinations of Zeugma and Gaziantep in Türkiye and were familiar with the destination through its online promotional platforms. This procedure ensured that respondents had both actual destination experience and exposure to online destination-related content. Due to the large size of the research population, it was not possible to reach the entire population; therefore, a representative sample was selected by considering time and cost constraints. According to Krejcie & Morgan (1970), for populations exceeding 10,000, a sample size of 387 is sufficient at a 5% significance level and a 5% sampling error. Accordingly, the study aimed to reach at least 387 participants. Data were collected using a convenience sampling method through a pre-tested structured questionnaire. A five-point Likert scale was employed in the survey instrument.

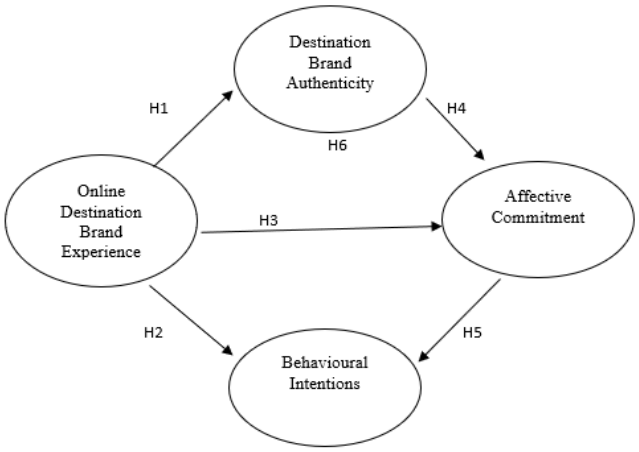


Figure 1. Research Model

RESULTS AND DISCUSSION

Demographics

The demographic characteristics of the participants are as follows (Table 1). Of the participants, 28.5% were between the ages of 25 and 34. The sample consisted of 47.2% males and 52.8% females. Regarding marital status, 41.6% of the participants were married, while 58.4% were single. In terms of education level, 44.5% of the respondents held a bachelor's degree. With respect to income level, 17.3% of the participants reported very low income, whereas 11.5% reported very high income.

Table 1. Demographic Characteristics of the Respondents

Demographic Characteristics		**n**	**%**
Age	18-24	84	16.3
	25-34	147	28.5
	35-44	134	26.1
	45-54	63	12.2
	55-64	41	8.0
	65 ≤	46	8.9
Gender	Male	243	47.2
	Female	272	52.8
Marital status	Married	214	41.6
	Single	301	58.4
Education	Primary education	23	4.5
	High school	44	8.5
	Associate degree	122	23.7
	Bachelor's degree	229	44.5
	Master's degree/Ph.D.	97	18.8
Perception of income status	Very low	89	17.3
	Low	132	25.6
	Average	173	33.6
	High	62	12.0
	Very high	59	11.5

Data Analysis

Data analysis was conducted using the SmartPLS software. SmartPLS enables the assessment of both measurement and structural models (Hair et al., 2014; Çavuşoğlu, 2021). In evaluating the measurement model, reliability was

assessed using Cronbach's alpha (CA) and rho_A, while internal consistency was examined through composite reliability (CR). Convergent validity was evaluated based on factor loadings and average variance extracted (AVE).

Discriminant validity was tested using the Fornell–Larcker criterion and the Heterotrait–Monotrait (HTMT) ratio. For the structural model, multicollinearity was examined using the inner variance inflation factor (VIF) prior to hypothesis testing. Subsequently, R^2 values were calculated to assess explained variance, and f^2 values were computed to determine effect sizes. Finally, path analysis was performed to test the proposed hypotheses.

External Model Results

Reliability and validity tests of the scale were conducted for the measurement model. For reliability and validity, the CA, rho_A, and CR values are expected to be greater than 0.70 (Nunnally & Bernstein, 1994), while factor loadings and average variance extracted (AVE) values are expected to exceed 0.50 (Kaiser, 1974). According to the results of the analyses, the reliability coefficients (CA and rho_A) and CR values were found to be above the threshold of 0.70, and both factor loadings and AVE values exceeded the recommended cutoff levels (Table 2 and Figure 2).

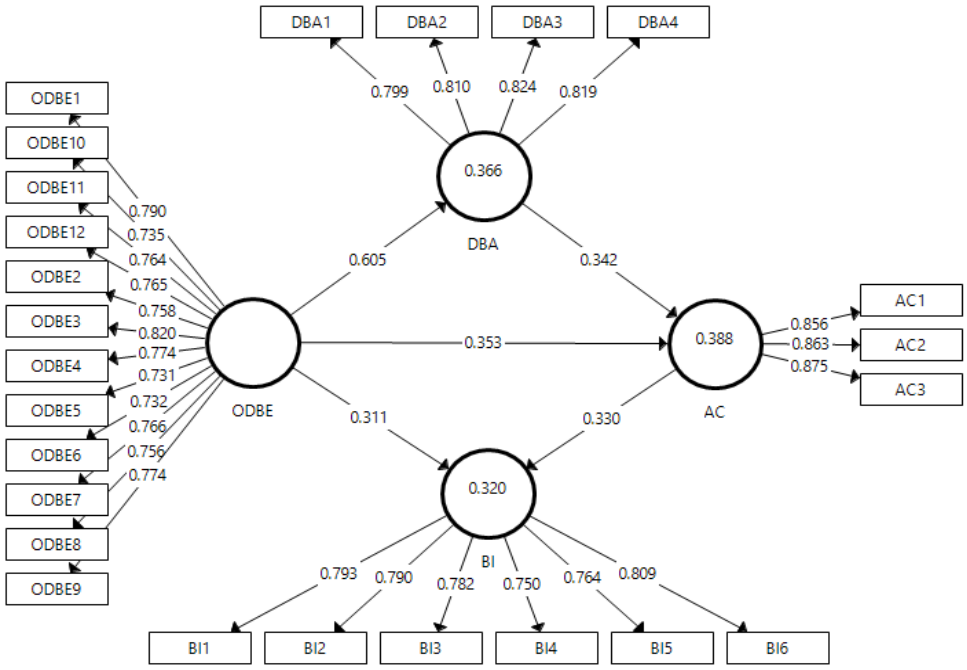


Figure 2. Average Variance Explained

The Fornell–Larcker criterion was applied to assess the discriminant validity of the scales (Fornell & Larcker, 1981). The results of the analyses indicate that the square roots of all AVE values on the diagonal in Table 3 are greater than the corresponding inter-construct correlation coefficients, thereby confirming discriminant validity.

Table 2. Reliability and Validity

Variables	CA	CR	rho-A	AVE
ODBE	0.935	0.944	0.936	0.584
DBA	0.829	0.886	0.831	0.661
BI	0.873	0.904	0.874	0.611
AC	02.831	0.899	0.832	0.747

Table 3. Fornell-Larcker Results

Variables	1	2	3	4
ODBE	**0.764**			
DBA	0.605	**0.813**		
BI	0.495	0.373	**0.782**	
AC	0.560	0.556	0.504	**0.864**

In addition, HTMT values were calculated to assess discriminant validity (Hair et al., 2016). HTMT values are expected to be below 1.00 (Voorhees et al., 2016). The results of the analyses indicate that all HTMT values are below this threshold (Table 4). The goodness-of-fit indices of the variables in the research model were used to assess the measurement model. SRMR and NFI values were analyzed using SmartPLS. The results indicate that the SRMR value is 0.039, which is below the critical threshold of 0.08 (Hu & Bentler, 1999). For the NFI, Hair et al. (2013) suggest that values close to 1 indicate good model fit. Accordingly, the NFI value was found to be 0.925. Overall, these results demonstrate that the research model meets the recommended goodness-of-fit criteria.

Table 4. HTMT Results

Variables	1	2	3	4
ODBE				
DBA	0.685			
BI	0.547	0.438		
AC	0.634	0.667	0.592	

Internal Model Results

In evaluating the structural model, inner VIF, R^2, f^2, and path coefficients were considered. All inner VIF values were below 3, indicating that multicollinearity among the constructs was not a concern (Diamantopoulos & Siguaw, 2006). Examination of the R^2 values shows that online destination brand experience explains 36% of destination brand authenticity, 32% of behavioural intention, and 38% of affective commitment (Table 5).

Table 5. R^2 Results

Construct		R^2		
Destination Brand Authenticity		0.36		
Behavioural Intention		0.32		
Affective Commitment		0.38		

These values exceed the commonly accepted threshold of 0.20 in consumer research (Marmaya et al., 2019). Furthermore, the f^2 analysis conducted to assess the explanatory power of the independent variables revealed that all effect size values were above 0.02 (Cohen, 1988). Based on these findings, all assumptions of the structural model were satisfied, and hypothesis testing was subsequently conducted.

Table 6. Hypotheses Results
p <0.001***, p <0.01**, p <0.05*; ODBE: Online Destination Brand Experience,
DBA: Destination Brand Authenticity, BI: Behavioural Intentions, AC: Affective Commitment

Hypotheses		ß	S.D.	t value	p value	VIF	f^2
H_1	ODBE >>> DBA	0.605	0.028	21.601	0.000***	1.000	0.578
H_2	ODBE >>> BI	0.311	0.045	6.958	0.000***	1.457	0.097
H_3	ODBE >>> AC	0.353	0.045	7.893	0.000***	1.578	0.129
H_4	DBA >>> AC	0.342	0.043	7.865	0.000***	1.578	0.121
H_5	AC >>> BI	0.330	0.044	7.495	0.000***	1.457	0.110

The results of the analyses indicate that online destination brand experience has a positive effect on destination brand authenticity, behavioural intention, and affective commitment. The structural model and standardized path coefficients are presented in Figure 3. Accordingly, hypotheses H1, H2, and H3 are supported (Table 6).

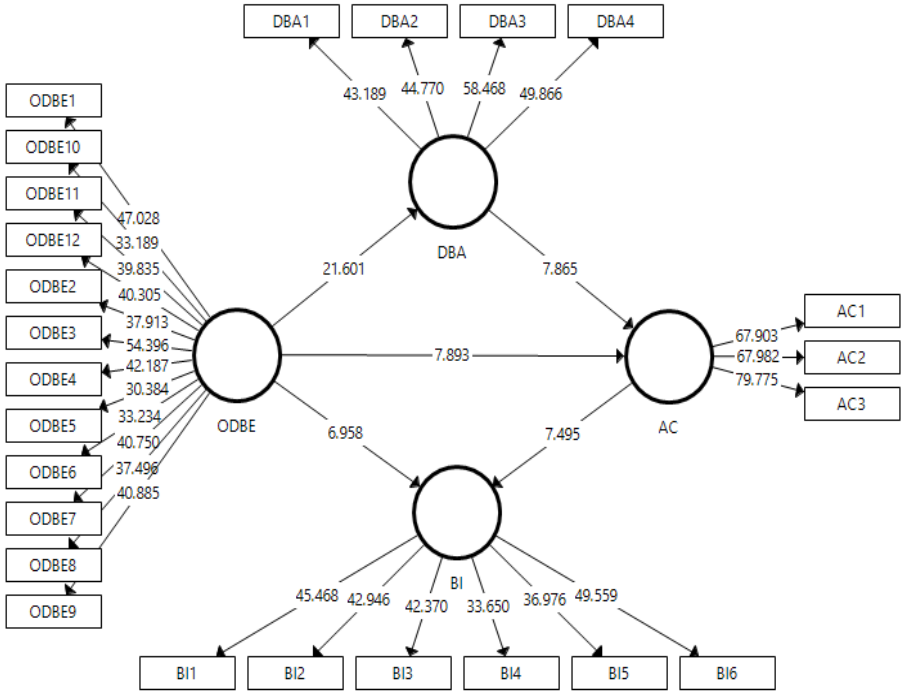


Figure 3. Structural Equation Modeling

Moreover, destination brand authenticity was found to have a positive effect on affective commitment, and affective commitment similarly exerted a positive effect on behavioural intention. Therefore, hypotheses H4 and H5 are also supported (Table 6). Finally, the mediating effect of destination brand authenticity in the relationship between online destination brand experience and affective commitment was examined. The mediation analysis revealed that destination brand authenticity significantly mediates this relationship. Accordingly, hypothesis H6 is supported (Table 7).

Table 7. Mediation Effect Analysis Results p=<0.001***, p=<0.01**, p≤ <0.05*

Hypotheses	***ß***	***S.D.***	***t value***	***p value***
ODBE >>> DBA >>> AC	0.207	0.029	7.216	0.000***

CONCLUSION

The study examines the effects of online destination brand experience on destination brand authenticity, affective commitment, and behavioural intention, while also investigating the mediating role of destination brand authenticity.

The findings indicate that all proposed hypotheses are supported.Specifically, the hypotheses proposing that online destination brand experience positively influences destination brand authenticity, affective commitment, and behavioural intention are supported. These results are consistent with prior studies in the literature (Khan & Fatma, 2021; Jimenez-Barreto et al., 2020; Chen et al., 2022; Jin et al., 2020; Illouz & Illouz, 2017; Bilgihan et al., 2016). In addition, the hypothesis suggesting that destination brand authenticity positively affects affective commitment is supported in line with previous research (Manthiou et al., 2018; Kim & Song, 2020; Khan & Fatma, 2021). Similarly, the hypothesis proposing that affective commitment positively influences behavioural intention is also consistent with the literature (Brakus et al., 2009; Khan & Fatma, 2021; Jimenez-Barreto et al., 2020; Donthu & Gustafsson, 2020; Lalicic et al., 2020; Choi et al., 2018). Finally, the mediation analysis reveals that destination brand authenticity plays a significant mediating role in the relationship between online destination brand experience and affective commitment.

The findings make several important theoretical contributions to the destination branding literature. This study theorizes that online destination brand experience (ODBE) is not merely a tool for information search, but also a fundamental cognitive and sensory process that constructs perceptions of destination brand authenticity (DBA).

While authenticity has traditionally been associated with physical visitation in the literature, the findings provide theoretical support for the notion that authenticity perceptions can also be effectively triggered in digital environments through multimedia content and virtual experience simulations delivered via destination websites (Liu et al., 2017; Jimenez-Barreto et al., 2020). Accordingly, online brand experience is suggested to enhance users' intentions to physically visit the destination, extending its role beyond pre-visit information provision to a key determinant of travel motivation (Li et al., 2023). Another important contribution of the study is the demonstration that ODBE exerts direct effects on behavioural intentions, such as visit intention and recommendation (Suhud et al., 2024). The psychological mechanism operating through DBA indicates that online experiences are transformed into enduring loyalty outcomes only when they pass through a filter of authenticity or perceived genuineness (Khan & Fatma, 2021). This finding suggests that interaction with a website alone does not directly generate commitment; rather, such interaction first constructs a perception of authenticity in tourists' minds, which subsequently triggers affective commitment. Furthermore, the internal and subjective responses experienced by tourists during their interaction with a destination website provide a sufficient basis for forming judgments about whether the destination is genuine and honest. This process, in turn, fosters the development of positive psychological attitudes toward the destination (Phat et al., 2025).

The findings also provide several practical implications for destination marketing organisations (DMOs). Official destination websites should be designed not merely as sources of information, but as experience simulation platforms. High-quality videos, high-resolution visuals, and interactive content that appeal to users' senses can enable tourists to develop strong evidence of a destination's authenticity before visiting. DMOs should therefore be more willing to use authenticity as a strategic mediator, as interactive experiences offered without first constructing authenticity perceptions are likely to be insufficient in generating long-term outcomes such as commitment and recommendation (Khan & Fatma, 2021). Accordingly, DMOs need to better examine and systematically build authenticity perceptions so that the destination brand is perceived as genuine by tourists. Destinations perceived as artificial or insufficiently authentic may face long-term strategic losses. In this regard, co-branding and joint promotional efforts with national tourism brands or partner brands possessing high authenticity values may yield positive results by transferring authenticity perceptions from strong to weaker brands, thereby directly enhancing visit and behavioural intentions.

At the same time, maintaining a balance between authenticity and technology is critical, as excessive technology may be perceived as intrusive or risky and could ultimately undermine authenticity (Gardiner et al., 2022).

Similarly, ODBE should be viewed not only as a promotional tool in destination marketing, but also as a mechanism for brand recovery and reputation management. While effectively managed online destination brand experiences can enhance tourists' visit intentions and brand loyalty through social media content, poorly managed digital experiences may lead to significant economic and reputational damage for destinations (Shah et al., 2025). To further strengthen behavioural intentions, tourists' regulatory focus orientations should be taken into account. For tourists who are risk-averse and security-oriented, authenticity functions as a safety signal, making this aspect particularly important. Marketing communications targeting this segment should emphasize the destination's traditional values, honesty, and ability to deliver on its promises. Ultimately, a high-quality digital experience not only directly increases behavioural intentions but also indirectly strengthens recommendation intentions by reinforcing perceptions of authenticity.

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Abbreviations: ODBE – Online Destination Brand Experience; DBA – Destination Brand Authenticity; AC – Affective Commitment; BI – Behavioural Intention; PLS-SEM – Partial Least Squares Structural Equation Modeling; AVE – Average Variance Extracted; CA – Cronbach's Alpha; CR – Composite Reliability; DMOs – Destination Marketing Organizations

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AGENTIC AI ADOPTION IN HOTEL REVENUE MANAGEMENT: AN EXTENDED META-UTAUT FRAMEWORK

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Abstract: The emergence of agentic artificial intelligence (AI), systems capable of autonomous reasoning, decision-making, and cross-functional execution, represents a paradigm shift from traditional predictive analytics to autonomous decision-makers in hotel revenue management (RM). Drawing upon the Meta-Unified Theory of Acceptance and Use of Technology (Meta-UTAUT), this study investigates the factors influencing the adoption of agentic AI among revenue managers in the Egyptian hospitality industry. A quantitative research design was employed, collecting primary data from 213 hotel revenue management managers across major Egyptian tourism destinations, including Cairo, Alexandria, Hurghada, and Sharm El-Sheikh. An extended Meta-UTAUT model was developed to examine the relationships between performance expectancy, effort expectancy, social influence, facilitating conditions, attitude toward use, and behavioural intention. Structural Equation Modelling (SEM) was utilised to test the formulated hypotheses and determine the strength and significance of these relationships. The results indicate that all nine direct hypotheses and four mediating hypotheses were supported, demonstrating that performance expectancy, effort expectancy, social influence, and facilitating conditions significantly influence both behavioural intention and attitude toward use, while attitude toward use plays a significant mediating role in the adoption process, demonstrating that performance expectancy, effort expectancy, and social influence significantly affect both behavioural intention and attitude toward use, while facilitating conditions positively impact attitude toward use. The results confirm that attitude toward use serves as a crucial mediating variable in the adoption process, providing empirical validation for the extended theoretical framework in the context of autonomous AI systems.

Keywords: agentic AI, hotel revenue management, extended Meta-UTAUT, technology adoption, Egypt

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INTRODUCTION

Artificial intelligence (AI) is rapidly reshaping hotel decision-making, moving the industry beyond rule-based automation toward agentic AI, systems that can plan, reason, and act autonomously across multi-step tasks to achieve goals (e.g., monitoring demand signals, testing rate strategies, coordinating channel actions, and learning from outcomes). While UTAUT/Meta-UTAUT has been extensively applied to hospitality technology adoption, and AI in revenue management has been widely discussed (Kadagidze & Ugrelidze, 2023), agentic AI adoption in hotel RM, particularly among Egyptian revenue managers, remains empirically undertested (Surianingsih et al., 2024).

In practice, hotels already rely on revenue management systems (RMSs) for forecasting and price optimisation, but these systems are often perceived as "black boxes", which can reduce managerial trust and willingness to follow algorithmic recommendations. A recent study in *tourism economics* highlights that explainable AI (XAI) may be critical for RM because interpretability can reduce mistrust and improve acceptance of AI-supported pricing and forecasting decisions, especially among expert stakeholders who must justify decisions internally (Salem et al., 2024). Despite the operational promise, adoption of agentic AI in hotel RM is not a purely technical issue, it is fundamentally behavioural and organisational.

Revenue managers must believe that agentic tools improve performance, are usable under time pressure, fit existing workflows, and are socially and institutionally supported (Huang, 2025). The broader hospitality technology-adoption literature consistently emphasises that adoption outcomes depend on users' perceptions of usefulness/benefits, ease of use, normative pressures, and enabling infrastructure. A recent meta-analysis synthesising hotel-context UTAUT/UTAUT2 evidence (2021–2025) found that core UTAUT constructs, performance expectancy, effort expectancy, social influence, and facilitating conditions, show reliable positive relationships with behavioural intention in hotel technology settings, while also varying by user type (operators vs. guests) and technology context (Kamal & Kamarulzaman, 2025).

At the same time, agentic AI introduces new psychological and governance dynamics that can strengthen the role of user attitudes. Unlike traditional decision-support tools, agentic systems can proactively initiate actions, negotiate trade-offs, and optimise over time, features that may amplify perceived risk, loss of control, and accountability concerns in RM

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(Dwivedi et al., 2026). In hospitality and tourism, recent research agendas on AI agents highlight both opportunities (efficiency, personalisation, and sustainability) and challenges (reliability, ethical risks, transparency, and responsibility allocation), reinforcing the need to examine adoption with attention to users' evaluative responses and trust-related judgements. These characteristics provide a strong rationale for extending the UTAUT logic using a Meta-UTAUT framing that explicitly incorporates attitude toward use as a proximal driver of behavioural intention, particularly when the technology is perceived as autonomous and high-stakes (Venkatesh et al., 2012). Supporting this approach, Meta-UTAUT has recently been applied in hospitality contexts (e.g., advanced service technologies), demonstrating its usefulness for explaining acceptance mechanisms beyond the classic UTAUT paths (Ibrahim & Islam, 2024).

The relationship between facilitating conditions and attitude toward use represents a critical yet often underexplored dimension in the adoption of agentic AI for hotel revenue management. Facilitating conditions, encompassing the organisational and technical infrastructure, availability of resources, training programmes, and ongoing support systems, can significantly shape users' attitudes by either reducing psychological barriers or amplifying concerns about implementation challenges (Venkatesh et al., 2003; Rahman et al., 2024). When revenue managers and hotel executives perceive that adequate technological infrastructure, expert assistance, and institutional support mechanisms are in place, their apprehension about transitioning from traditional rule-based systems to autonomous AI agents diminishes, fostering more favourable dispositions toward the technology (Oliveira et al., 2016; Koenig, 2025). This relationship operates through both cognitive and affective pathways: cognitively, strong facilitating conditions signal organisational commitment and resource adequacy, which users interpret as validation of the technology's legitimacy and viability (Tamilmani et al., 2021); affectively, the presence of comprehensive support structures reduces anxiety and uncertainty associated with complex AI systems, particularly given the autonomous decision-making capabilities that distinguish agentic AI from conventional automation (Dwivedi et al., 2019; Raheem & Hossain, 2025).

The study provides evidence-based strategies for technology adoption in emerging market hospitality settings, emphasising the importance of demonstrating performance benefits, ensuring system usability, leveraging social influence mechanisms, and establishing robust technological infrastructure. This study makes several distinctive contributions: (1) it extends Meta-UTAUT theory to the novel context of agentic AI, distinguishing autonomous, decision-making AI systems from generative AI tools, in hospitality revenue management; (2) it provides the first empirical investigation of autonomous AI adoption within the Egyptian hotel industry, addressing a significant gap in developing economy hospitality technology research; and (3) it validates attitude toward use as a critical mediating mechanism in agentic AI acceptance. In the Egyptian hospitality context, where hotels demonstrate varying degrees of technological preparedness and organisational competency, the strength of facilitating conditions becomes especially influential in shaping initial attitudes, as properties with limited prior experience in advanced analytics may view robust support infrastructure as essential for building confidence in AI-driven revenue management (Baabdullah et al., 2019).

Moreover, the heterogeneity across luxury Red Sea resorts, boutique Cairo hotels, and business properties suggests that facilitating conditions may differentially impact attitude formation depending on organisational resources and existing technological capabilities (Alalwan et al., 2017). However, research indicates that while facilitating conditions primarily predict behavioural intention and actual use through perceived behavioural control mechanisms, their indirect influence on attitude should not be underestimated, particularly during the critical early adoption phases when users are forming fundamental evaluative judgements about whether agentic AI represents an opportunity or threat to their professional roles and operational effectiveness (Venkatesh et al., 2012).

To strengthen the theoretical grounding of this study, the present research explicitly positions agentic AI adoption within the intersection of three converging streams of literature: (1) technology adoption theories, particularly the Meta-UTAUT framework; (2) artificial intelligence adoption in hospitality and tourism contexts; and (3) AI-driven revenue management and decision-support systems. While prior studies have extensively applied UTAUT and its extensions to general hospitality technologies (e.g., mobile services, service robots, and AI-enabled customer interfaces), relatively limited attention has been given to autonomous, agentic AI systems in operational decision-making domains such as revenue management. Moreover, some existing studies focus on general AI awareness or digital transformation, rather than directly addressing the behavioural mechanisms underlying the adoption of AI-driven decision-support tools. Therefore, this study refines the theoretical alignment by integrating recent and domain-specific literature on AI adoption in hospitality, algorithmic decision-making, and revenue management systems, ensuring that all cited works directly contribute to explaining how and why revenue managers adopt agentic AI technologies.

LITERATURE REVIEW

To ensure conceptual clarity, this study operationalises agentic AI as autonomous, goal-oriented artificial intelligence systems capable not only of generating recommendations but also of initiating, executing, and adapting revenue management actions with limited human intervention. In the context of hotel revenue management, agentic AI systems extend beyond traditional analytics or decision-support tools by continuously monitoring market conditions (e.g., demand fluctuations, competitor pricing, and booking pace), generating optimised pricing and inventory strategies, and autonomously implementing these decisions across distribution channels. For example, an agentic AI system may dynamically adjust room rates in real time, apply length-of-stay restrictions, reallocate inventory across online travel agencies, and refine its strategies based on observed performance outcomes. This operational definition distinguishes agentic AI from conventional revenue management systems, which typically require human validation before execution, and from generative AI tools, which primarily assist in content generation rather than operational decision-making.

Theoretical foundation and literature alignment

This study is grounded in the Meta-UTAUT framework, which extends the original Unified Theory of Acceptance and Use of Technology by incorporating additional psychological and contextual mechanisms, particularly attitude toward use as a mediating construct. The selection of this framework is justified by its strong empirical support in explaining technology adoption in organisational and hospitality contexts, especially when technologies involve uncertainty, complexity, and perceived risk. To ensure theoretical alignment, the literature review focuses on four closely related domains.

First, research on artificial intelligence adoption in hospitality highlights how AI technologies, such as service robots, predictive analytics, and intelligent systems, are increasingly shaping operational and strategic decision-making. These studies emphasize perceived usefulness, trust, and organizational readiness as key drivers of adoption.

Second, literature on AI-driven revenue management systems demonstrates the growing role of machine learning and automation in pricing, forecasting, and demand optimization. Unlike traditional decision-support systems, recent AI-based RM tools incorporate adaptive learning and real-time decision-making, making them more complex and requiring higher levels of user acceptance and trust.

Third, emerging research on agentic AI introduces a new paradigm in which systems act autonomously rather than merely supporting human decisions. This shift raises important behavioural and organizational questions about control, accountability, and transparency that are not fully addressed in traditional technology adoption studies.

Finally, prior applications of UTAUT and Meta-UTAUT in hospitality provide a strong theoretical basis for examining adoption behaviour, but many of these studies focus on customer-facing technologies rather than professional decision-making tools. By integrating these four streams, the present study ensures that the theoretical framework is both conceptually robust and directly relevant to the adoption of agentic AI in hotel revenue management.

Agentic AI and the shift from decision support to autonomous action in hospitality

Hospitality scholarship increasingly distinguishes between conventional "AI-enabled decision support" and agentic AI, where systems can plan, coordinate, and execute multi-step actions with limited human intervention (Chatti & Argoubi, 2025). In tourism and hospitality, agentic AI is framed as a step change because it redistributes decision rights, introduces new accountability pathways, and requires hotels to manage human-AI collaboration, governance, and risk controls more explicitly than earlier automation waves did. Complementing this macro view, work on algorithmic management in hotels shows that as algorithmic systems become more embedded, managerial roles evolve toward "translation," facilitation, and coaching, helping teams understand and operationalize algorithmic outputs while maintaining motivation, coordination, and service quality (Jianu et al., 2025). This emerging stream implies that adoption of agentic AI is not merely "technology acceptance," but acceptance of algorithmic agency in domains where decisions have visible performance consequences (Ngo, 2025).

AI in hotel revenue management and the importance of transparency and trust

Revenue management is a natural use case for AI because it depends on high-frequency analysis of demand signals, competitor pricing, distribution constraints, and inventory controls, complementing broader evidence on AI's synergy with hotel financial management functions (Milton, 2024). However, hospitality research also notes that AI in RM can face resistance when recommendations are perceived as non-transparent, difficult to justify, or misaligned with managerial expertise and accountability requirements (Mullapudi, 2025). This matters even more for agentic RM systems than for advisory revenue management. When an AI system shifts from recommending to acting (e.g., implementing rate changes or restrictions), the adoption calculus becomes more complex: users evaluate not only predictive accuracy but also reliability under unusual market conditions, integration with workflows, escalation logic, and auditability. The wider hospitality employee-focused AI literature supports this view (Agrawal et al., 2024).

Technology adoption models in hospitality: from UTAUT to Meta-UTAUT extensions

To explain why professionals, adopt advanced technologies, hospitality research frequently builds on UTAUT/UTAUT2 (Venkatesh et al., 2003, 2012) while adapting constructs to sector realities such as service experience, operational constraints, and multi-stakeholder pressures. Recent hospitality meta-evidence supports the continued relevance of the core UTAUT predictors. At the same time, hospitality scholars increasingly rely on Meta-UTAUT approaches that incorporate additional psychological and contextual factors (e.g., trust, anthropomorphism, aesthetics, privacy) and elevate attitude as a mechanism linking beliefs to intention in emerging technology contexts. Although much of this evidence is guest-facing (e.g., robots), it is theoretically informative for professional settings: when technologies introduce uncertainty, perceived agency, or accountability concerns, users' global evaluations (attitude) become more diagnostic than any single belief (Godolja et al., 2025).

Performance expectancy and behavioural intention

Performance expectancy, defined as the belief that using a technology will improve of job performance and the provide actual benefits, is one of the most powerful factors in technology adoption across a range of settings (Rahi et al., 2019). Performance expectancy in the context of agentic AI in hotel revenue management includes perceptions of the system's capacity to optimize pricing policies, improve forecast accuracy, increase revenue growth, decrease the amount of manual work, and enable higher-quality decision-making (Tamilmani et al., 2021). In RM, PE is likely to include expectations about improved forecasting, faster reaction to demand, better price optimization, and reduced manual workload, benefits that become stronger when AI is positioned as continuously learning and executing (Naghavi et al., 2024). The agentic AI is autonomous, continuously learning from the market and independently adjusting its strategies without necessarily needing human intervention, which may enhance performance expectations as users expect more than traditional revenue

management systems can provide (Hosseini & Seilani, 2025). The strong correlation between performance expectancy and behavioral intention has been proven in empirical studies in various areas of technology (Baabdullah et al., 2019; Sair & Danish, 2018). Therefore, the suggested hypothesis is as follows:

H1: Performance Expectancy has a significantly positive effect on Behavioural Intention

Effort expectancy and behavioural intention

Effort expectancy takes on special importance in the context of agentic AI in hotel revenue management as these devices are sophisticated, and the machines that apply machine learning algorithms involve technical complexity, making the transition to AI-assisted or AI-independent systems associated with a learning curve (Morosan & Dursun-Cengizci, 2024). The relationship between effort expectancy and behavioural intention has been well documented in the context of technological applications in organizational settings. Studies have consistently shown that once users believe that technologies are simple to use and do not involve much effort or investment, their adoption and continuance intentions toward the systems rise to high levels. The latter relationship is particularly strong in the early stages of adoption, as users form initial judgments of system usability based on demonstrations, training, or early interactions (Gunesekera et al., 2019). The urgency of decision-making in revenue management, where professionals are required to process information quickly and make price adjustments to reflect market conditions, makes effort expectancy crucial, as cumbersome or cognitively challenging systems could slow decision-making effectiveness rather than improve it (Hayes et al., 2021). Therefore, the suggested hypothesis is as follows:

H2: Effort Expectancy has a significantly positive effect on Behavioural Intention

Social influence and behavioural intention

Social influence refers to the degree of perception among individuals that important others think they ought to use a given technology, which is indicative of social pressure, normative beliefs, and interpersonal forces within technology adoption decisions. The basic acknowledgment of social influence is that adoption decisions on technologies are not always made in isolation, but rather have a societal aspect where the opinions, suggestions, and actions of peers, supervisors, industry leaders, and personal networks play a major role in influencing individuals' intentions and actions. SI is salient in hotels due to cross-functional interdependence (sales, marketing, operations, GM/ownership) and strong normative pressures tied to competitive benchmarking and brand standards (Figueroa-Armijos et al., 2023).

Social influence has various channels in organizational technology adoption situations which include direct suggestions by colleagues whom one has high regard for, adoption behaviour by other similar organizations, industry association promotion, management pressure to adopt technology, and symbolic sense of being viewed as technologically advanced or innovative (Al-Adwan et al., 2024). Hotel revenue management professionals work in communities of professionals who are closely connected with each other and whose best practices are spread as people gather in industry associations, presentations by technology vendors, peer discussions, and competitive practices as people observe. As industry leaders or reputable individuals in the hotel industry switch to the use of agentic AI systems and share positive experiences, normative pressures develop that other hotels should also switch to stay within the same level of competition and professionalism (D'Emidio, 2025). Therefore, the suggested hypothesis is as follows:

H3: Social Influence has a significantly positive effect on Behavioural Intention

Facilitating conditions and behavioural intention

The spirit behind facilitating conditions is that adoption intentions and positive attitudes cannot always be effectively translated into actual use unless they are properly supported by structures, provision of resources, and environmental facilitators (Priyastomo et al., 2025). In agentic RM, FC should be interpreted broadly to include reliable data pipelines, connectivity across PMS/RMS/channel manager/BI systems, governance policies (approval thresholds, audit logs), and training for human-AI collaboration (Winskowski & Homölle, 2022). With respect to the adoption of agentic AI in the hotel revenue management process, the conditions of facilitation include availability of excellent internet connection and computing infrastructure, presence of quality training programs that lead to the development of AI literacy and system competence, availability of consistent technical support in addressing implementation challenges, compatibility of agentic AI systems with current property management systems or revenue management processes, and organizational commitment via resource allocation and management support that justifies time investment in learning and using the new technologies (Sun et al., 2025). Therefore, the suggested hypothesis is as follows:

H4: Facilitating Conditions have a significant positive effect on Behavioural Intention

Performance expectancy and attitude toward use

According to Rahi et al. (2019), the effects of performance expectancy are not limited to behavioural intention but also include the formation of attitudes that mediate technology acceptance. Whereas the traditional UTAUT framework places performance expectancy as a direct antecedent of behavioural intention, the Extended Meta-UTAUT framework acknowledges that performance beliefs also mediate attitudinal inclinations toward technologies, which, in turn, mediate intentions and behaviour. Attitudes reflect more or less enduring positive or negative judgments of things, actions, or concepts, formed by information-integration processes in which beliefs about consequences are evaluated against outcome valuations.

The performance expectancy-attitude toward use relationship operates through both cognitive and affective channels. On the cognitive level, positive associations with the technology form around expectations of good performance, as people are likely to realize desired goals and results with its use. Emotionally, performance expectations may have an impact, such as enthusiasm, confidence, and optimism about future performance, especially when projected performance improvements cover

existing pain points or professional ambitions (Wang & Chen, 2025). Therefore, the suggested hypothesis is as follows:

H5: Performance Expectancy has a significantly positive effect on Attitude Toward Use

Effort expectancy and attitude toward use

The role of effort expectancy in shaping technology acceptance has both attitudinal mediation effects and behavioural intentions. The Extended Meta-UTAUT framework acknowledges that ease or difficulty perceptions of technology use are related to general evaluative orientations about technology usage, which lead people to develop positive or negative attitudes (Chatterjee et al., 2023). When people have a sense that agentic AI systems will be simple to master, user-friendly, and require minimal cognitive effort to use successfully, such ease perceptions will contribute to positive attitudes toward the technology overall. On the other hand, negative attitudes, such as trepidation, unwillingness, or cynicism, are created by expectations of steep learning curves, complex interfaces, or cognitively challenging interactions (Hsieh & Lee, 2024).

The connection between effort expectancy and attitude toward use takes place through several psychological processes applicable to agentic AI adoption in hotel revenue management (Kukanja & Planinc, 2025). This decrease in negative experiences that are anticipated leads to higher positive attitudinal orientations (Zampetakis et al., 2016). The possibility of agentic AI systems making the work processes of revenue management professionals simpler instead of more complex is also a source of positive attitudes in situations where they already face significant analytical demands and time constraints (Hughes et al., 2025). Therefore, the suggested hypothesis is as follows:

H6: Effort Expectancy has a significantly positive effect on Attitude Toward Use

Social influence and attitude toward use

To a greater extent, social influence not only affects technology acceptance by directly influencing behavioural intentions but also through the process of attitude formation, as social contexts and interpersonal relations are found to influence not only what people intend to do but also how they feel and evaluate technologies (Trivedi et al., 2022). When revenue management professionals see respected peers talk about agentic AI in a positive way, suggest its usage, or show interest in its functionality, the social cues shape their own attitude development, thereby leading to a positive or negative orientation based on the valence of the social messages they obtain (Akter & Ahmed, 2025).

The interaction between social influence and attitude toward use operates through informational and normative processes. Informationally, social influence offers vicarious learning experiences, in which one develops an attitude on the basis of what other people report, their opinions, and what they demonstrate (Maity et al., 2019). Whenever hotel revenue managers learn that associates in other properties are enjoying positive experiences with agentic AI, improved revenue performance, increased decision confidence, or less workflow burden, they have been influenced by such testimonies to form attitudes, as they offer social evidence of the value of the technology and dispel doubts about what it entails (Hodari et al., 2020). When the adoption of agentic AI is linked to progressive, innovative, or professionally advanced hotel operations in industry networks, revenue management professionals could form positive attitudes toward the technology in part by identifying with these desirable features and the urge to conform to the professional norms that arise in their reference groups (Gass & Seiter, 2022). Therefore, the suggested hypothesis is as follows:

H7: Social Influence has a significantly positive effect on Attitude Toward Use.

Facilitating conditions and attitude toward use

The interaction between facilitating conditions and attitude toward use is a significant but subtle process in technology adoption (Or, 2024). Once users appreciate that sufficient resources, training, and technical support are in place, their fears will diminish, and their attitude toward the technology will improve. This association works both directly and indirectly: on the one hand, the presence of strong facilitating conditions can lead to positive correlations with the technology itself; on the other hand, perceived ease of use is positively affected, and anxiety is negatively affected, which in turn influences attitude (Zhou et al., 2019). The facilitating conditions-attitude toward use relationship, although a less explored UTAUT relationship compared to other relationships, encompasses significant theoretical implications regarding the effects of environmental facilitators in influencing the psychological orientations toward technologies (Dwivedi et al., 2019). On the other hand, when facilitating conditions are considered weak or absent, skeptical or negative attitudes are likely to emerge, where people perceive the technology as not well supported, incongruent with organizational realities, or unlikely to be given the long-term investment it may require to be successfully implemented (Clark et al., 2016).

Though the intensity of this relationship can vary by degree of user experience, beginner users tend to be more attitudinally responsive to facilitating conditions than experienced users, who already have internal resources and competency (Hornbæk & Hertzum, 2017). Also, in circumstances where use is mandatory, the conditions of facilitation do not necessarily have a significant impact on attitude formation, as users are required to use the technology whether they feel it or not; however, with sufficient support, negative attitudes do not develop. It is argued that although facilitating conditions are the most direct predictors of behavioral intention and actual use (especially through perceived behavioral control) (Khechine & Lakhal, 2018). Therefore, the suggested hypothesis is as follows:

H8: Facilitating Conditions have a positive and significant effect on Attitude Toward Use.

Attitude toward use and behavioral intention

Agentic AI changes the psychological object of adoption from "a tool I use" to "an actor I delegate to." In such settings, attitude provides a compact evaluation that integrates perceived usefulness, effort, risk, and control into an overall stance toward the technology. Hospitality AI research supports the importance of attitudinal and trust-related pathways: for

example, customer-facing AI adoption studies show that perceived benefits and trust mechanisms help explain behavioral intentions in AI-adopting hotels (Kamal & Kamarulzaman, 2025). Evidence from Meta-UTAUT applications in hospitality further supports the model of attitude as a mediator between expectancy beliefs and intention. In the International Journal of Hospitality Management, the Meta-UTAUT robot study found that attitude mediates the relationships between PE/EE and behavioral intention (Aikins & Dimitrijevska-Markoski, 2026; Marghany et al., 2025). Translating this to agentic RM, attitude can capture whether revenue managers feel comfortable with AI autonomy, whether they perceive agentic actions as aligned with RM logic, and whether they believe the system's outputs are defensible to stakeholders (e.g., GM/ownership). Therefore, the suggested hypothesis is as follows:

H9: Attitude Toward Use has a significantly positive effect on Behavioural Intention

Contextualizing adoption in Egypt: Digital readiness and emerging-market constraints

Empirically, the focus on Egyptian hotel revenue managers is well motivated because emerging-market hospitality environments often exhibit wider variance in data maturity, integration quality, and resource availability,conditions that directly map onto facilitating conditions. Egypt-focused work on technology transformation highlights the benefits and challenges of digital transformation in Egyptian hotels, including partial readiness and department-level constraints (Noby et al., 2024). Broader empirical evidence from Egypt's travel and hospitality sector also shows that AI/automation adoption decisions are shaped by factors such as compatibility, data security, external pressures, and organizational readiness (Ismail et al., 2025).

Research gap and study contribution

Across top-tier and emerging hospitality/tourism journals, three points converge. First, hospitality research anticipates a shift toward agentic systems that require stronger governance and human-AI collaboration (Ali & Ali, 2025; Dwivedi et al., 2026). Second, RM-focused AI work highlights that transparency and explainability are essential to make AI outputs usable and defensible in practice (Akhtar et al., 2024). Third, Meta-UTAUT models have proven effective in explaining hospitality technology adoption, particularly when attitude serves as a mediating mechanism between expectancy beliefs and behavioural intention (Hasanein et al., 2025). However, despite these advances, empirical research on agentic AI adoption in hotel revenue management, particularly among revenue managers in emerging markets such as Egypt,remains limited. This study addresses this gap by developing and testing an extended Meta-UTAUT framework that examines how performance expectancy, effort expectancy, social influence, and facilitating conditions influence both attitude toward use and behavioural intention in the context of agentic AI adoption for hotel revenue management among Egyptian revenue managers. In contrast to earlier studies that relied on broadly related or cross-domain technology adoption literature, this review prioritizes recent and context-specific research on artificial intelligence in hospitality, revenue management systems, and AI-driven decision support. This ensures that each theoretical construct within the Extended Meta-UTAUT model is supported by evidence directly related to the study context. By aligning the cited literature with the specific characteristics of agentic AI,such as autonomy, continuous learning, and decision execution,the study enhances both the theoretical precision and empirical relevance of the proposed model. After reviewing the previous studies, the suggested hypotheses are as follows:

H10: Attitude toward use mediates the relationship between performance expectancy and behavioural intention

H11: Attitude toward use mediates the relationship between effort expectancy and behavioural intention

H12: Attitude toward use mediates the relationship between social influence and behavioural intention

H13: Attitude toward use mediates the relationship between facilitating conditions and behavioural intention

Research model

Having established the theoretical model (illustrated in Figure 1) and proposed hypotheses, the following section outlines the research methodology for empirically testing the proposed relationships, including the research design, sampling procedure, data collection methods, and analytical approach.

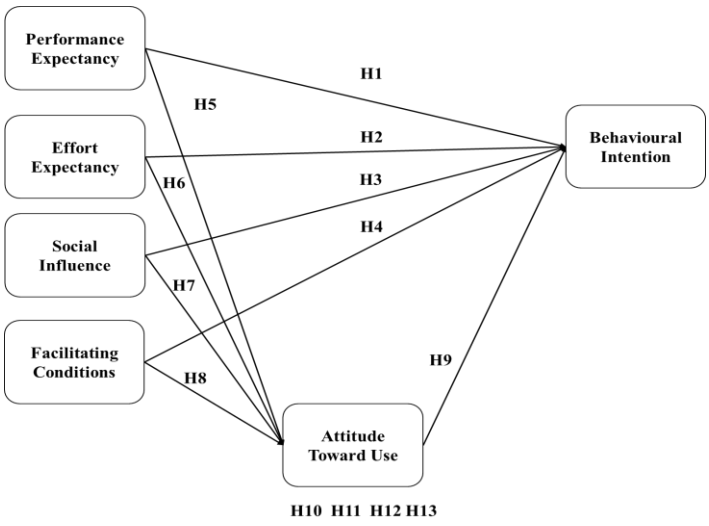


Figure 1. Research Model (Source: Dwivedi et al., 2019)

METHODOLOGY

To ensure a consistent understanding of agentic AI among respondents, a brief standardized explanation was provided at the beginning of the questionnaire. The definition described agentic AI as autonomous revenue management systems capable of analysing market data, generating pricing decisions, and automatically implementing these decisions across hotel systems with minimal human intervention. In addition, respondents were given practical examples (e.g., automatic price adjustments, real-time inventory control, and self-optimizing revenue strategies) to contextualize the concept within their daily operational environment. This approach was adopted to reduce ambiguity and ensure that participants evaluated the constructs based on a shared, contextually relevant understanding of agentic AI rather than general perceptions of artificial intelligence.

Research design and philosophical approach

The paper uses a quantitative research design, adopting a positivist epistemology to inform research inquiry into the adoption of agentic artificial intelligence in hotel revenue management in the Egyptian hospitality industry. The quantitative method was chosen due to its ability to test theoretical relationships systematically, measure latent constructs using validated measures, and produce findings that apply to the study's entire population. The research is informed by positivist philosophical assumptions that the phenomena of technology adoption are objectively measurable, that relationships among constructs exist independently of the researcher, and that empirical observation based on structured data collection is valid for making inferences about the determinants of adoption (Shibly et al., 2022). The deductive character of this study begins with theoretical hypotheses grounded in the Extended Meta-UTAUT model and proceeds to empirical validation through testing, consistent with the existing traditions of research on technology acceptance (Razzak & Jassem, 2021).

Population and sampling

The research population will be hotel revenue management professionals employed in establishments within the largest Egyptian cities, who will be the main decision-makers and influencers in the hotel agentic AI adoption decisions. The sampling procedure followed a purposive (judgmental) sampling approach, targeting hotel professionals directly involved in revenue management decisions. Eligible participants included revenue managers, revenue analysts, assistant revenue managers, and senior managers responsible for pricing and demand management functions. These roles were selected to ensure that respondents possessed relevant knowledge and practical experience with revenue management systems and emerging AI technologies. Participants were identified through multiple sources, including industry directories, professional networks, hotel contact databases, and tourism-related associations. Data collection was conducted across four major Egyptian tourism destinations (Cairo, Alexandria, Hurghada, and Sharm El-Sheikh) to capture variability in hotel types and operational contexts. The selection process prioritized medium-to-large-sized hotels where formal revenue management practices are more likely to be established. To reduce selection bias, invitations were distributed across different hotel categories (e.g., business hotels, resorts, and chain-affiliated properties), ensuring diversity in organizational size, market segment, and technological maturity. This approach enhances the representativeness of the sample within the constraints of a non-probability sampling design commonly used in organizational technology adoption studies.

These cities together account for a large share of the total number of hotel rooms in Egypt and encompass a diverse array of operational settings, including urban business hotels, beach resorts, cultural tourism properties, and mixed-use establishments. The sampling frame was established through consultation with the Egyptian Hotel Association, tourism ministry databases, and industry directories to select hotels with revenue management functions, given the notion that small properties might not have dedicated revenue management functions and that larger hotels tend to have many revenue management employees. Since the target population is specialized and it is not feasible in an emerging market setting to obtain full sampling frames, a purposive sampling strategy was used to ensure representation of pertinent respondent attributes.

Revenue analysts, senior managers, revenue managers, assistant revenue managers, and revenue managers were identified as suitable respondents, as they had first-hand experience evaluating revenue management technology, making decisions on technology adoption, and using systems. To determine a sufficient sample size for structural equation modeling, guidelines for the minimum sample size required in SEM were used. Then, based on the standard rule of the number of observations per estimated parameter (10-15) and the complexity of the Extended Meta-UTAUT model with eight hypothesized paths and measurement model parameters, the target was set at 200 respondents. The last sample of 213 respondents exceeds this threshold, providing sufficient statistical power to estimate parameters and test hypotheses using SEM procedures. The sample size calculation can be expressed as:

$$\frac{1.645^2 * 0.50\ (1-0.50)}{0.1^2} = 68$$

where Z = 1.645 is the critical Z-value corresponding to a 90% confidence level (a dimensionless standard normal deviate); p = 0.5 is the estimated population proportion of the target attribute (dimensionless), selected at its most conservative value to maximize the required sample size; (1 - p) = 0.5 is the complement of that proportion; and e = 0.1 is the maximum acceptable margin of error, set at 10% (i.e., ±0.10 on a 0-1 proportion scale). Applying these values yields a minimum required sample of 68 respondents per group or stratum.

The final sample size of 213 respondents is considered adequate for Partial Least Squares Structural Equation Modelling (PLS-SEM) analysis. Following the "10-times rule," the minimum required sample size should be at least ten times the maximum number of structural paths directed at any construct in the model. In this study, the most complex construct (behavioural intention) has four incoming paths, suggesting a minimum sample size of 40. Additionally, recent

methodological guidelines recommend larger samples (e.g., >200) to ensure statistical power and model stability. Therefore, the sample size of 213 exceeds these thresholds and is sufficient for reliable estimation and hypothesis testing.

Data collection instrument

The measurement instrument was developed based on previously validated scales from the technology adoption literature, particularly studies applying UTAUT and Meta-UTAUT frameworks. Items measuring performance expectancy, effort expectancy, social influence, facilitating conditions, behavioural intention, and attitude toward use were adapted from established sources (e.g., Venkatesh et al., 2003; 2012; Tamilmani et al., 2021; Chatterjee et al., 2023), with wording modified to fit the context of agentic AI in hotel revenue management. All items were measured using a five-point Likert scale ranging from "strongly disagree" to "strongly agree." To ensure content validity, the questionnaire was reviewed by academic experts in hospitality and information systems, as well as industry professionals in revenue management. A pilot test was conducted with a small group of respondents to assess clarity, relevance, and wording. Construct validity and reliability were evaluated using PLS-SEM measurement model assessment procedures, including indicator loadings, composite reliability (CR), average variance extracted (AVE), and discriminant validity (HTMT criterion). All constructs met the recommended thresholds, confirming the measurement instrument's adequacy.

Data collection procedure

Data collection was implemented over a four-month period, from September 2024 to December 2024, which will allow sufficient time to cover the target population, which is geographically spread, while ensuring consistent timing between responses. Several distribution channels were used to achieve the highest response rates and sample representativeness. The distribution was mostly online, via survey platforms (via email), where revenue management professionals were contacted based on hotel contacts, industry association membership, and professional network contacts.

The online platform enabled effective data collection across different cities, in addition to offering capabilities such as progress indicators, response validation, and automated data collection, which improved data quality. Regarding professional experience, respondents spanned a wide range, from less than 5 years to more than 10 years in hospitality and revenue management. This diversity enhances the robustness of the findings by incorporating perspectives from both relatively new and highly experienced professionals. In terms of organizational context, respondents were drawn from different types of hotels, including luxury resorts, business hotels, and chain-affiliated properties, primarily located in Cairo, Alexandria, Hurghada, and Sharm El-Sheikh. This diversity reflects variations in operational environments, technological readiness, and market dynamics within the Egyptian hospitality industry.

Additional distribution was made via face-to-face delivery at industry conferences and professional gatherings, where revenue management practitioners met and offered a chance to interact with them in person, clarify questions, and build relationships, which might have added to the motivation to respond. Ethical issues were addressed by making the data collection protocol focus on voluntary participation, informed consent, and confidentiality guarantees to help participants be honest and considerate in their responses. Respondents were informed of the purpose of the research, the intended use of the data collected, and their rights to terminate their participation or refuse to provide detailed answers to certain questions.

Data analysis techniques

Data analysis was conducted using Partial Least Squares Structural Equation Modelling (PLS-SEM) with SmartPLS version 3. This approach was selected due to its suitability for exploratory research, complex models with multiple constructs, and prediction-oriented objectives. PLS-SEM is also appropriate for studies with relatively moderate sample sizes and non-normal data distributions, to confirm the properties of measurement, and test hypotheses on structural relationships stipulated in the Extended Meta-UTAUT framework. The first analysis was conducted through data screening to detect missing data patterns, outliers, and potential data entry errors. The analysis of missing data revealed that missing values accounted for less than 5 percent of the data set and were not systematically present; instead, they were randomly distributed, allowing the application of expectation-maximization algorithms to impute missing data.

The Mahalanobis distance calculation reads were used to detect outliers in the sample, with some of the multivariate outliers being reviewed separately; those that represented a valid extreme response were included in the analysis, whereas those that seemed to be due to an apparent data entry error or a poor response to the question were eliminated. All measured variables were summarized using descriptive statistics (means, standard deviations, skewness, kurtosis) to describe the sample and evaluate distributional characteristics for future multivariate analysis. Structural Equation Modelling (SEM) was the primary technique used in the analysis: it is a complex multivariate method that estimates the parameters of measurement models (relationships between latent constructs and their indicators) and structural model parameters (relationships between latent constructs). AVE values greater than 0.50, and Composite Reliability (CR) values greater than 0.70 also provided further convergent validity evidence. Discriminant validity was tested by comparing squared correlations between constructs with AVE values. AVE greater than squared correlation, there are constructs that represent more variance on their indicators than they overlap with other constructs. The model fit was assessed as a series of fit indices that offer various measures of model adequacy, i.e. the chi-square test of exact fit, incremental fit measures such as Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI), absolute fit measure such as Root Mean Square Error of Approximation (RMSEA) and residual-based fit measure Standardized Root Mean Square Residual (SRMR). The standard measures, such as CFI and TLI values of above 0.90, RmseA below 0.08, and SRMR below 0.08, were used to determine the acceptable model fit. After developing sufficient properties for the model of measurement, structural model analysis was used to estimate path coefficients that depicted the proposed relationships between constructs. The estimation

was carried out using maximum likelihood when the sample size was sufficient, and the data were approximately normal. Path coefficients were interpreted in terms of magnitude, direction, and statistical significance; path coefficients with critical ratios (t-values) greater than 1.96 were considered statistically significant at the $p < 0.05$ level.

The analysis followed a two-step approach: (1) assessment of the measurement model and (2) evaluation of the structural model. The measurement model was assessed using indicator loadings, composite reliability (CR), average variance extracted (AVE), and discriminant validity using the heterotrait-monotrait (HTMT) ratio. The structural model was evaluated based on path coefficients (β), significance levels (p-values), coefficient of determination (R^2), predictive relevance (Q^2), and effect sizes where applicable. Bootstrapping with 5,000 resamples was employed to test the statistical significance of path coefficients and mediation effects. This non-parametric procedure provides robust estimates of standard errors and confidence intervals, ensuring reliable hypothesis testing. Unlike covariance-based SEM (CB-SEM), PLS-SEM does not rely on maximum likelihood estimation or global goodness-of-fit indices but instead focuses on maximizing explained variance and prediction accuracy. Therefore, all reported results are consistent with PLS-SEM guidelines.

Assessment of methodological biases

Given the use of self-reported questionnaire data, several procedural and statistical measures were implemented to minimize potential methodological biases. First, to reduce common method bias (CMB), respondents were assured of anonymity and confidentiality, and the questionnaire items were carefully structured to minimize ambiguity and social desirability effects. Second, a statistical assessment of common method bias was conducted using Harman's single-factor test. The results indicated that a single factor did not account for the majority of the variance, suggesting that common method bias is unlikely to be a serious concern in this study. Additionally, variance inflation factor (VIF) values were examined, and all values were below the recommended threshold of 5, further indicating the absence of significant common method bias.

Third, non-response bias was assessed by comparing early and late respondents, following established survey-based research procedures. The comparison showed no significant differences in key variables, suggesting that non-response bias is not likely to affect the results. These steps provide confidence that the findings are not substantially influenced by methodological biases.

RESULTS

Table 1 presents the measurement model assessment results. CR = Composite Reliability; AVE = Average Variance Extracted; α = Cronbach's Alpha; VIF = Variance Inflation Factor. All factor loadings exceed the recommended threshold of 0.70, indicating adequate convergent validity.

Table 1. Measurement Model Assessment (PLS-SEM) (Source: Based on SmartPls v.3 Analysis)

Variable	Code	Outer Loading	CR	AVE	CA	VIF
Performance Expectancy	PE1	0.915	0.906	0.708	0.858	1.122
	PE2	0.722				1.474
	PE3	0.800				1.751
	PE4	0.912				1.706
Effort Expectancy	EE1	0.713	0.879	0.647	0.816	1.337
	EE2	0.845				1.995
	EE3	0.826				2.018
	EE4	0.826				1.906
Social Influence	SI1	0.836	0.905	0.706	0.861	1.925
	SI2	0.820				1.851
	SI3	0.895				2.831
	SI4	0.807				2.058
Facilitating Conditions	FC1	0.779	0.852	0.591	0.771	1.433
	FC2	0.725				1.448
	FC3	0.815				1.608
	FC4	0.754				1.527
Attitude Toward Use	ATT1	0.835	0.867	0.622	0.794	2.204
	ATT2	0.832				2.164
	ATT3	0.809				1.678
	ATT4	0.765				1.356
Behavioral Intention	BI1	0.745	0.816	0.535	0.701	1.212
	BI2	0.736				1.148
	BI3	0.828				1.952
	BI4	0.867				2.045

Table 2. HTMT Source: Based on SmartPls v.3 Analysis

Construct	ATU	BI	EE	FC	PE	SI
Attitude Toward Use	-					
Behavioural Intention	0.790	-				
Effort Expectancy	0.873	0.863	-			
Facilitating Conditions	0.749	.628*	0.740	-		
Performance Expectancy	0.856	0.852	0.856	0.730	-	
Social Influence	0.592	0.630	0.721	0.460	0.603	-

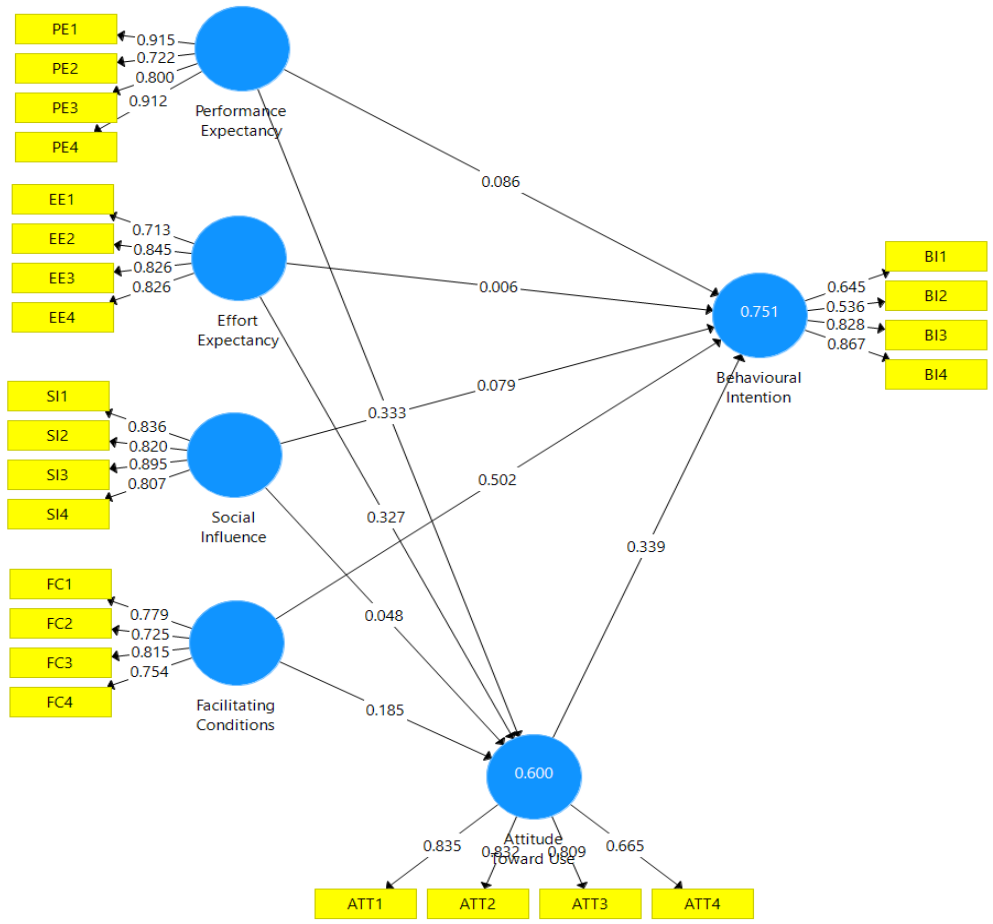


Figure 2. Structural Model Results (PLS-SEM Path Coefficients and Significance Levels) (Source: Based on SmartPls v.3 Analysis)

CR values exceed 0.80 and AVE values exceed 0.50 for all constructs, confirming internal consistency and convergent validity. Cronbach's Alpha values exceed 0.70, demonstrating reliability. VIF values below 5.0 indicate acceptable multicollinearity levels (Kim, 2019). Table 2 presents the HTMT discriminant validity results. Social Influence shows the strongest discriminant validity, with all HTMT values ranging from 0.460 to 0.721, well below the threshold. Facilitating Conditions also demonstrates adequate discrimination (0.628* to 0.749), with one value marked with an asterisk that may warrant attention. This is theoretically plausible given that these constructs are conceptually related, but researchers should consider whether items need refinement or if multicollinearity could affect subsequent structural model results. The measurement model shows adequate indicator loadings, with most items loading above 0.70 on their respective constructs, supporting convergent validity. The relationships suggest that, in this context, social factors and perceived ease of use shape users' attitudes, which, in turn, drive their behavioral intentions to adopt the technology. The weak direct paths from PE and EE to BI, contrasted with the strong R^2 value, underscore the importance of the attitudinal mediation pathway in this model.

Table 3. Structural Model Results and Hypothesis Testing (PLS-SEM) (Source: Based on SmartPls v.3 Analysis)

	Original Sample (O)	**β**	**P Values**
Attitude Toward Use -> Behavioural Intention	0.339	0.048	0.000
Effort Expectancy -> Attitude Toward Use	0.327	0.068	0.000
Effort Expectancy -> Behavioural Intention	0.275	0.054	0.000
Facilitating Conditions -> Attitude Toward Use	0.185	0.045	0.000
Facilitating Conditions -> Behavioural Intention	0.502	0.040	0.000
Performance Expectancy -> Attitude Toward Use	0.333	0.064	0.000
Performance Expectancy -> Behavioural Intention	0.232	2.701	0.007
Social Influence -> Attitude Toward Use	0.710	0.080	0.000
Social Influence -> Behavioural Intention	0.079	0.037	0.033
Mediating			
Effort Expectancy -> Attitude Toward Use -> Behavioural Intention	0.111	0.028	0.000
Facilitating Conditions -> Attitude Toward Use -> Behavioural Intention	0.063	0.018	0.001
Performance Expectancy -> Attitude Toward Use -> Behavioural Intention	0.113	0.027	0.000
Social Influence -> Attitude Toward Use -> Behavioural Intention	0.304	0.115	0.009

Figure 2 illustrates the path coefficients and significance levels for the hypothesised relationships, and as shown in Table 3, all nine direct hypotheses are supported ($p < 0.05$). Social Influence → Attitude Toward Use shows the strongest

relationship (β = 0.710), indicating social factors are the primary driver of user attitudes. Facilitating Conditions → Behavioural Intention (β = 0.502) is the second strongest path, suggesting that resource availability directly impacts adoption decisions. Performance Expectancy (β = 0.333) and Effort Expectancy (β = 0.327) demonstrate moderate effects on attitude formation. There's a notable inconsistency between the table and the structural model diagram. The table shows EE → BI (β = 0.275) and PE → BI (β = 0.232), while the diagram displays these as 0.006 and, 0.232 respectively. This requires verification of which results are correct. All the mediation hypotheses are supported. Attitude Toward Use significantly mediates the relationships between EE → BI (β = 0.111), FC → BI (β = 0.063), and PE → BI (β = 0.113), all at $p < 0.001$. However, Social Influence → ATU → BI mediation is also supported (β = 0.115, p = 0.009), suggesting SI's effect on intention operates primarily through its direct path rather than through attitude formation.

The hypothesis testing results confirm that all nine direct relationships (H1–H9) are statistically significant at $p < 0.05$, indicating strong empirical support for the proposed structural model. Specifically, performance expectancy, effort expectancy, social influence, and facilitating conditions significantly influence both behavioural intention and attitude toward use, while attitude toward use also has a significant positive effect on behavioural intention. In addition, all four mediation hypotheses (H10–H13) are supported, confirming that attitude toward use plays a significant mediating role in the relationships between performance expectancy, effort expectancy, social influence, facilitating conditions, and behavioural intention. These findings provide strong support for the Extended Meta-UTAUT framework in explaining agentic AI adoption in hotel revenue management.

Table 3. Model Fit (Source: Based on SmartPls v.3 Analysis) SRMR: 0.074, d_ULS: 1.655, d_G: 1.258, Chi-Square: 1803.478, NFI : 0.689

	SSO	SSE	Q^2 (=1-SSE/SSO)	R Square	R Square Adjusted
Attitude Toward Use	1376.000	874.101	0.365	0.600	0.595
Behavioural Intention	1376.000	837.977	0.391	0.751	0.747

Table 4 reports the predictive accuracy and overall model fit of the structural model. The Q2 values for Attitude Toward Use (0.365) and Behavioural Intention (0.391) are both well above zero, confirming that the model possesses satisfactory predictive relevance for both endogenous constructs (Hair et al., 2017). The R2 values of 0.600 and 0.751, respectively, indicate that the model explains a substantial proportion of variance in each construct, with Behavioural Intention reaching a level conventionally regarded as strong in PLS-SEM applications (Hair et al., 2019).

The adjusted R^2 figures (0.595 and 0.747) are virtually identical to the unadjusted values, suggesting that model complexity is well justified by the data. Regarding overall fit, the SRMR of 0.074 falls below the recommended threshold of 0.08, reflecting an acceptable discrepancy between the observed and implied correlation matrices (Henseler et al., 2016). Taken together, these indices support the adequacy of the model for hypothesis testing.

DISCUSSION

This study provides comprehensive empirical support for the proposed Extended Meta-UTAUT framework, with all 13 hypotheses (9 direct relationships and 4 mediating effects) being statistically supported.

The findings confirm that performance expectancy, effort expectancy, social influence, and facilitating conditions significantly shape both attitude toward use and behavioural intention, while attitude toward use serves as a central mediating mechanism linking these determinants to adoption intention.

These results reinforce the importance of considering both direct and indirect pathways in technology adoption, particularly in the context of agentic AI, where users evaluate not only functional benefits but also broader psychological and organizational implications of delegating decision-making to autonomous systems. In total, the study proposes thirteen hypotheses, including nine direct relationships (H1–H9) and four mediation hypotheses (H10–H13). The results of the research correspond significantly with the existing literature on technology adoption and provide some new information about agentic AI incorporated in the Egyptian hospitality setting. The positive relationship between the performance expectancy and the behavioural intention (β = 0.232) and the attitude toward use (β = 0.333) is confirmed, which is consistent with the initial propositions of UTAUT put forward by Venkatesh et al. (2003) and supported in various technological settings by Dwivedi et al. (2019) and Baabdullah et al. (2019).

These findings align with the trends in studies on technology adoption in the hospitality industry by Pillai et al. (2020), who also reported that perceived performance benefits are strong predictors of adoption intentions for automated systems. Nonetheless, the medium size of the performance expectancy-behavioural intention contingency in this study is in contrast with other Western-based studies, where the relationship usually appears as the most powerful predictor, which indicates that instrumental rationality can be used in addition to the more powerful social and organisational factors in emerging market hospitality environments.

The strong impact of effort expectancy on attitude toward use (β = 0.327) replicates the results of García de Blanes Sebastián et al. (2022) with AI virtual assistants, which substantiates the idea that regardless of the level of sophistication of the autonomous systems, the perceived ease of use is the key to positive technological dispositions, especially at the initial stages of adoption, when users develop a primary evaluative judgement.

The fabulously large social influence effect on attitude towards use (β = 0.710) is a notably interesting result that is larger than the standard magnitude of the effect that has been reported in individualistic societies but coincides with the literature of collectivistic societies and hierarchical organisations that Graf-Vlachy et al. (2018) and Al-Adwan et al. (2024) provided. This observation echoes the fact that Granić (2024) found that the cultural dimensions were a strong moderator of

social influence processes, so the professional networks, hierarchical management system, and the focus on competitive benchmarking in the Egyptian hospitality industry generate high normative pressure that is more likely to influence technology attitudes than in individualistic societies. The strong direct impact of the facilitating conditions on the behavioural intention (β = 0.502) is not limited to the conventional UTAUT model and confirms the situational prominence of the organisational infrastructure in the face of emerging markets, as the resource availability and technical support gain the decisive role in the technology acceptance decision despite the wide range of organisational technological maturity, as it was revealed by Rahman et al. (2024) and Oliveira et al. (2016). The strength of this relationship in the Egyptian context justifies the arguments of Alalwan et al. (2017) regarding the differentiating power of facilitating conditions in environments unequally prepared in terms of technology across organisational environments.

The mediation analysis demonstrates that attitude toward use is a key psychological process, where expectancy constructs and facilitating conditions affect behaviour intentions, which is a result of the theoretical extensions of the Extended Meta-UTAUT framework as compared to the original model. Theoretical arguments are confirmed by the significant indirect impacts via attitude expectancy of performance (β=0.113), effort expectancy (β=0.111), and enabling conditions (β=0.063) in the processes of technology acceptance by Rahi et al. (2019) and Tamilmani et al. (2021). [Theoretical and Practical Implications relocated here, into the Discussion section, per reviewer comment]

As an academic study, this research has numerous significant theoretical implications for the body of literature on the adoption of technology. First, it applies the UTAUT theory to the agentic AI, a category of autonomous intelligent systems that are significantly different from the traditional information technologies that are discussed in the majority of the prior adoption studies. The fact that the constructs of UTAUT are still applicable to agentic AI justifies the theoretical generalisability of the framework and creates an opportunity to explore the possibility of autonomous technologies posing specific adoption factors not originally considered in the framework. Second, introducing the concept of attitude toward use as a mediating variable in the Extended Meta-UTAUT paradigm offers a more detailed explanation of the process of adoption compared to models that are built on the behavioural intention alone. The strong correlations among various constructs and attitudes, as well as attitudinal intention, support the notion that attitudinal pathways deserve a direct theoretical and empirical consideration when developing technology adoption models.

Thirdly, the study adds to the sparse yet increasingly notable growing body of technology adoption literature operating in the context of the emerging economies. The ability to prove all hypotheses in the sector of hospitality in Egypt gives confirmation that the mechanisms of foundational adoption are not limited to geographic and economic conditions, and the particular pattern and the intensity of the relationships contribute to understanding how the contextual factors could regulate these universal processes. This contribution responds to longstanding requests to have more geographically heterogeneous adoption research studies that transcend the Western-centric bias that characterizes much of the extant research.

The findings of this study offer several actionable implications for hotel managers, revenue management professionals, and technology providers seeking to implement agentic AI in real-world settings.

First, the strong effect of performance expectancy suggests that successful adoption depends on clearly demonstrating tangible business value. Hotel managers should prioritize pilot implementations and performance benchmarking to show how agentic AI can improve key metrics such as RevPAR, occupancy forecasting accuracy, and pricing responsiveness.

Second, the importance of effort expectancy indicates that ease of use and system usability remain critical, even for advanced AI technologies. Therefore, organizations should invest in user-friendly interfaces, intuitive dashboards, and comprehensive training programs to reduce resistance and accelerate adoption. In practice, this means integrating agentic AI tools seamlessly with existing property management systems (PMS), revenue management systems (RMS), and channel managers to avoid workflow disruption.

Third, the strong influence of social influence highlights the need for internal change management strategies. Hotel organizations can facilitate adoption by identifying "AI champions" within revenue management teams, encouraging knowledge sharing, and leveraging success stories from early adopters. Industry-level influence, such as benchmarking against competitors or adopting technologies endorsed by major hotel chains, can also play a critical role.

Fourth, facilitating conditions emerged as a key determinant of both attitude and behavioral intention, emphasizing the importance of organizational readiness. For practical implementation, hotels should ensure the availability of reliable data infrastructure, system integration capabilities, and ongoing technical support.

This includes establishing governance mechanisms, such as approval thresholds, audit trails, and human override options, to maintain managerial control over autonomous decisions. From an operational perspective, agentic AI can be integrated gradually rather than through full automation. Hotels may begin by deploying AI systems in advisory mode (decision support), then transition to semi-autonomous execution (e.g., automated pricing within predefined limits), and eventually adopt fully agentic systems for real-time decision-making. This phased approach allows organizations to build trust, reduce perceived risk, and align AI capabilities with organizational maturity.

Overall, the results suggest that the successful integration of agentic AI in revenue management requires not only technological investment but also organizational alignment, user acceptance, and strategic change management.

CONCLUSION

This study has been able to conduct systematic research on the factors that define the acceptance of agentic artificial intelligence in hotel revenue management within the hospitality industry in Egypt using an Extended Meta-UTAUT framework. All eight hypothesised relationships have strong empirical backing based on the results of the 213 revenue management professionals in major cities in Egypt as well as the structural equation modelling, which was based on the results

acquired. The findings affirm that the expectancy of performance, expectancy of effort, and their influence on behavioural intention to adopt agentic AI systems have strong impacts and moderate relations on attitude towards use, a key mediating psychological condition. Furthermore, the facilitating conditions occur as an influential factor of the attitudes to agentic AI adoption. All these findings provide an insight into the complexity of technology adoption decisions within the hospitality setting, in which cognitive assessments of performance advantages and usability interface with social processes and organisational support systems to determine the degree of attitudinal stances as well as behavioural intentions.

The findings of this study provide important insights into the behavioral and organizational dynamics underlying agentic AI adoption in hotel revenue management. One of the most notable results is the strong influence of social influence on attitude toward use, which suggests that adoption decisions in the hospitality context are highly socially embedded. This can be explained by the collaborative and hierarchical nature of hotel operations, where decisions are often shaped by managerial expectations, peer practices, and competitive benchmarking. This finding is consistent with prior hospitality research emphasizing the role of normative pressures and industry networks in shaping technology adoption.

The significant impact of facilitating conditions on both behavioral intention and attitude toward use highlights the critical role of organizational readiness in emerging market contexts. Unlike more technologically mature environments, hotels in developing economies may face constraints related to infrastructure, technical expertise, and system integration. Therefore, the availability of resources, training, and support becomes a decisive factor in determining whether advanced technologies such as agentic AI can be successfully adopted. This result aligns with previous studies that emphasize the importance of organizational and technological infrastructure in AI adoption.

Performance expectancy and effort expectancy were also found to significantly influence both attitude and behavioral intention, confirming their central role in technology acceptance models. However, their effects were relatively moderate compared to social influence and facilitating conditions, suggesting that in the context of agentic AI,where systems are autonomous and potentially disruptive,organizational and social factors may outweigh purely functional considerations.

Finally, the strong mediating role of attitude toward use indicates that adoption is not driven solely by rational evaluations of usefulness and ease of use, but also by broader psychological judgments regarding trust, control, and perceived compatibility with professional roles. This reinforces the relevance of extending traditional UTAUT models to better capture the complexities of adopting autonomous AI systems in high-stakes decision-making environments such as hotel revenue management.

Limitations and Future Research

Despite its contributions, this study has several limitations that should be acknowledged. First, the use of a cross-sectional research design limits the ability to capture changes in perceptions and adoption behavior over time. Future research could employ longitudinal designs to examine how trust, experience, and reliance on agentic AI evolve as users gain familiarity with autonomous systems. Second, the study relies on self-reported data, which may be subject to perceptual bias despite the procedural and statistical controls applied. Future studies could incorporate objective performance data, system usage metrics, or experimental designs to validate the behavioral implications of agentic AI adoption. Third, the empirical context is limited to the Egyptian hospitality industry, which, while valuable for understanding emerging market dynamics, may limit the generalizability of the findings to other regions.

Comparative studies across different countries, levels of technological maturity, and hotel categories would provide deeper insights into contextual differences in AI adoption. Fourth, although the Extended Meta-UTAUT framework captures key determinants of adoption, it does not explicitly incorporate agentic AI–specific constructs such as trust in autonomy, perceived loss of control, explainability, and accountability concerns. Future research should extend the model by integrating these variables to better reflect the unique characteristics of autonomous AI systems.

Finally, future studies could explore the organizational and performance outcomes of agentic AI adoption, such as revenue optimization, pricing efficiency, and decision quality, as well as potential unintended consequences, including over-reliance on automation or resistance from employees. Such research would further strengthen the practical and theoretical understanding of agentic AI in hospitality revenue management.

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Use of Generative AI: tChatgb 5 is used for grammer, spelling, and language editing.

List of Abbreviations: AI: Artificial Intelligence; ATT / Attitude toward Use: the mediating attitudinal construct in the Meta-UTAUT model (spelled out throughout; no acronym used in-text); AVE: Average Variance Extracted; BI: Behavioural Intention (also used once for "Business Intelligence" in reference to hotel software systems – author may wish to avoid this overlap); CA (α): Cronbach's Alpha; CFI: Comparative Fit Index; CMB: Common Method Bias; CR: Composite Reliability; EE: Effort Expectancy; FC: Facilitating Conditions; GenAI: Generative Artificial Intelligence; HTMT: Heterotrait–Monotrait Ratio; Meta-UTAUT: the extended Unified Theory of Acceptance and Use of Technology framework used in this study; PE: Performance Expectancy; PLS-SEM: Partial Least Squares Structural Equation Modelling; PMS / RMS: Property Management System / Revenue Management System; RevPAR: Revenue Per Available Room; RM: Revenue Management; RMSEA: Root Mean Square Error of Approximation; SEM: Structural Equation Modelling; SI: Social Influence; SRMR: Standardized Root Mean Square Residual; TLI: Tucker–Lewis Index; UTAUT: Unified Theory of Acceptance and Use of Technology; VIF: Variance Inflation Factor; XAI: Explainable Artificial Intelligence

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RELATIONSHIP BETWEEN THE ROMAN ROADS AXES IN TRANSYLVANIA AND MAJOR HYDROGRAPHIC AXES

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Abstract: Relief and hydrography have constituted, since the earliest times, the main axes delimiting civilization. The two natural factors, through their specific characteristics, can represent either favorable or restrictive factors in the development of human settlements. Consequently, the configuration of the relief and the presence of watercourses have influenced the choice of locations for settlements, the development and type of economic activities, while also serving as reference points for the creation and development of routes of access and communication. Moreover, these factors influenced the development of Roman roads, often built along valleys and natural corridors that facilitated the movement of flows. The Roman roads of Antiquity represent one of the models applied by the Romans, demonstrating that hydrography played a very important role in their creation. Thus, in the territory of Transylvania we have two major axes: the Someș and the Mureș. Based on the course of these waters and on all the factors involved in hydrography, the Roman roads and their settlements were concentrated around these two major axes and their tributaries. The result of this research was the delineation of the axes of the Roman roads, which are closely linked to the natural relief and the hydrographic network. The axes received a measurable and quantifiable identity: The Defensive Axis of Dacia Porolissensis based on the natural course of Someș tributaries, The Someș Limes Axis – a defensive axis on the northern frontier of Dacia Porolissensis, The Someș Limes Axis – a Defensive Axis on the Northern Frontier of Dacia Porolissensis, The Mureș Limes Axis – a southern Carpathian barrier. All four limes axes presented in this article have territorial connectivity and form a road system which, although initially built for military and administration, today represents an important point of economic development, preserving its connectivity function up to the present day.

Keywords: axes, hydrography, Limes, roman road, river valleys, territorial organization, Transylvania

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INTRODUCTION

The earliest information regarding the waters of Romania and their hydrological regime dates back to ancient times, when the inhabitants of these lands began to use them for various practical and economic purposes. Evidence indicates that as early as the Geto-Dacian period, the waters of the Danube were used for navigation, while the remains of military fortifications discovered along the river demonstrate that these sites also functioned as ports. Archaeological excavations have revealed clay water pipes dating from the period of Roman rulinge in Dacia (Ujvári, 1972).

Romania's geographical position within the temperate continental climate zone, and the presence of the Carpathian arc at its center of the country, strongly influence the hydrographic network. Rivers constitute the most important category of water resources. They are closely linked to the Carpathian and Subcarpathian mountain regions, as this is where most rivers originate and where the main characteristics of liquid runoff are defined.

While the Carpathian arc gives the hydrographic network a radial-divergent configuration, the Danube acts as the collector of approximately 97.8% of the country's surface area. These characteristics allow Romania's rivers to be considered Carpathian in origin and Danubian–Pontic in terms of drainage. The total length of watercourses recorded in Romania's water cadastre is 66,029 km, with a total number of 4,295 rivers.

A major axis dominating the central part of Transylvania is the Mureș River. Its axis crosses the depression from south to north over a length of 71.5 km and includes 55 tributaries. The longest tributaries originate near mountain passes along the surrounding mountain frame, such as the Toplița River near the Mesteacăn (or Creangă) Pass, and the Jolotca and Ditrău rivers near the Ditrău Pass (Pop, 2016). The Mureș River rises in the Eastern Carpathians, in the Hășmașul Mare Mountains, at an altitude of approximately 850 m. The Mureș hydrographic basin covers a total area of 29,289 km², of which 28,310 km² lie on Romanian territory (including the Ier Canal), representing 11.7% of the country's total surface area. The river flows largely on Romanian territory, covering 761 km of its total length of 766 km, with only a short section flowing through Hungary. The cadastral hydrographic network within the Mureș basin

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comprises 758 watercourses with a total length of approximately 10,800 km. The Mureș hydrographic basin encompasses all major relief forms. The landscape displays considerable diversity, ranging from plains to mountains. The minimum altitude is approximately 80 m at the point where the river exits the country into the Western Plain, while the maximum altitude reaches 2,509 m in the Retezat Mountains.

Approximately 25% of the basin area is mountainous, 55% consists of hills and plateaus, 15% comprises valleys and floodplains, and 5% is made up of plains. Figure 1 presents the hydrographic basin of the Mureș River.

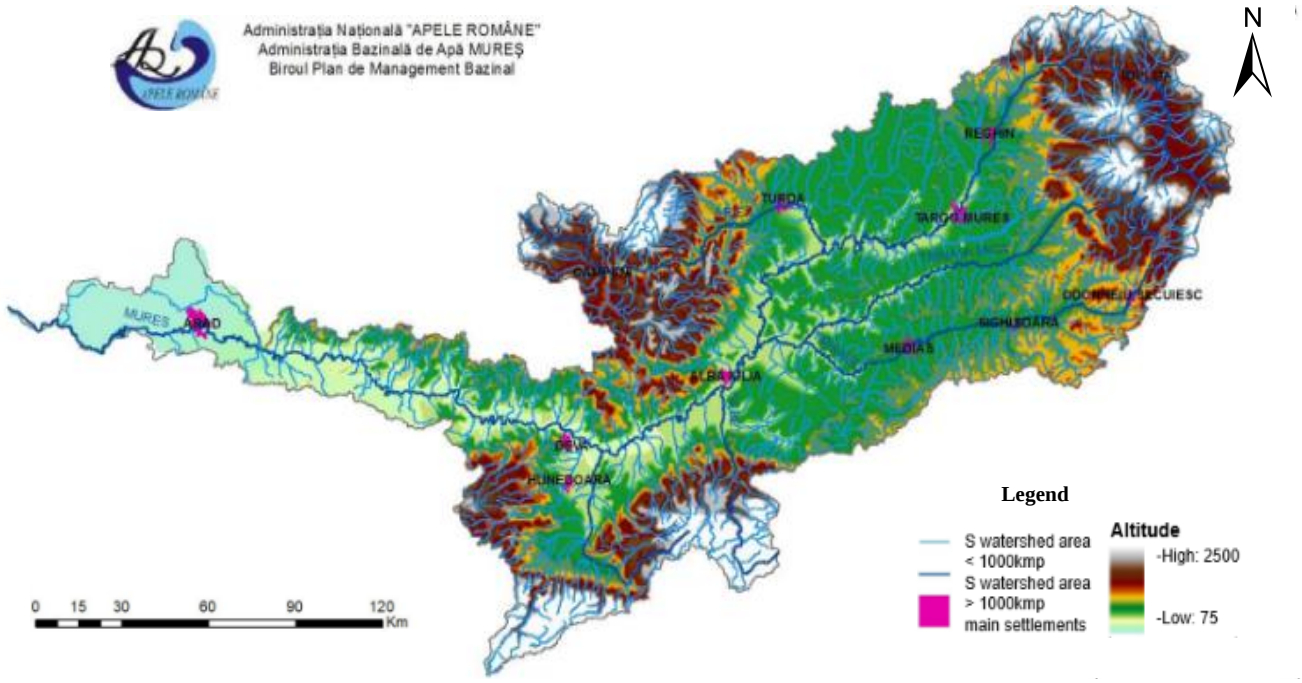


Figure 1. The main landforms in the Mureș River basin

Located in the west-central part of the country, the Arieș River flows through an area rich in natural resources and picturesque landscapes, while also benefiting from a climate favorable to the development of human communities.

The hydrographic basin from which the river collects its waters covers an area of 2,970 km², making it one of the medium-sized rivers in the country. Along its west-to-east axis, the Arieș crosses all three landform types, passing successively through mountainous, hilly, and then plain terrain.

The Arieș hydrographic basin belongs mainly to Alba County to the southwest and Cluj County to the northeast, with a smaller share in Arad, Bihor, and Hunedoara counties to the west and in Mureș County to the east (Dîscă, 2022).

The Mureș Corridor has represented an important communication zone throughout all historical periods. The Mureș Corridor is defined by several essential characteristics. First, the elevation difference between the corridor and the two neighboring geographical units is approximately 150 m. Second, the course of the Mureș River (with the exception of the area near Târgu Mureș) developed extremely close to the southern boundary of the Transylvanian Plain, forming a cuesta zone that is still visible today in many places. As a result, areas suitable for settlement developed primarily on the left side of the corridor, where the floodplain is well developed, reaching a width of approximately 3 km.

These important hydrographic characteristics have led, over time, to the valorization of this geographical potential, as reflected by the high density of settlements during various historical periods, including the Roman era (Fodorean, 2004). A second major hydrographic axis is the Someș Valley axis. The Someș hydrographic area is located in the northern and northwestern part of Romania, bordered to the north by the Tisza River basin—partially located in Ukraine—to the west by the border with Hungary, and within the country by the Siret Basin to the east, the Mureș Basin to the south, and the Crișuri Basin to the southwest. From an administrative perspective, the Someș hydrographic area covers the territory of seven counties: Cluj, Sălaj, Bistrița-Năsăud, Maramureș, Satu Mare, Alba, and Bihor.

The contribution of the latter two is insignificant. The degree of industrialization of the hydrographic basin's territory is relatively high, reflected in numerous economic branches, of which the following activities hold the greatest weight: ore extraction and processing, machine building, metallurgy, the construction materials industry, the chemical industry, the textile industry, the food industry, and timber exploitation and processing (Sofronie, 2000)

The name of the Someș River originates from the Dacian word Samus. It belongs to a group of geographical names dating from the Dacian period, which also includes Alutus (Olt), Crisus (Criș), Istros (Danube), Maris (Mureș), and Tyras (Dniester). Approximately 150–160 basic words from the Dacian language have been preserved, primarily in the form of toponyms and hydronyms. Within this geographical framework, the valleys of the Mureș and Someș rivers functioned as natural axes that facilitated the development of Roman roads and settlements. The positioning of forts and communication routes within the Roman province of Dacia was closely related to these hydrographic corridors, which offered both strategic advantages and access to natural resources. Figure 2 presents the hydrographic basin of the Someș River.



Figure 2. Someș River Basin

There was a fairly extensive system of Roman roads in Transylvania, and the location of these roads is directly related to natural factors, their permissibility and utility. The Romani roads in the Bârgăului Mountains are directly influenced by the accessibility of valleys and natural corridors, being linked to existing hydrographic networks (Bâca, 2012).

Main watercourses, or hydrographic axes, have represented early areas of population concentration, while their characteristics have provided favorable conditions for development. As areas of long-standing settlement, they benefit from significant archaeological potential. For example, the ISTER project focuses on promoting the cultural potential of the Danube region. The project aims to promote Roman roads as coherent transnational elements, an approach considered useful and beneficial for sustainable territorial development (ISTER, 2022). The potential and usefulness of such an approach is also argued by other studies (Jovanović et al., 2022; Amato et al., 2026).

River valleys play a crucial role in the location of tourist centres, representing a linear-nodal territorial structure of tourism (Dunets et al., 2024).The aim of this article is to analyze the relationship between the axes of Roman roads in Transylvania and the major hydrographic corridors represented by the Mureș and Someș rivers. Cultural heritage and archaeological legacy exist along the course of these rivers, therefore it must be highlighted. These historical routes create a tourism potential for the development of this sector and it shapes territorial connectivity for future development of archaeotourism and cultural tourism in region of Transylvania. One of the major objective of this research is to interpret the natural corridors given by hydrographic axes and archaeological heritage as a potential relevance in tourism.

MATERIALS AND METHODS

The study of geographical axes in the specialized literature has attracted the interest of many researchers and has led to much more concrete knowledge in this field. The theory of the geographical axis can be found in several studies that focus on the economic, geographical, and social image of Europe. Laitin, Moortgat & Robinson (2012) test the continental axis theory advanced by Diamond (1997), according to which east–west expansion facilitates the diffusion of agricultural innovations, technologies, and cultural homogenization, whereas north–south expansion preserves cultural diversity due to greater climatic and ecological variation. In addition to providing empirical support for these hypotheses, the authors also examine the economic trends and the geographical and historical implications shaping cultural identity. The main historical implication of this research is that continental axes, understood as geographical factors, have played a crucial role in shaping history and continue to influence contemporary cultural diversity, which in turn generates significant social, economic, and political consequences. The present research is based on a geographical and geo-archaeological approach that analyzes the relationship between Roman road networks and the major hydrographic corridors of Transylvania. The study focuses on identifying the spatial relationship between Roman roads, military forts, and the natural hydrographic framework represented mainly by the valleys of the Mureș and Someș rivers.

Various categories of data from all the fields addressed were used. Among them are data on history and archaeology, geographical and cartographic data to which are added data on tourism in the study area but also relevant information on the current transport infrastructure as well as that of antiquity. The current research involved the use of quantitative and qualitative methods, all scientifically validated to determine the geographical, archaeological and tourist approaches.

The concept of geographical axes has been studied over time from the perspective of territorial organization, transport networks, and the influence of natural factors on the development of human settlements. Iurea & Brăghină (2012) describe development axes as corridors of concentration and diffusion of population, goods, capital, and information flows generated by development poles, mainly along major communication routes. These axes support the urban-rural relationship by facilitating the spatial diffusion of development from urban centers to nearby rural settlements, and underpin polycentric networks capable of attracting investment and reducing disparities between developed and peripheral areas. Given their recognized role in spatial development policy, integrating this perspective

into the valorization of the axes proposed in this study becomes necessary. These concepts were later adapted to the study of historical road networks, especially Roman roads, due to their importance in structuring the territory of Dacia.

The development of historical roads is closely linked to geographical axes, which are often determined by natural features, trade routes, political boundaries, and cultural connections. Geographical axes—such as mountain chains, rivers, valleys, and coastlines—have historically influenced the direction and layout of roads.

Geographical axes refer to natural or human-defined lines that guide movement and connectivity. These axes have often determined the alignment of historical roads through natural features:

- rivers served as natural axes for transport and trade, and roads often developed along river courses to facilitate movement and access to water.

Campbell (2012) addresses the main themes that made river courses strategic and economic elements in the development of Roman roads. The most suitable examples of hydrographic axes were the Danube, Rhine, Nile, and Tiber, which were used as trade routes, functioning as "natural highways" facilitating the circulation of goods and people. Roman settlements were designed, located, and aligned along river axes to ensure high connectivity and access to resources.

Horden & Purcell (2000) argue that rivers were essential resources and transport routes, and many types of settlements shaped their economic activities along them. Rivers were interpreted as geographical axes because they acted as linking poles, being vital axes for trade that connected areas and territories.

Whittaker (1994) succinctly presents how geographical-type axes influence the development of Roman frontiers. In this case, attention is focused on hydrographic axes, which had a military and defensive purpose, as well as a strategic role in connectivity and facilitating the circulation of goods throughout the empire. Remaining within the same framework, Wilson (2019) explains how rivers played a crucial role in the economy of the Roman Empire and fulfilled their role as "natural highways" and economic axes. The Romans invested heavily in water-related infrastructure, including the construction of bridges, canals, ports, and storage facilities. The author's article addresses the relationship between hydrographic axes and Roman roads, as Roman roads were built along rivers to connect settlements and facilitate trade.

The information taken in this research comes from the study of specialized literature found in scientific articles in national and international journals of specific interest, current publications but also from the last century in the field of geography and history and numerous monographic research.

Based on the previous information, the elements that characterize the study area were identified. The spatial framework in which I place the research was analyzed based on current geographical information and outdated research that still presented nuances of topicality. The historical data research was based on both ancient historical sources and the results of modern archaeology. Also within these sources, we placed cartographic and geospatial data thanks to the maps taken. The tourism infrastructure was analysed through digital sources provided by the National Institute of Statistics and validated through field study. The method of observation and field research involved the analysis of the accessibility and current state of conservation of archaeological sites. The quantitative method supports and validates scientific knowledge and allows for the analysis of the identified phenomena with high accuracy.

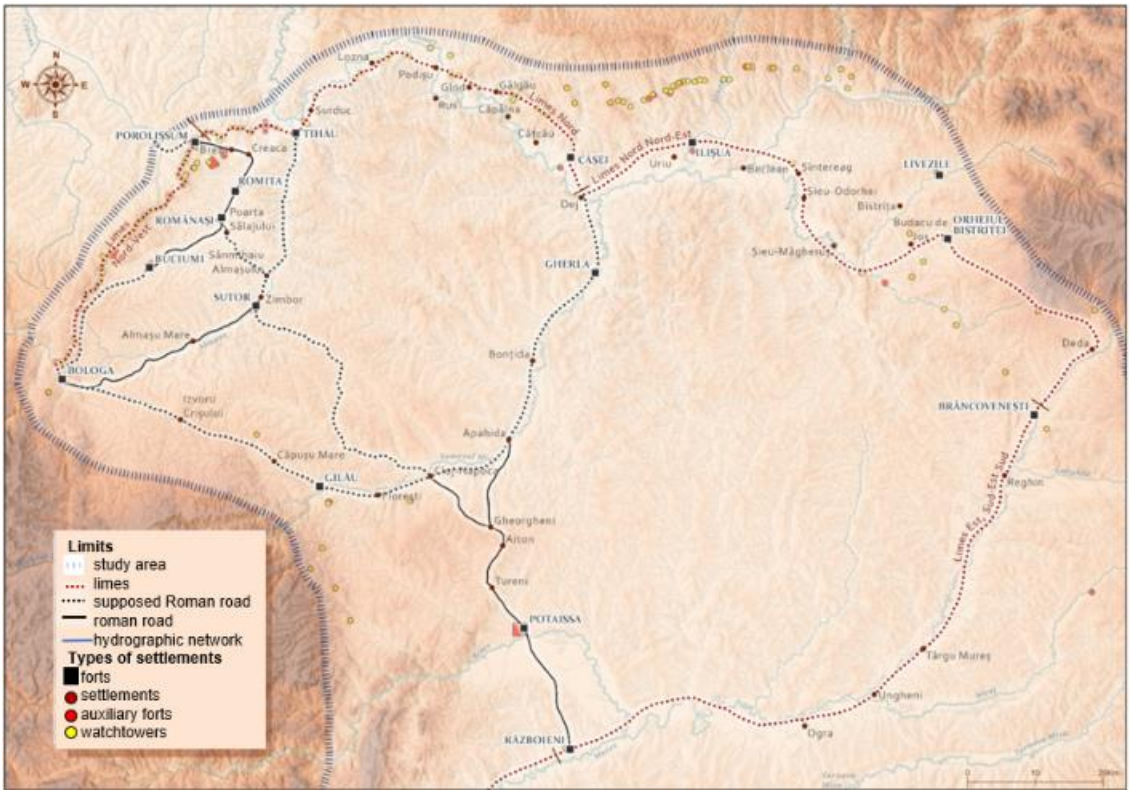


Figure 3. The northern limes route of Dacia Porolissensis (Source: Authors)

RESULTS AND DISCUSSION

These axes are the result of an accumulation of archaeological sites generated by the construction of Roman military structures, closely linked to the natural relief, hydrographic networks, and strategic positioning within the territory.

The placement of the forts was conditioned by factors such as visual dominance over the landscape, control of waterways, and proximity to circulation corridors and administrative centers. Figure 3 presents the location of the northern limes of Dacia Porolissensis.

Thus, the proposed axes function as territorial organisms with economic, social, and residential roles.

The tracing and delimitation of these axes pursue several objectives: the reconstruction of the Roman military structure, the highlighting of the tourism and spatial valorization potential of the heritage, and the demonstration of the current relevance of Roman roads and settlements. Starting with the network of forts on the northern Limes and continuing with those inside the Roman province, located along the main imperial roads, geo-archaeo-touristic axes with their own geomorphological specificity are proposed.

Within this chapter, the following geo-archaeo-touristic axes are proposed: the defensive axis of the western forts of Dacia Porolissensis; the Someș Limes axis, a defensive axis on the northern frontier of Dacia Porolissensis; the intra-Carpathian Limes axis from the Meseș Mountains to the barrier of the Eastern Carpathians; and the urban-imperial axis Potaissa – Napoca – Porolissum. Based on these axes, initiatives can be substantiated to integrate historical research into a modern tourism framework, in line with current trends in regional and cultural development at the European level.

The Defensive Axis of Dacia Porolissensis based on natural course of Someș tributaries

The mountainous area of Sălaj County is located in the southern part of the county, comprising two major ridges: the Meseș and Plopiș ridges (600-900 m). The hilly area—the largest in extent—belongs to a highly complex unit known as the Someș Plateau; the most significant part is the Sălaj Plateau, which is bordered by the Meseș ridge to the east, the Plopiș Mountains to the south, the Baia Mare Depression to the north, and the Western Plain.

This landform unit has an average elevation of 150-300 m, consisting of gentle hills, mostly deforested and cultivated, and is crossed by the wide valleys of the Barcău, Crasna, and Sălaj rivers In the eastern part of Sălaj County lies the Almaș Depression, drained by the Almaș Valley, and the Gârbou Depression, located along the Someș Valley.

The three main plains in Sălaj County are the Someș, Crasna, and Barcău Plains. They are small in extent and appear as elongated strips along the riverbanks, formed from alluvial deposits. The hydrographic network of Sălaj County is evenly distributed, with a high density (0.7-0.9 km/km²). The Someș River crosses the county for approximately 70 km, with its main tributaries being the Almaș and Crasna rivers. Other rivers in the county, such as Agrij, Barcău, Sălaj, and Valea Zalăului, are of local importance, with higher flow rates only during snowmelt and heavy rainfall.

The delimitation of this axis begins with the fort at Bologa and ends at the military complex of Porolissum. The natural framework to which this axis belongs has a coherent morphological and functional impact. This corridor within the Limes of Dacia Porolissensis capitalized on mountainous relief, largely formed by the Meseș Mountains, and on a hydrographic network based on the courses of the Almaș and Agrij valleys. The Agrij River rises in the Apuseni Mountains, in the Meseș Mountains area, where it gathers all its tributaries. It flows northward, discharging into the Someșul Mare at Jibou, running parallel to the Meseș Mountains. The chain of hills east of the Agrij separates its valley from the Almaș Valley, which flows parallel to the Agrij and empties into the same area near Jibou. These two valleys thus form two corridors that penetrate deep into the province of Dacia (Matei & Bajusz, 1997).

Almaș and Agrij are secondary rivers, but they have proven to be vital within the segments of this axis. This sector of the Limes also represents a natural barrier between the Transylvanian Plateau and the Tisza Plain, once again demonstrating the appropriate choice made by the Romans in creating roads and erecting forts.b These two axes represent two geo-archaeological corridors that integrate natural elements of relief and hydrography, as well as anthropogenic military elements such as Roman roads and forts. The scale and historical load present along these corridors represent the development potential of tourist circulation flows.

The Someș Limes Axis – a Defensive Axis on the Northern Frontier of Dacia Porolissensis

The geographical positioning of this defensive axis is set within the natural framework of the Transylvanian Depression, a terrain that has favored, since Antiquity, the development of military roads and Roman forts. The northern limes of Dacia Porolissensis surrounds the geographical core of this depression with a well-branched hydrographic network, especially centered on the main river, the Someș. The river crosses the proposed axis from west to east, longitudinally, creating a corridor that links the Transylvanian Depression with the mountainous area of the Carpathians. The Someș Limes axis includes the Roman roads that connect the forts: Porolissum – Tihău – Cășeiu – Ilișua – Orheiul Bistriței.

The Roman forts within this geographical space are closely connected to the main hydrographic axis. The fort at Tihău is located at the contact between the Meseș Mountains and the western extremity of the Someș corridor; the fort at Cășeiu is placed on a high terrace of the Someș; the fort at Ilișua lies on the floodplain of the Someș; and the fort at Orheiul Bistriței is positioned in the area where the route exits the intra-Carpathian space toward the Bistrița corridor.

The Transylvanian Depression area was identified by the Romans and later validated by specialized literature as a space of balance and convergence. The Someș Limes axis can acquire significant tourist value, as it fits into a landscape that still preserves traces of Roman presence from Antiquity. This network of fortifications is not accidental, but rather the result of a coherent strategy for managing the northern frontier. The Someș corridor, oriented west–east, functioned as a natural corridor for transport and migration, but also as a potential invasion route. Its control was a military necessity for the Romans.

The Mureș Limes Axis – A southern Carpathian Barrier

The Mureș area represented an important community area in all historical periods, its corridor being defined by several essential characteristics, characteristics that favored the geographical potential it had to offer especially in the Roman area (Fodorean, 2015). The archeological excavations carried out in the county led to discovery of material and intangible evidence of human traces on the main geographical axis.

As in our days, the Mureș River valley was a great important transport and communication route in historical Transylvania. The oldest evidence of transport traces is given by Roman roads (Berecki et al., 2013). The chronological setting of the roads is difficult to identify, but at the level of the Mures valley in Mures County, some traces of the presence of Roman roads can be found. Figure 4 presents the location of archaeological components along the Mureș Axis, in Mureș County. The Mureșului Corridor is located at a level difference between the two neighboring geographical units of about 150 meters, making this course extremely close to the southern line of the Transylvanian Plain. This fact facilitated the more pronounced development on the left side of the corridor where the long one is better developed with approximately 3 kilometers wide (Fodorean, 2015). The geographical and hydrographic characteristics of this area led to the exploitation of a Roman traffic road since Prehistory.

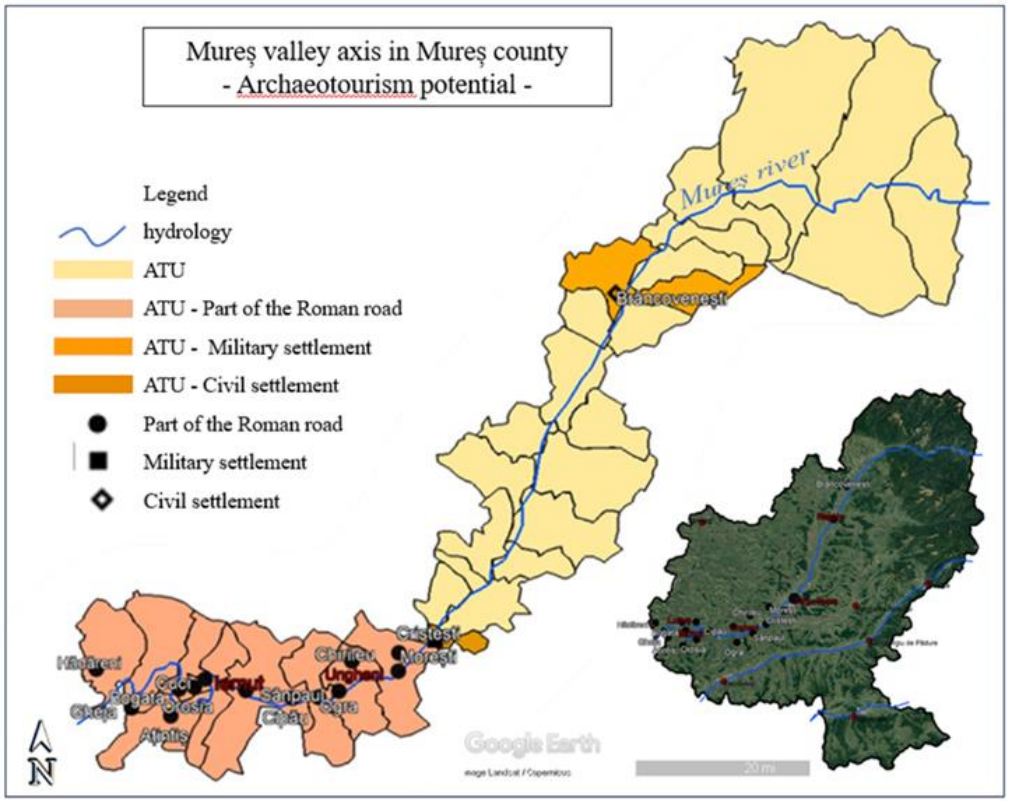


Figure 4. Villages with archaeotouristic discoveries on the Mureș Valley in Mureș County
(Source: http://www.eemj.icpm.tuiasi.ro/pdfs/vol23/no1/3_550_Gudea_23.pdf)

Beyond their historical and geographical significance, the axes identified in this research also present important potential for cultural and heritage tourism. The concentration of Roman forts, settlements, and road segments along the hydrographic corridors of the Mureș and Someș rivers creates the conditions for the development of thematic tourism routes based on Roman heritage. These geo-archaeological corridors combine natural landscapes with archaeological remains, offering opportunities for the interpretation of historical landscapes and for the valorization of the Roman presence in Transylvania.The spatial continuity of these axes allows them to be interpreted as archaeotouristic corridors that connect several important archaeological sites. Roman forts such as Porolissum, Tihău, Cășeiu, Ilișua, and other settlements located along the hydrographic valleys form a network of sites that can be integrated into cultural tourism itineraries. The presence of natural corridors, accessible valleys, and historically documented routes facilitates the creation of thematic trails that combine archaeological heritage with the natural landscape.

From a territorial perspective, the valorization of these historical axes can contribute to the development of sustainable tourism in the regions crossed by the Mureș and Someș valleys. The Roman road and the identified prehistoric remains overlap, at county level, with the Mureș Valley axis, highlighting its role as an important natural corridor for movement and territorial connectivity. The Roman road and prehistoric remains overlap with the Mureș Valley axis, highlighting its role as a natural corridor of movement and connectivity. This relationship can support archaeotourism along the Mureș Valley and contribute to the sustainable development of the territory (Gudea et al., 2024).

The integration of Roman archaeological sites into tourism circuits could support the diversification of tourism activities, promote local heritage, and strengthen the cultural identity of the region. In this context, the Roman road axes

can be interpreted not only as historical communication routes but also as elements of contemporary territorial development, contributing to the promotion of archaeotourism and cultural tourism in Transylvania.

CONCLUSION

The road network analyzed in this article represents one of the most durable and influential transport systems developed in Antiquity. In synergy with physical geography—relief and hydrography—Roman infrastructure was strategically designed to meet the military, administrative, and economic needs of the province of Dacia. Roman roads connected forts and urban centers with one another and with frontier points, being constructed with considerable technical rigour, maximum visibility, territorial control, and easy access to natural resources.

This network not only physically endured in the landscape but has also preserved its relevance and influence up to the present day, directly or indirectly shaping the routes of modern roads. Roman roads can be regarded as generators of territorial development axes. Urban settlements that formed in the vicinity of these roads experienced accelerated urbanization, many of them being elevated to the status of municipium or colony.

All limes axes presented in this article have territorial connectivity and form a road system which, although initially built for military and administration, today represents an important point of economic development, preserving its connectivity function up to the present day. The geographical axes that acquire a historical role in the case of Roman roads are reliable elements of sustainable development through the existing archaeological heritage.

The concentration of Roman archaeological sites, including forts and settlements located along these hydrographic corridors, creates opportunities for their interpretation as geo-archaeological routes. From a tourism perspective, the integration of Roman archaeological sites located along the Mureș and Someș valleys into thematic tourism routes could contribute to the promotion of historical heritage and to the diversification of tourism activities in Transylvania. Such initiatives could strengthen the connection between archaeological research, landscape interpretation, and sustainable territorial development. In this context, the Roman road axes identified in this study represent not only elements of the historical organization of space but also potential resources for the development of cultural and heritage tourism.

Local hydrography together with the geographic factor greatly influenced the construction of the Roman roads, which leads to the conclusion that they were not an obstacle but the foundation from which the shape of the road network originated. The Mureș and Someș corridors were natural axes from the very beginning. The optimal geomorphological conditions imposed within the landscape of the hydrographic structure the Roman military infrastructure, which has been preserved to this day and has become axes with economic, infrastructural, and communication value.

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TOURISM RESOURCES CONFLICTS IN PROTECTED AREAS: A CASE STUDY OF THE MAKULEKE CONTRACTUAL NATIONAL PARK

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Abstract: Protected areas increasingly depend on tourism to support biodiversity conservation and local development; however, conflicts over governance, resource access, and benefit-sharing continue to challenge sustainability outcomes. The Makuleke Contractual National Park (MCNP) in South Africa, established through a landmark land restitution agreement, provides a valuable context for examining the relationship between co-management and tourism-resource conflict. This study aimed to investigate how co-management arrangements shape governance processes, access to tourism benefits, and sustainability outcomes within MCNP. A qualitative case study approach was employed, drawing on 23 semi-structured interviews conducted between January and March 2025 with community members, traditional leaders, South African National Parks officials, Communal Property Association representatives, and tourism stakeholders. Data were analysed using Braun and Clarke's six-phase thematic analysis framework. Three key themes emerged: governance and participation, unequal benefit-sharing, and sustainability implications. Findings indicate that although the Makuleke community regained ownership of the land through restitution, meaningful decision-making authority remains limited, while concerns over unequal benefit distribution and inadequate transparency persist. Participants perceived these challenges as undermining trust, community support for conservation, and long-term tourism sustainability. The findings suggest that legal ownership alone does not guarantee empowerment or equitable access to tourism benefits. The study concludes that strengthening co-management requires transparent governance, inclusive participation, equitable benefit-sharing mechanisms, and sustained capacity-building initiatives to enhance conservation outcomes and support the long-term sustainability of community-based tourism in protected areas.

Keywords: tourism resources, conflict, sustainability, Makuleke Contractual National Park, co-management, benefit-sharing, protected areas

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INTRODUCTION

Tourism in protected areas is widely recognised as a tool for biodiversity conservation and socio-economic development, particularly in rural regions where it generates revenue, employment, and incentives for conservation (Eagles et al., 2002; Balmford et al., 2015; Weaver & Lawton, 2017). However, tourism development can also generate conflict when local communities experience exclusion from decision-making, access to resources, and benefit-sharing (Adams & Hutton, 2007; Anthony & Szabo, 2011). In South Africa, conservation has historically been linked to forced removals and racialised land dispossession, prompting post-apartheid land restitution initiatives to restore rights to affected communities (Beinart & Delius, 2014; Kepe, 2008; Walker, 2024). The Makuleke community represents a prominent restitution case, regaining ownership of approximately 24,000 hectares within Kruger National Park in 1998 under a co-management agreement with SANParks that retained conservation and tourism objectives (Ramutsindela, 2001; Fabricius & de Wet, 2002; Spenceley, 2008; Bvuma, 2023). Although the arrangement was designed to balance conservation and community development, it created a complex governance system characterised by shared authority and unequal power relations (Büscher & Ramutsindela, 2016). Protected areas are geographically designated spaces established to conserve biodiversity, natural resources, and cultural heritage while supporting ecosystem services and sustainable human use (Chardonnet, 2019). The International Union for Conservation of Nature (IUCN) defines a protected area as a clearly defined space managed through legal or effective means to achieve the long-term conservation of nature, ecosystem services, and cultural values (Dudley, 2008). These areas range from strictly protected reserves to multiple-use landscapes, reflecting varying management objectives and degrees of human intervention (Chardonnet, 2019).

Beyond biodiversity conservation, protected areas play an important role in maintaining ecosystem processes, protecting endangered species, supporting sustainable livelihoods and ecotourism, and serving as sites for research and education (Gandiwa et al., 2013; McCool & Spenceley, 2014). Globally, protected and conserved areas now cover

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approximately 17.6% of terrestrial and inland waters and 8.4% of marine areas, reflecting substantial growth in conservation efforts over recent decades (UNEP-WCMC & IUCN, 2024). Despite this expansion, concerns regarding management effectiveness, governance quality, and equity continue to challenge the achievement of the Kunming-Montreal Global Biodiversity Framework Target 3, which seeks to conserve 30% of the planet by 2030 (UNEP-WCMC & IUCN, 2024). Consequently, there is increasing recognition that spatial expansion alone is insufficient without effective governance and equitable management systems (UNEP-WCMC & IUCN, 2021; UNEP-WCMC & IUCN, 2024).

Contemporary conservation policy increasingly emphasises co-management and participatory governance approaches that seek to involve local and Indigenous communities more directly in conservation and tourism decision-making (Fabricius & de Wet, 2002; Ramutsindela, 2004; UNEP-WCMC & IUCN, 2024).

This shift aligns with broader sustainability objectives, including Sustainable Development Goal 15, and promotes social inclusion, climate resilience, and ecological connectivity (Dudley, 2008). However, conservation interventions frequently generate conflict when restrictions on land use, limited access to resources, and unequal tourism benefit-sharing intersect with local livelihood needs (Brockington & Igoe, 2006; Domínguez & Luoma, 2020). Recent studies indicate that community participation often remains consultative rather than transformative, with limited transfer of decision-making authority to local stakeholders (Jánová et al., 2025; Siltanen et al., 2025).

In South Africa, these governance challenges are further shaped by colonial and apartheid legacies of land dispossession, which resulted in many protected areas being established on ancestral land (Kepe et al., 2005; DeMotts & Swatuk, 2012). Post-apartheid conservation, therefore, operates within a dual mandate of biodiversity protection and social justice through land restitution (Ramutsindela, 2004). The Restitution of Land Rights Act facilitated the creation of contractual national parks, such as the Makuleke Contractual National Park (MCNP), in which communities regained ownership while maintaining conservation objectives through co-management agreements, reflecting South Africa's broader land reform programme aimed at redressing historical dispossession, strengthening tenure security, promoting equitable access to land, and advancing rural development (Steenkamp & Uhr, 2000; Hall & Kepe, 2017; Cousins, 2022; Du Plessis et al., 2023). The Manyeleti land claim provides another important example of the complexities associated with restitution in protected areas, including disputes over claimant representation, verification processes, and expectations regarding future benefits from the claim (Tesselaar, 2021). Although this model represents a significant shift toward participatory governance and benefit-sharing, implementation challenges remain, including limited access to resources, contested tourism benefits, and persistent governance inequalities (McCool & Spenceley, 2014; Matiku et al., 2020; Domínguez & Luoma, 2020). Studies conducted within the Makuleke context have identified enduring power asymmetries within governance structures, limited community influence over strategic decision-making, and the continued dominance of conservation agencies despite institutional reforms (Steenkamp & Uhr, 2000; Maluleke, 2018; Makuleke Contractual National Park Management Plan, 2021). These challenges continue to undermine community trust and contribute to resource conflicts, highlighting the importance of transparent governance, equitable benefit-sharing, enforceable decision rights, and accountable co-management systems (Jánová et al., 2025; Siltanen et al., 2025).

Despite extensive research on protected area governance, community participation, and land restitution, limited research has examined how governance arrangements, tourism benefit-sharing, and stakeholder experiences interact to shape tourism resource conflicts and sustainability outcomes within the Makuleke Contractual National Park. Therefore, this study investigates how co-management arrangements influence governance processes, access to tourism benefits, and sustainability outcomes in the Makuleke Contractual National Park.

Conflict and Co-Management in Protected Areas

Conflicts in protected areas arise when multiple stakeholders compete for access to land, natural resources, and decision-making authority, often creating tensions between conservation objectives and local livelihoods (Eagles et al., 2002). These conflicts are frequently linked to conservation policies that restrict traditional land-use practices, limit access to livelihood resources, alter land-tenure arrangements, and distribute tourism benefits unevenly (Anthony & Szabo, 2011; Thondhlana & Cundill, 2017). Tourism can further intensify inequalities when benefits accrue to elites or external operators, while local communities bear social and environmental costs (Brockington & Igoe, 2006; Snyman & Bricker, 2021; Snyman et al., 2023). In response, co-management emerged as a collaborative governance approach through which state agencies and local communities share responsibility for protected area management (Berkes, 2009; Borrini-Feyerabend et al., 2012; Fedreheim & Blanco, 2017). Supported by international frameworks such as the Durban Accord, co-management aims to promote participation, equity, and conservation effectiveness (IUCN-The World Conservation Union, 2005). In South Africa, this approach has been closely linked to land restitution, particularly in contractual national parks such as the Makuleke Contractual National Park (MCNP), where communities regain ownership while conservation status is maintained (Steenkamp & Uhr, 2000; Maluleke, 2018; Makuleke JMB/GKSDP, 2021).

Despite its promise, evidence suggests that co-management often delivers mixed outcomes, with decision-making authority remaining concentrated within state institutions and private tourism operators, resulting in symbolic rather than meaningful participation (AWARD, 2020; Maluleke, 2018; Scheyvens & van der Watt, 2021). Similar findings from other countries indicate that effective co-management requires sustained engagement, accountability, and genuine power-sharing (Thomlinson & Crouch, 2012; UNEP-WCMC, 2024). In the Makuleke context, historical displacement, land-use restrictions, unresolved tenure concerns, and unequal access to tourism benefits continue to generate conflict despite formal co-management structures (Thondhlana et al., 2016; Matiku et al., 2020). SANParks' retention of significant authority and

the dominance of private concessionaires further constrain community influence over tourism development and revenue distribution (Chaderopa, 2016). Human-wildlife conflict, including crop damage and livestock losses, further reinforces community dissatisfaction with conservation initiatives (Gandiwa et al., 2013; Salerno et al., 2020).

Collectively, the literature demonstrates that protected-area conflicts are fundamentally governance and justice issues rooted in historical inequalities and power asymmetries, highlighting the need for transparent governance, equitable benefit-sharing, enforceable decision rights, and accountable co-management systems (Dube, 2018; Borrini-Feyerabend et al., 2012; Jánová et al., 2025; Siltanen et al., 2025). Political Ecology provides the primary theoretical lens for this study by explaining how power relations, historical inequalities, and governance structures shape access to tourism resources, environmental decision-making, and the distribution of conservation benefits and costs (Blaikie & Brookfield, 1987; Robbins, 2012). The theory argues that tourism and conservation conflicts are rooted in unequal control over land, resources, participation, and development opportunities rather than ecological concerns alone (Aastrup, 2020; Di Marzo & Espinosa, 2023; Darwis et al., 2025). In the context of the Makuleke Contractual National Park (MCNP), Political Ecology is particularly relevant because land restitution restored ownership rights while governance arrangements continue to influence access to tourism opportunities, participation, and development decisions (Akampurira, 2023; Mthimkhulu & Nel, 2024; Turner, 2004; Turner, 2006). The theory further highlights the importance of transparency, accountability, equitable benefit-sharing, and meaningful stakeholder participation in achieving sustainable tourism outcomes (Heslinga et al., 2017; Soliev et al., 2021; Ramukumba, 2021; McKercher, 2025). To strengthen the analysis, the study also draws on Stakeholder Theory (Freeman, 1984), which examines stakeholder interests and interactions; Conflict Theory, which explains tensions arising from unequal access to power and resources; and the Triple Bottom Line framework (Elkington, 1997), which assesses sustainability across environmental, social, and economic dimensions.

More than two decades after restitution, challenges relating to governance, tourism benefit-sharing, community participation, and sustainability remain evident, raising concerns about the extent to which co-management arrangements have addressed historical inequalities and delivered meaningful benefits to local communities (Balint & Mashinya, 2006; Thondhlana & Cundill, 2017; Derman et al., 2017). Table 1 provides a synthesis of key literature on co-management and protected area governance. It highlights major trends, limitations, and research gaps relevant to tourism resource conflicts and sustainability in the Makuleke Contractual National Park.

Table 1. Literature Synthesis on Co-management and Protected Area Governance (Source: Authors' own creation)

Author(s)	Year	Study Focus/Location	Methodology	Key Findings	Limitations	Research Gap/Relevance to MCNP
Ramutsindela	2004	Conservation and land restitution (South Africa)	Conceptual analysis	Restitution introduces new governance challenges in protected areas	Limited empirical evidence	Does not examine tourism governance and stakeholder perceptions in contractual parks
Kepe	2008	Land restitution and conservation conflicts (South Africa)	Case study	Conservation and community rights often remain contested after restitution	Site-specific findings	Limited focus on tourism benefit-sharing and sustainability outcomes
Spenceley	2012	Tourism in protected areas (South Africa)	Literature review	Tourism can support conservation and livelihoods when benefits are equitably distributed	Broad focus	Limited attention to restituted contractual parks
Thondhlana & Cundill	2017	Community participation in conservation (South Africa)	Qualitative study	Participation often remains limited despite co-management arrangements	Focus on community perceptions	Limited examination of tourism finance and governance processes
Maluleke	2018	Co-management in MCNP	Case study	Power asymmetries persist despite restitution and co-management	Historical focus	Limited assessment of current governance arrangements and sustainability outcomes
Matiku et al.	2020	Restitution and conservation governance (South Africa)	Qualitative analysis	Land restitution does not automatically guarantee resource access or empowerment	Limited stakeholder perspectives	Does not examine tourism-related conflicts in detail
Snyman & Bricker	2021	Benefit-sharing (Southern Africa)	Literature synthesis	Transparency and fair benefit-sharing enhance community support	Not specific to restituted parks	Limited understanding of transparency and conflict in contractual parks
Ntuli et al.	2021	Governance and poaching (Southern Africa)	Empirical study	Governance exclusion contributes to resistance and illegal resource use	Cross-sectional study	Limited evidence on long-term sustainability impacts
Scheyvens & van der Watt	2021	Tourism empowerment (Global)	Conceptual review	Participation often remains symbolic	No empirical testing	Need for empirical evidence from restituted South African parks
Snyman et al.	2023	Revenue-sharing programme (Rwanda)	Longitudinal review	Fair benefit-sharing reduces conflict	Different governance context	Limited application to co-managed contractual parks
Jánová et al.	2025	Participation in governance	Systematic review	Genuine participation requires enforceable decision rights	Few restitution cases	Need for evidence from South African restitution contexts
Siltanen et al.	2025	Protected-area governance	Standards synthesis	Equity and accountability are central to governance success	Normative guidance	Limited empirical assessment of stakeholder experiences

Recent studies indicate that co-management in restituted protected areas often fails to transform underlying power relations significantly. Although governance structures and benefit-sharing mechanisms are formally established, communities frequently have limited decision-making authority, while inadequate transparency in tourism revenues and financial management undermines trust and accountability (Snyman & Bricker, 2021; Maluleke, 2018; Jánová et al., 2025). Evidence further shows that perceptions of unfair benefit distribution, weak accountability, and limited community influence can reduce local support for conservation and contribute to conflict (Ntuli et al., 2021; Snyman et al., 2023). While the literature consistently identifies power imbalances, limited participation, and unequal benefit-sharing as key challenges, most studies examine these issues in isolation and offer limited insight into how they interact to shape resource conflicts and sustainability outcomes in restituted protected areas (Matiku et al., 2020; Snyman & Bricker, 2021). Consequently, there remains a need to understand better how governance arrangements, tourism finance, and stakeholder experiences shape conflict and sustainability within contractual national parks such as the Makuleke Contractual National Park.

Governance and Land Restitution in South Africa

Conflict in protected areas arises when multiple stakeholders compete over access to land, natural resources, tourism opportunities, and decision-making authority, often creating tensions between conservation objectives and local livelihood needs (Eagles et al., 2002; Anthony & Szabo, 2011; Thondhlana & Cundill, 2017). In many contexts, conservation policies have restricted traditional land-use practices and resource access, while tourism development has intensified disputes over benefits perceived as unevenly distributed among stakeholders (Brockington & Igoe, 2006; Domínguez & Luoma, 2020; Snyman & Bricker, 2021). These conflicts are frequently rooted in broader governance challenges, including unequal power relations, limited participation, inadequate transparency, and exclusion from decision-making processes (Jánová et al., 2025). From a Political Ecology perspective, such conflicts reflect historical and structural inequalities that shape access to resources and influence over environmental governance rather than merely technical management failures (Aastrup, 2020; Akampurira, 2023). In response to the limitations of exclusionary conservation approaches, co-management emerged as a collaborative governance model that shares responsibility and decision-making between conservation authorities and local communities (Berkes, 2009; Borrini-Feyerabend et al., 2012; Fedreheim & Blanco, 2017). Co-management is intended to promote local participation, strengthen legitimacy, integrate indigenous knowledge, and improve benefit-sharing while maintaining conservation objectives (AWARD, 2020; IUCN-The World Conservation Union, 2005).

However, empirical evidence suggests that co-management outcomes remain mixed, as decision-making power often remains concentrated within state institutions and private tourism operators, resulting in symbolic rather than substantive participation (Maluleke, 2018; Scheyvens & van der Watt, 2021; Jánová et al., 2025). Across Africa and South Africa in particular, studies consistently show that power asymmetries, limited community influence, and unequal access to tourism benefits continue to undermine trust, generate conflict, and constrain sustainable conservation outcomes even within formally co-managed protected areas (Kepe, 2008; Matiku et al., 2020; Ntuli et al., 2021). Consequently, the literature suggests that successful co-management depends not only on the establishment of participatory structures but also on meaningful community influence, transparent governance, equitable benefit-sharing, and accountable decision-making processes.

The Makuleke settlement is widely recognised as a landmark example of balancing land restitution, biodiversity conservation, tourism development, and community livelihood enhancement within a protected area (Maluleke, 2018; Bvuma, 2023). However, recent scholarship suggests that while restitution restored legal ownership, it did not necessarily translate into meaningful empowerment, equitable decision-making, or control over tourism resources (Chitonge, 2022; Abdullateef, 2024). Across South Africa, claimant communities often regain ownership of land while remaining subject to conservation frameworks that limit their influence over land use and development decisions (Bezerra & Paphitis, 2021; Mthimkhulu & Nel, 2024). Although tourism has been promoted as a key mechanism for generating socio-economic benefits through employment, revenue generation, and local economic development (Matiku et al., 2020), studies continue to highlight challenges related to unequal benefit-sharing, limited participation, governance constraints, and restricted community influence within co-management arrangements (Chitonge, 2022; Appiah-Boateng et al., 2025).

Similar concerns have been identified in other restitution and co-management contexts, including leadership disputes, social conflict, persistent inequalities, and tensions that undermine conservation and tourism outcomes (Krüger et al., 2016; Tsawu, 2025). Furthermore, communally owned protected areas may simultaneously restore ownership rights while reproducing new forms of exclusion through conservation territorialisation and restrictive governance systems (Mthimkhulu & Nel, 2024). Consequently, despite being frequently presented as a successful conservation-restoration model (Ramutsindela & Shabangu, 2013), important questions remain regarding the extent to which co-management arrangements have fostered meaningful participation, equitable benefit-sharing, and sustainable tourism outcomes.

This study addresses this gap by examining stakeholder perspectives on governance, participation, benefit-sharing, and tourism-related resource conflicts within the Makuleke Contractual National Park.

Sustainability and Community Participation

Sustainability in protected areas extends beyond biodiversity conservation to include social equity, effective governance, and economic benefits (McCool & Spenceley, 2014). Community participation remains a critical component of sustainable tourism development in protected areas because governance arrangements and institutional structures influence the extent to which local communities benefit from tourism and conservation initiatives (Lekgau & Tichaawa, 2019; Strydom et al., 2019). Research shows that while community participation is widely promoted in co-management arrangements, it often remains consultative rather than transformative, with communities having limited influence over

decision-making and benefit distribution (Berkes et al., 2000; Maluleke, 2018; Domínguez & Luoma, 2020). These governance challenges can undermine trust, community support, and long-term conservation outcomes (Musakwa et al., 2020; Setokoe & Ramukumba, 2022). Evidence further suggests that equitable benefit-sharing, transparent governance, and inclusive decision-making are essential for sustainable protected area management (Ntuli et al., 2021; Chidakel & Child, 2022; Vandermale & Mason, 2024). Despite formal co-management structures in the Makuleke Contractual National Park, concerns regarding limited participation, unequal benefits, and inadequate transparency persist (Maluleke, 2018; Snyman & Bricker, 2021). Although previous studies have examined restitution, conservation governance, and community participation, limited research has explored how governance arrangements, tourism benefit-sharing, and resource conflicts interact to shape sustainability outcomes. This study addresses this gap by examining stakeholder perspectives on these issues within the Makuleke Contractual National Park (Borrini-Feyerabend et al., 2012; Spenceley & Rylance, 2021).

METHODOLOGY

This study employed a qualitative case study design to explore tourism resource conflicts and their implications for sustainable tourism management within the specific context of MCNP. Highlighting this context emphasises the study's importance for understanding conflict dynamics in co-managed protected areas, thereby clarifying the research scope. The qualitative methodology aimed to gather in-depth insights into stakeholder perceptions, experiences, and interactions within their real-life contexts (Yin, 2018; Creswell & Creswell, 2017). The approach allowed for a comprehensive examination of MCNP as a bounded system, suitable for exploring 'how' and 'why' questions involving multiple stakeholders and complex social phenomena (Hennink et al., 2020; Islam & Aldaihani, 2022). This design facilitated a detailed understanding of conflicts surrounding tourism resources and the sustainability dynamics of co-managed protected areas. The Makuleke Contractual National Park is located in the northern part of Kruger National Park in Limpopo province, South Africa.

Figure 1 illustrates the location of the Makuleke Contractual National Park within Kruger National Park and the surrounding Makuleke communities. Figures 2 and 3 present tourism facilities and tourism infrastructure observed during fieldwork, providing contextual information regarding tourism development within the study area.



Figure 1. Shows the location of the Makuleke Contractual National Park within
Kruger National Park and the three villages of the Makuleke community (Source: Du Plessis, 2023)



Figure 2. Tourism facilities at Makuleke Contractual National Park: (a) Return Africa Pafuri Camp along the Luvuvhu River, northern Kruger National Park, South Africa (Source: Photos taken by the author during fieldwork, February 2025)



Figure 3. Entrance signage to Makuleke Contractual Park and The Outpost Lodge, northern Kruger National Park, South Africa (Source: Taken by the author during fieldwork, February 2025)

It was chosen for this study because of its unique status as the first co-managed protected area within the country's land restitution framework (Ramutsindela, 2004; Fabricius & De Wet, 2002; Qwatekana & Mazibuko, 2020). The park covers approximately 24,000 hectares and is jointly managed by the Makuleke community and South African National Parks (SANParks) through a Joint Management Board (JMB). The park boasts high biodiversity conservation value and features various tourism enterprises, including The Outpost Lodge, Return Africa Pafuri Camp, and Pel's Post Lodge (du Plessis, 2023).

Primary data were collected through semi-structured interviews conducted between January and March 2025, targeting key stakeholder groups, including traditional leaders, Makuleke community members from the villages of Makuleke, Mabiligwe, and Makahlule, SANParks officials, and private tourism operators. The interview guide was developed following an extensive literature review, designed to obtain detailed information regarding stakeholder perceptions of conflict drivers, sustainability concerns, governance challenges, and potential solutions.

The semi-structured format allowed participants to express nuanced views while maintaining a consistent thematic focus across interviews (Bhalla et al., 2023). A total of 23 interviews were conducted until thematic saturation was achieved, ensuring a depth of information and a broad coverage of perspectives (Boddy, 2016; Braun & Clarke, 2021).

Purposive sampling was employed to intentionally select informants with specific knowledge and experience related to MCNP governance and tourism activities (Taherdoost, 2016). Efforts were made to ensure diverse representation across age, gender, roles, and affiliations, enhancing the richness of the dataset. To analyse the interview transcripts, a thematic analysis was conducted using Braun and Clarke's six-step approach (Braun & Clarke, 2006).

This rigorous and systematic process involved familiarisation with the data, generating initial codes, searching for themes, reviewing those themes, defining and naming them, and finally producing the report. This method provided a reliable foundation for identifying core conflict issues, stakeholder perceptions, and governance challenges relevant to MCNP's sustainability, fostering confidence in the findings.

RESULTS AND DISCUSSIONS

This section presents the study's findings based on semi-structured interviews with key stakeholders involved in the Makuleke Contractual National Park. The analysis used thematic analysis, which enabled the identification of recurring patterns and key themes related to tourism resource conflicts and sustainability. The results are presented in two parts: first, the demographic profile of participants to provide contextual background, and second, the thematic findings that capture stakeholder perspectives on the causes, nature, and impacts of tourism resource conflicts in the study area.

Participant Profile

The participant profile provides important contextual information for understanding the range of perspectives represented in the study. By categorising participants according to their stakeholder affiliation and social position, the analysis captures how experiences of tourism resource conflicts and co-management may differ across groups. Examining the views of community members, traditional leaders, tourism operators, SANParks officials, and the CPA representative enables a more nuanced understanding of the interests, power relations, and governance dynamics shaping tourism and conservation outcomes within MCNP.

Furthermore, the demographic composition of participants provides a basis for exploring variations in perceptions across gender and age groups, which are often overlooked despite their influence on participation, benefit-sharing, and decision-making processes. Table 2 summarises the demographic and stakeholder characteristics of the participants and provides the foundation for the thematic analysis that follows.

Table 2 presents the demographic and stakeholder characteristics of the 23 interview participants. Community members constituted the largest stakeholder group (61%; n = 14), reflecting the study's emphasis on local experiences of tourism governance, conservation, and benefit-sharing. Other participants included tourism operators (4%; n = 1), Lodge

managers (13%; n=3), SANParks officials (9%; n = 2), traditional leaders (9%; n = 2), and one CPA representative (4%; n = 1). Participants were drawn from Makuleke, Makahlule, and Mabiligwe villages, as well as neighbouring communities. The sample included both male (61%) and female (39%) participants.

It was dominated by respondents aged 41 years and older (78%), indicating a strong representation of individuals with long-standing experience of land restitution, conservation, and co-management processes. The diversity of stakeholder affiliations and community positions enabled comparison of convergent and divergent perspectives regarding governance, participation, benefit-sharing, and sustainability within MCNP.

Table 2. Demographic and Stakeholder Profile of Interview Participants (n = 23) Source: Authors' fieldwork (2025)

Demographic Variable	Category	Participant Codes	n	%
Stakeholder Role	Community Members	Community Member 1-14	14	61
	SANParks Officials	SANParks Official 1-2	2	9
	Tourism Operators	Tourism Operator 1	1	4
	Lodge managers	Lodge Manager 1-3	3	13
	Traditional Leaders	Traditional Leader 1-2	2	9
	CPA Representative	CPA Representative 1	1	4
Village of Residence	Makuleke	-	7	30
	Makahlule	-	4	17
	Mabiligwe	-	2	9
	Other Areas	-	10	43
Age Group	21–30 years	-	2	9
	31–40 years	-	3	13
	41–50 years	-	10	43
	51 years and above	-	8	35
Gender	Male	-	14	61
	Female	-	9	39
Primary Connection to MCNP	Live near the Park	-	6	26
	Work in / Manage the Park	-	5	22
	Represent Community Interests in Park Affairs	-	5	22
	Tourism Stakeholder	-	1	4
	Other	-	6	26

Thematic Analysis

This study aimed to examine how co-management influences governance, access to tourism benefits, and resource conflicts within the Makuleke Contractual National Park (MCNP). Data generated from 23 semi-structured interviews with community members, traditional leaders, a CPA representative, SANParks officials, and tourism operators were analysed thematically. Three interrelated themes emerged from the analysis: Governance and Participation, Unequal Benefit-Sharing, and Sustainability Implications.

These themes provide a framework for understanding stakeholder experiences and perceptions of co-management within MCNP. By exploring the long-term outcomes of restitution and co-management, the study contributes to ongoing debates on the extent to which legal ownership translates into effective governance, economic inclusion, and sustainable conservation outcomes. The findings and discussion are presented under the three themes below.

Theme 1: Governance and Participation

A dominant theme across stakeholder groups was the perception that legal ownership had not translated into equivalent decision-making authority within the co-management arrangement. Although structures such as the Joint Management Board (JMB), Communal Property Association (CPA), and community consultation forums were intended to facilitate shared governance, participants frequently reported that strategic and operational decisions remained concentrated within SANParks and private concessionaires. As Community Member 9 explained:

"Consultation is there, but decisions come from above."

This distinction between consultation and influence was a recurring concern, with participants questioning whether engagement processes translated into meaningful authority over employment, development priorities, and park management decisions. Similar concerns were reflected in Community Member 4's observation that SANParks often sought to "do things their way," reinforcing perceptions of centralised decision-making. Operational stakeholders also identified communication challenges as a governance concern. As Lodge Manager 1 noted:

"There are consultation structures in place, but communication between stakeholders is not always consistent, which can create misunderstandings about how decisions are made."

These communication gaps were linked to broader tensions regarding stakeholder priorities. For example, Lodge Manager 3 argued:

"The community is on everything, but SANParks only cares more about conservation. They don't care about the business... So this is where the CPA or the community must play a role here to make sure that we have common grounds with SANParks and us."

Together, these views suggest that governance tensions in MCNP stem not only from decision-making authority but also from communication challenges and competing stakeholder priorities. Similar findings have been reported in transfrontier conservation areas, where institutional arrangements and protected area policies create barriers to meaningful community participation in wildlife tourism and decision-making processes (Lekgau & Tichaawa, 2019). Traditional leaders similarly emphasised the need for a more balanced partnership based on shared responsibility and mutual benefit. As Traditional Leader 1 noted:

"We need to work until we strike that balance so we can move in the same direction."

These perceptions suggest that restitution created expectations of shared governance that many participants felt had not been fully realised in practice. Importantly, governance concerns were not limited to community stakeholders. SANParks officials also acknowledged shortcomings in stakeholder engagement and communication, with SANParks Official 1 stating:

"We need to conduct stakeholder engagement sessions; currently, we do not have that platform."

While community members interpreted these shortcomings as evidence of unequal authority, SANParks officials tended to frame them as operational and communication challenges. This divergence highlights how governance tensions are understood differently by stakeholders, despite a shared recognition that current engagement mechanisms are insufficient.

Overall, participants associated governance challenges with limited influence over decision-making, weak communication, and uncertainty regarding stakeholder roles within the co-management system.

These findings extend earlier work by Maluleke (2018), which identified unequal power relations and limited community influence during the early implementation of the agreement. More than two decades after land restitution, similar concerns persist, suggesting that the central challenge is no longer the restoration of ownership rights but the effective translation of those rights into meaningful governance authority. The findings therefore reinforce broader evidence that formal participation structures do not necessarily guarantee substantive participation, particularly where institutional authority and decision-making power remain unevenly distributed.

The findings corroborate concerns regarding the implementation of benefit-sharing mechanisms. While the MCNP Management Plan prioritises socio-economic development through employment creation, tourism partnerships, and community benefits, participants highlighted perceived inequalities in the distribution of these benefits.

From a Political Ecology perspective, these findings demonstrate that land restitution and formal co-management structures do not necessarily transform underlying power relations. Although the Makuleke community regained legal ownership of the land and is represented within governance structures, participants perceived that substantive decision-making authority remains concentrated within SANParks and other institutional actors. This supports Political Ecology's contention that formal reforms may coexist with persistent inequalities in resource governance and control. Furthermore, the findings extend Stakeholder Theory by illustrating that stakeholder representation alone does not guarantee meaningful participation. While community members are included in consultation processes, participants perceived limited influence over strategic decisions affecting tourism development, conservation management, and benefit distribution. The findings therefore suggest that effective co-management requires not only stakeholder inclusion but also genuine decision-making authority and accountability mechanisms that enable stakeholders to influence outcomes.

Theme 2: Unequal Benefit-Sharing

Participants widely perceived tourism benefits as unevenly distributed despite community ownership of the land. Concerns centred on concession agreements, employment opportunities, revenue transparency, and limited participation in tourism-related economic benefits. As Community Member 6 explained:

"Even though Makuleke owns the land, the kind of business we entered does not allow us to have much benefit. We are not part of the profits."

The same participant further noted:

"The concessionaires brought capital. We only brought land, so we get a concession fee and nothing from the profits."

These accounts suggest that stakeholders perceived a disconnect between land ownership and economic influence within tourism operations, a concern also highlighted in studies examining the livelihood outcomes of the Pafuri Triangle Agreement among the Makuleke community (Bvuma, 2023). While previous studies have examined co-management and benefit-sharing in the Makuleke region, the present findings indicate that tourism governance has become a key site of contestation, with concerns extending beyond revenue distribution to include concession arrangements, employment opportunities, and financial accountability. This suggests that tourism governance functions as an important mechanism through which power, inclusion, and economic benefits are negotiated in restituted protected areas. Similar concerns have been reported in protected-area tourism, where benefit-sharing outcomes are shaped by partnership structures and the degree of community participation in decision-making processes (Snyman & Bricker, 2019; Spenceley & Snyman, 2017; Qwatekana & Mazibuko, 2020). Moreover, benefit-sharing extends beyond direct financial transfers to include employment, local procurement, enterprise opportunities, and skills development, which may explain why dissatisfaction persists despite the existence of some economic benefits (Ramukumba, 2021; Kegamba et al., 2021).

The findings support Conflict Theory by demonstrating how unequal access to tourism revenues, employment opportunities, and decision-making authority contributes to tensions among stakeholders despite formal co-management arrangements. Participants perceived that although the Makuleke community regained ownership of the land, economic benefits associated with tourism remain unevenly distributed. From a Political Ecology perspective, this reflects broader power relations that shape who controls tourism revenues, information, and development opportunities. The findings therefore suggest that benefit-sharing is not merely an economic issue but also a governance and justice concern.

Concerns regarding transparency and accountability further emerged as a significant source of tension. Participants frequently questioned the accuracy of reported tourism revenues and the adequacy of existing reporting mechanisms. As Community Member 8 stated:

"We do not trust the figures they provide, suspecting they may not reflect the real amounts being earned."

These perceptions indicate that limited access to financial information was associated with reduced accountability and weakened trust in tourism governance. Although this study did not examine audited financial records and cannot verify these claims, participant concerns reflect broader evidence that limited transparency can undermine stakeholder trust, whereas clear and accountable revenue-sharing mechanisms strengthen legitimacy and community support (Spenceley & Snyman, 2017).

A Lodge Manager 3 explained:

"The communities closer to the park, such as Bennde-Mutale, feel that they live closer to an orange tree that they cannot even pick the oranges to enjoy".

The metaphor of an "orange tree" reflects feelings of exclusion among neighbouring communities who perceive tourism benefits as inaccessible despite their proximity to the park. These perceptions suggest that benefit-sharing tensions extend beyond financial returns and include questions of fairness, recognition, and access to employment opportunities. Similar findings have been reported in protected-area tourism studies where perceived inequities contribute to stakeholder dissatisfaction and conflict (Snyman & Bricker, 2019).

The findings also revealed considerable variation in how benefits were experienced across communities. Neighbouring communities, particularly Bennde-Mutale, perceived themselves as excluded from tourism opportunities despite their proximity to the park and exposure to conservation-related costs. Community Member 14 noted:

"Jobs go to Makuleke only; we are also here and are not considered."

This concern was echoed by a tourism operator, who observed:

"The communities closer to the park, such as Bennde-Mutale, feel that they live closer to an orange tree that they cannot even pick the oranges to enjoy."

The convergence of views across stakeholder groups suggests broad recognition of uneven benefit distribution. Consistent with previous studies, participants perceived access to tourism benefits as shaped by institutional relationships, beneficiary status, and proximity to tourism opportunities rather than geography alone (Bennett et al., 2021; Kegamba et al., 2023; Mutanga et al., 2017). Importantly, perceived inequities extended beyond financial returns to include employment, information access, representation, and participation opportunities, reinforcing benefit-sharing as a broader governance issue and a significant source of tension within the MCNP co-management arrangement. The findings corroborate concerns regarding the implementation of benefit-sharing mechanisms. While the MCNP Management Plan prioritises socio-economic development through employment creation, tourism partnerships, and community benefits, participants highlighted perceived inequalities in the distribution of these benefits.

These findings provide strong support for Conflict Theory, which explains how unequal access to resources, opportunities, and benefits can generate tensions among social groups. Participants consistently perceived that tourism revenues, employment opportunities, and economic benefits were distributed unevenly despite community ownership of the land. Such perceptions contributed to dissatisfaction, mistrust, and contestation regarding tourism governance arrangements. From a Political Ecology perspective, the findings further demonstrate that benefit-sharing is not merely an economic issue but also a question of power and control over resources. The ability to influence concession agreements, access financial information, and participate in revenue-allocation decisions was viewed as equally important as the benefits themselves. Consequently, the findings suggest that tourism resource conflicts emerge not only from limited benefits but also from perceived inequalities in governance and access to decision-making processes.

Theme 3: Sustainability Implications

Participants frequently associated governance challenges, limited participation, and perceived inequities in benefit-sharing with broader concerns regarding conservation, tourism development, and community well-being. Across stakeholder groups, respondents viewed governance quality as closely connected to the long-term sustainability of the park. However, these accounts reflect stakeholders' perceptions and experiences rather than objectively verified ecological, social, or economic outcomes.

A recurring concern was that limited access to tangible benefits weakened community support for conservation initiatives. Participants argued that when local communities do not experience visible improvements in livelihoods, their willingness to support conservation efforts may decline. Community Member 11 explained:

"If there are no visible economic benefits or rewards for the neighbouring communities, they are not going to cooperate and protect the environment."

A similar view was expressed by a SANParks official. SANParks Official 1 stated:

"If people do not benefit, they stop caring about conservation and become resentful."

The convergence of perspectives between community members and SANParks officials suggests a shared recognition that perceptions of fairness and inclusion may influence attitudes towards conservation. Participants also linked exclusion from tourism opportunities and limited employment prospects to broader frustrations in community–park relations. For example, Community Member 12 remarked:

"We go into the park to poach because we need to eat. We are hungry and unemployed."

Similarly, Community Member 13 explained:

"We closed the gate because we were angry and we are not getting jobs in the park."

These accounts illustrate how some participants interpreted poaching and protest actions through the lens of unemployment, exclusion, and unmet livelihood expectations. Similar patterns have been reported in community–conservation studies, where perceived economic marginalisation is associated with declining conservation support and increased conflict (Carius & Job, 2019; Gidebo, 2022; Ghaderi et al., 2022; Koricha & Adem, 2024; Nugroho & Numata, 2020; Wei et al., 2024). However, these perceptions should not be interpreted as evidence of a direct causal relationship, as illegal resource use and conservation outcomes are shaped by complex interactions among socio-economic, governance, institutional, and contextual factors (Huber et al., 2023; Zhang et al., 2024; Zhang et al., 2025).

Lodge Manager 3 observed:

A recurring concern was that limited access to tangible benefits weakened community support for conservation initiatives. Participants repeatedly linked conservation support to the visible benefits derived from tourism. For instance, Lodge Manager 3 stated:

"If those communities are not seeing any benefits from the park, it's not going to help at all".

This observation suggests that stakeholders perceive a direct relationship between community benefits and conservation attitudes. Participants argued that when local people do not experience tangible improvements in their livelihoods, support for conservation initiatives may diminish. These findings align with studies showing that equitable benefit-sharing can strengthen conservation support, whereas perceived exclusion may contribute to resistance and conflict (Ntuli et al., 2021; Snyman et al., 2023).

The findings reinforce the relevance of the Triple Bottom Line framework by demonstrating the interconnected nature of environmental, social, and economic sustainability within the MCNP. Participants perceived that governance challenges and inequitable benefit-sharing negatively influenced all three dimensions simultaneously.

Social sustainability was affected through declining trust and strained stakeholder relationships; economic sustainability was constrained by limited employment and livelihood opportunities; and environmental sustainability was perceived to be vulnerable where local support for conservation weakened. The findings therefore suggest that sustainability outcomes cannot be achieved through conservation objectives alone but depend on balancing environmental protection with social equity and economic inclusion.

From a Stakeholder Theory perspective, the results further indicate that long-term sustainability is more likely when stakeholders perceive governance processes as fair, transparent, and responsive to their interests.

Overall, the findings suggest that visible livelihood benefits, meaningful participation, and perceptions of economic inclusion are important elements in sustaining community support for conservation and tourism development. Participants also perceived governance tensions as a potential threat to future tourism development. Community members, traditional leaders, and tourism stakeholders expressed concerns that persistent mistrust, uncertainty, and unresolved disputes could weaken collaboration and constrain investment opportunities.

Although the study did not assess actual tourism performance or investment trends, these findings indicate that stakeholders view governance quality as central to the long-term viability of tourism and conservation. More broadly, participants consistently linked exclusion from decision-making and perceived inequities in benefit-sharing to declining trust, weakened conservation support, and strained community–park relations. These findings highlight the interconnected nature of governance, conflict, and sustainability, suggesting that effective conservation outcomes depend not only on ecological management but also on governance legitimacy, meaningful participation, and equitable benefit-sharing.

The findings reinforce the Triple Bottom Line framework by demonstrating that social, economic, and environmental sustainability are interconnected and cannot be pursued independently.

CONCLUSION

The Makuleke Contractual National Park illustrates both the potential and challenges of land restitution and co-management in South Africa. While the model has created opportunities for conservation, tourism development, and community benefits, persistent governance challenges, unequal power relations, limited participation, and concerns over benefit-sharing continue to constrain sustainability. The findings suggest that legal ownership alone does not guarantee meaningful influence over decision-making or equitable access to tourism benefits.

The study highlights that sustainable tourism depends on inclusive governance, transparent decision-making, equitable benefit-sharing, and meaningful stakeholder participation. Strengthening accountability, dialogue, and collaborative management arrangements can reduce conflict and improve trust among stakeholders. The study also contributes theoretically by demonstrating the complementary value of Political Ecology, Stakeholder Theory, Conflict Theory, and the Triple Bottom Line framework in understanding tourism resource conflicts in restituted protected areas.

Political Ecology explains how historical inequalities and power relations continue to shape governance outcomes; Stakeholder Theory highlights the importance of meaningful participation; Conflict Theory explains tensions arising from unequal access to benefits; and the Triple Bottom Line framework illustrates how governance and benefit-sharing affect environmental, social, and economic sustainability simultaneously. Together, these perspectives provide a more integrated explanation of how tourism resource conflicts emerge and persist within co-managed protected areas.

The study also contributes theoretically by demonstrating the value of Political Ecology, Stakeholder Theory, Conflict Theory, and the Triple Bottom Line framework in explaining tourism resource conflicts in restituted protected areas. The findings show that co-management and land restitution do not automatically result in equitable power-

sharing, meaningful participation, or sustainable outcomes. Despite formal land ownership, the Makuleke community continues to experience limited influence in decision-making and benefit-sharing processes, reflecting the persistence of historical power inequalities. The study highlights that stakeholder influence is shaped by access to resources, expertise, and institutional authority rather than ownership alone. These findings suggest the need for stronger alignment between land restitution and conservation policies to promote transparency, accountability, and equitable benefit-sharing.

To enhance sustainability, co-management arrangements should strengthen community participation in governance structures, improve transparency in the allocation of tourism revenue, and implement participatory monitoring and decision-making processes. Capacity-building initiatives in governance, tourism management, financial literacy, and entrepreneurship should also be prioritised. Furthermore, regular stakeholder engagement forums and independent conflict-resolution mechanisms can improve trust and collaboration.

Ultimately, sustainable conservation and tourism outcomes depend on transforming legal restitution into genuine empowerment through inclusive governance, equitable benefit-sharing, and meaningful stakeholder participation.

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LANDSCAPE URBANISM SUPPORTS SPONGE CITY DEVELOPMENT IN THE HANGZHOU ASIAN GAMES VILLAGE

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Abstract: This study investigates the influence of landscape urbanism design and green infrastructure on the performance of sponge cities, an increasingly vital approach to sustainable urban water management in rapidly urbanizing contexts. Focusing on the Asian Games Village in in Hangzhou as a case study, the research explores the mediating role of stormwater management efficiency and the moderating effect of government policy support in this relationship. A quantitative method was employed, utilizing data from structured questionnaires completed by 296 urban development professionals. The hypothesized relationships were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). The findings confirm that both landscape urbanism design and green infrastructure significantly and positively impact sponge city performance. Stormwater management efficiency was identified as a crucial mediator in these relationships. Furthermore, the results revealed that government policy support acts as a moderator, strengthening the positive effects of landscape urbanism and green infrastructure on stormwater management. This research contributes a comprehensive conceptual model that integrates ecological design principles, operational performance, and governance frameworks. It provides practical guidance for urban planners and policymakers by highlighting the necessity of a systemic approach that combines innovative design with robust policy to create resilient and effective sponge cities, thereby advancing both theory and practice in sustainable urban development.

Keywords: landscape urbanism, sponge city, green infrastructure, stormwater management efficiency, government policy support

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INTRODUCTION

Urbanization and global climate change heightened stormwater management and prevention of urban flooding concerns within cities around the world, especially in developing Asian cities (Abhijith et al., 2025) The "sponge city" is a desirable approach to maximizing urban resilience via encouraging natural absorption, storage, and purification of rainwater in cities (Chen, 2023). Sponge city planning promotes the use of green infrastructure and ecological design principles in urban planning in an effort to minimize surface runoff, remove flood threats, and enhance water quality (Chikhi et al., 2024).

Landscape urbanism, which concerns itself with merging ecological systems with urban planning, provides an interesting model for addressing the challenges of sponge cities through the creation of multifunctional spaces for human and environmental advantage (Balon et al., 2023). Specifically, planning of mass event villages, like the Asian Games Village, presents a chance to implement landscape urbanism as an integrated method in developing resilient and sustainable cities capable of managing water and enhancing human health (Aderyani et al., 2025; Daniels & Tichaawa, 2025). Research on major Chinese cities further indicates that metropolitan development is shaped by interacting economic, political, infrastructural, social, and cultural forces (Li & Dawood, 2016a). A substantial body of evidence underscores the efficacy of landscape urbanism in enhancing urban ecological performance, particularly in stormwater management. Core principles of landscape urbanism, such as ecological zoning and multifunctional landscapes, play a vital role in reducing impervious surface cover and increasing infiltration capacity—both of which are critical for effective stormwater retention and filtration.

Green infrastructure components such as bioswales, rain gardens, and green roofs further complement this approach by significantly reducing runoff volumes and improving water quality. Empirical studies from Chinese cities, for example, report up to 60% reductions in stormwater runoff during heavy rainfall events following green infrastructure implementation.

These strategies collectively contribute to improving sponge city performance by strengthening natural hydrological cycles and mitigating urban flood risks. Furthermore, stormwater management efficiency has emerged as a key mediating factor, influencing the relationship between ecological urban design strategies and overall sponge city outcomes. High-performing stormwater systems enhance the regulation of flow rates, pollutant loads, and water recycling capabilities. Government policy support also plays a moderating role, with financial incentives and regulatory frameworks significantly shaping the adoption and success of sustainable water management practices (Abhijith et al., 2025; Carranza, 2024; Grabowski et al., 2023; Grichting & Salama, 2024; Huang et al., 2025; Khoshhalshaghaji et al., 2025; Kurniawan et al., 2023; Ling et al., 2024; Mao

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et al., 2025; Mendes et al., 2025; Štrbac et al., 2023). More broadly, resource-efficient innovation has been identified as a pathway toward sustainable development under technological and market turbulence (Iqbal et al., 2021).

Despite the widening knowledge base, several gaps exist in understanding the complex interactions among landscape urbanism design, green infrastructure implementation, and sponge city performance (Su & Tan, 2023; Tang et al., 2025; Zammit, 2025). First, much research to date focuses on these variables individually or considers green infrastructure technology without much consideration of the principles of landscape urbanism generally (Mendes et al., 2025). This fragmented approach restricts the fulfillment of comprehensively knowing how multifunctional urban typologies interact with stormwater systems and collectively contribute to urban resilience (Mao et al., 2025; Zhixin et al., 2025). Secondly, the mediating role of stormwater management efficiency in connecting ecological design strategies and sponge city outcomes remains insufficiently investigated, especially concerning massive-scale, transient urban complexes like the Asian Games Village (Wang et al., 2025). This gap highlights the need for empirical models to explicitly measure the way through which stormwater management acts as an avenue for design interventions to manifest into functional performance upgrades (Grichting & Salama, 2024; Liu, 2023). In addition, the moderating role of the support of government policy towards landscape urbanism and green infrastructure performance is still not adequately addressed in current studies (Balon et al., 2023). Although policy frameworks are well-documented to be key enablers, hardly any empirical studies have been conducted to examine how varying levels of policy strength and enforcement influence the relationship between design implementation and the effectiveness of stormwater management (Adedeji & Lenz, 2023; Kim, 2025; Mendes et al., 2025). This is particularly salient in the Asian context where governance arrangements in urban areas and policy environments vary considerably and impact the scalability and sustainability of sponge city initiatives (e Ali & Bashir, 2024). Closing these gaps is vital to constructing more robust, context-related frameworks that can advise on integrated urban water management strategies and help drive sustainable urban change in mega-event settings and other locales.

This article attempts to explore the complex relationships between landscape urbanism design, green infrastructure uptake, stormwater management efficacy, and sponge city performance, while highlighting the moderating role of government policy support in the context of the Asian Games Village in Hangzhou. The key objectives are: (1) to assess the direct relationships between landscape urbanism and green infrastructure and sponge city performance; (2) to examine the mediating role of stormwater management efficiency in these relationships; (3) to look at government policy support as a driver of the magnitude of these relationships. This study contributes to practice and theory significantly by providing a common model that integrates ecological design, infrastructural technology, and policy intervention in order to optimize sponge city performance. In its examination of the Asian Games Village a mega urban development project with high profile this study offers valuable information on the implementation of principles of landscape urbanism to problem conditions in the city in which sustainability and resilience are critical (Carranza, 2024). The results are anticipated to enlighten urban planners, policymakers, and environmental managers on the integral role of integrated design and governance interventions in ensuring appropriate management of stormwater and urban resilience, respectively. In addition, the research is bridging significant knowledge gaps, specifically in mediating and moderating factors influencing urban water management outcomes, thereby adding value to sustainable urbanism as a research field across Asia and the world (Suits et al., 2025).

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Landscape Urbanism Design and Sponge City Performance

Landscape urbanism planning is a planning and design approach that introduces ecological processes and landscape systems into the urban environment (Balon et al., 2023). Ecological zoning, one of its central principles, is based on the separation of city space by natural elements and environmental functions and multifunctional space that has several functions, including recreation, habitat provision, and stormwater management (Carranza, 2024). These design principles are responsible for the development of robust urban environments that enhance natural hydrological processes, biodiversity, and human well-being (Hoover et al., 2023; Mamirkulova et al., 2025). Sponge city performance, in this article, evaluates the capacity of the urban environment to capture, retain, and filter rainwater, thus barring the possibilities of flooding and water usage sustainability (Chikhi et al., 2024). Ecological zoning can minimize impervious surface flow through safeguarding natural water retention areas and preventing development from advancing to vulnerable areas (Ji & Rao, 2023). Multifunctional space, for example, parks with wetlands or retention basins, both control stormwater effectively and increase city and community appeal (Liu, 2023). Studies in various Asian cities confirmed that sites designed based on landscape urbanism principles have higher infiltration capacity and greater resilience during heavy rainfalls (Jensen & Cureton, 2024). Evidence supports the assumption that sponge city performance is positively affected by landscape urbanism design through the incorporation of ecological health and urban efficiency (Liang & Li, 2023; Liu et al., 2025).

H1: Landscape urbanism design significantly contributes to sponge city performance.

Green Infrastructure Application and Sponge City Performance

Green infrastructure refers to a decentralized network of natural systems that are designed to manage stormwater at the source (Grichting & Salama, 2024). Filter- and runoff-conveying bioswales, rain gardens for rainwater storage and infiltration, and green roofs for mitigating surface runoff by harvesting rainfall are the primary elements (Hapriyanto & Azmi, 2025). The elements support sponge city performance through enhanced infiltration, peak runoff attenuation, and improved water quality. Green infrastructure also contributes to cooling urban areas, maintaining biodiversity, and promoting greater environmental sustainability, and is therefore a major method for cities to combat dealing with climate change as well as metropolitan pressure (Khoshhalshaghaji et al., 2025). There is ample empirical evidence which bears witness to the fact that green infrastructure allows sponge city to function effectively (Kim, 2025). There are reported

consultations of sizeable runoff reductions and consultations of pollutant loads in urban spaces where rain gardens and bioswales have been implemented, especially in spaces with high intensity rainfall events (Ling et al., 2024). Green roofs, among other structures, have been reported to decrease runoff volume by up to 70%, with other thermal insulation properties (Mendes et al., 2025). Singaporean and Chinese urban case studies offer insights into the ways in which the massive deployment of green infrastructure results in the control of floods and improved urban microclimates (Štrbac et al., 2023). They form the basis of theory that green infrastructure development is a significant driver of improved sponge city performance, thus being a real-world, scalable means of sustainable urban water management.

H2: Effective implementation of green infrastructure contributes positively and significantly to sponge city performance.

Efficiency of Stormwater Management and Sponge City Performance

The efficiency of stormwater management systems and processes to treat precipitation volume and quality during and following rainfall is referred to as stormwater management effectiveness (Yadav et al., 2025). It involves features like peak flow control, enhanced infiltration, and cleaning of pollutants prior to runoff into natural water bodies (Wang et al., 2025). Appropriate stormwater management in sponge cities is important, and the challenge is to replicate the natural hydrology to alleviate flooding, recharge groundwater, and sustain urban ecological balance (Suits et al., 2025). Key performance indicators are decreased volume of runoff, decreased concentration of pollutants, and increased groundwater recharge rates (Stinshoff et al., 2025). The more sophisticated stormwater controls of more advanced cities such as detention basins, permeable pavements, and constructed wetlands have significantly lower urban flooding and water pollution rates (Mendes et al., 2025). Asian cities in their research have established that the improvement of stormwater management measures reduces surface runoff volumes by significant quantities, thus decreasing the burden on drainage infrastructure (Mao et al., 2025). These results verify the premise that the effectiveness of stormwater management positively influences the performance of sponge cities by regulating the urban system's capacity to sustain rainfall and reduce risks.

H3: The efficiency in stormwater management has a direct positive effect on the performance of the sponge city.

Stormwater Management Efficiency as Mediator

Landscape urbanism design prioritizes logical location of ecological and multifunctional spaces to enhance urban sustainability and resilience (Mao et al., 2025). The most important variables include the aspects of the design, such as ecological zoning, green corridors, and multifunctional landscapes, which enhance natural water flow and retention. Stormwater management performance refers to the degree to which urban infrastructure handles runoff volume, flow rates, and pollutant loads by functioning (Khoshhalshaghaji et al., 2025). The performance of the sponge city serves as an indicator of how well the city performs in recycling and holding back stormwater and thereby reduces flood risk and sustains ecological balance (Ma et al., 2023). The mediating role of stormwater management efficiency reveals that the advantages of landscape urbanism design in sponge city performance are primarily driven by improved capacity to handle stormwater (Liu, 2023). For instance, multifunctional landscapes in ecological zoning reduce impervious cover and increase infiltration and runoff regulation accordingly (Liu et al., 2025). Studies on Asian cities support that stormwater infrastructure incorporated in landscape urbanism planning optimizes peak flow reduction and water quality improvement benefits, and achieves effective stormwater management (Baghersad et al., 2025).

H4: The relationship between landscape urbanism design and sponge city performance is mediated by stormwater management efficiency.

Green infrastructure installation consists of integrating stormwater locally treated nature-based solutions, including bioswales, rain gardens, and green roof systems, within the urban setting. They enhance infiltration, reduce runoff, and enhance pollutant removal (Huang et al., 2025). The effectiveness of stormwater management, here used as a mediating variable, describes the extent to which such green infrastructure components maximize control of water quality and runoff in an efficient manner and thus affect citywide sponge city performance, where the urban system's capability to absorb, store, and reuse stormwater in a sustainable way is quantified (Kong et al., 2025). Thousands of studies have established that green infrastructure improves stormwater management efficiency through detrainment and filtration of contaminants and reduction and filtration of runoff peaks, respectively (Zhu et al., 2023). For instance, in an urban landscape, bioswales and rain gardens reduce volume runoff and retard peak discharge, thus improving the hydrologic capacity of urban catchments to absorb stormwater (Zhixin et al., 2025). In addition, green roofs have runoff reduction and thermal management benefits too, which supports improved hydrological performance additionally. These results show that the beneficial role of green infrastructure on sponge city performance primarily exists through its optimizing effectiveness of stormwater management (De Montis et al., 2024). Thus, stormwater management takes the functional bridge role to facilitate applications of green infrastructure to achieve its resultant benefit in sustainable urban water management.

H5: Stormwater management efficiency mediates the relationship between green infrastructure implementation and sponge city performance.

Government Policy Support as Moderator

Government policy support involves the policies, regulations, incentives, and financing instruments that make and promote sustainability-oriented approaches towards urban development (Alanazi et al., 2025; Ziari & Mosleh, 2025). Some of the most critical variables include policy interventions like zoning codes, environmental policies, fiscal policy incentives, and planning requirements that promote the use of landscape urbanism design principles (e Ali & Bashir, 2024). Whether or not stormwater management is successful serves as a proxy measure of the performance or effectiveness of how urban systems succeed in regulating and maximizing stormwater flow and quality (Kurniawan et al., 2023). Government

policy support as the moderating variable means that the positive impact of landscape urbanism design in enhancing stormwater management efficiency is more pronounced when it is supported vigorously by policies (Su & Tan, 2023). Empirical evidence indicates the requirement for policy environments to allow landscape urbanism to play its maximum possible role in urban water management (Baghersad et al., 2025). For example, cities with integrated green urban policy measures are bound to experience higher degrees of stormwater management and less flooding since they benefit from enhanced ecological zoning as well as multifunctional landscapes (Huang et al., 2025). Studies conducted in China and Singapore highlight how supportive policy settings facilitate cross-sector collaboration, allocate resources to landscape projects, and implement standards that enhance stormwater performance (Khodadad et al., 2023; Mendes et al., 2025; Zarei & Shahab, 2025). These findings validate the hypothesis that government policy support strengthens the relationship between landscape urbanism design and the effectiveness of stormwater management by providing the institution and funding necessary to overcome practical barriers and scale up successful interventions.

H6: Government policy support moderates the relationship between landscape urbanism design and stormwater management efficiency.

The deployment of green infrastructure involves mixing bioswales, permeable pavements, rain gardens, and green roofs in urban areas with a goal of managing stormwater in an environmentally friendly manner (Mao et al., 2025). Support in government policy through mixes of enabling tools such as environmental standards, finance schemes, technical specifications, and societal campaigns promoting the uptake of green infrastructure (Stinshoff et al., 2025). The efficiency of stormwater management measures the strength of cities to manage runoff volume, peak discharge, and pollutant load. The policy support moderation role indicates that this enhancing role of green infrastructure in stormwater management efficiency is intensified once the government provides substantial support and promotes it (Kong et al., 2025). Research has indicated that well-planned government policies are at the forefront in the proper implementation and functioning of green infrastructure in urban water management (Huang et al., 2025). For example, a policy incentive is stormwater fee credits and tax rebates, which have been shown to accompany higher rates of installation and maintenance of green infrastructure. In addition, planning regulations and regulatory requirements ensure that green infrastructure is incorporated in urban development plans in time to optimize its hydrological effectiveness (Zarei & Shahab, 2025). Portland and Seoul are examples or case studies demonstrating how policy support is correlated with enhanced stormwater performance, such as minimized flooding and better water quality.

H7: Government policy support moderates the relationship between green infrastructure implementation and stormwater management efficiency.

Theoretical Framework Supporting the Research

This research is grounded on the socio-ecological systems theory and urban thinking about resilience, which involves the dynamic interaction between human-built infrastructure and nature with a view to the development of resilient urban areas. Landscape urbanism design and green infrastructure are practiced as the focal ecological treatments that mimic the natural hydrological processes and thus enhance the efficiency of stormwater management a core process through which the performance of sponge cities is optimized (Jensen & Cureton, 2024). Theory suggests that urban systems work best when policy, design, and ecological elements are integrated into harmony with each other, emphasizing the government policy support function as a moderating variable in enhancing implementation and performance of green infrastructure and landscape urbanism interventions (Owojori & Erasmus, 2025). Moreover, stormwater management effectiveness serves as a mediating variable to convert design and investment in infrastructure into quantifiable impacts on sponge city performance because theories of environmental governance propose the interconnection between environmental and technological efficacy and institutional support. Such integrated planning offers a strong framework for understanding the intricate interdependencies of urban water governance and stresses the importance of integrating ecological planning, technological implementation, and policy instruments for the purpose of achieving sponge cities that are adaptive and resilient. The conceptual model of these postulated relationships is found in Figure 1, the direct effects of landscape urbanism planning and green infrastructure implementation on the performance of sponge cities, mediated by stormwater management effectiveness, and moderated by government policy support.

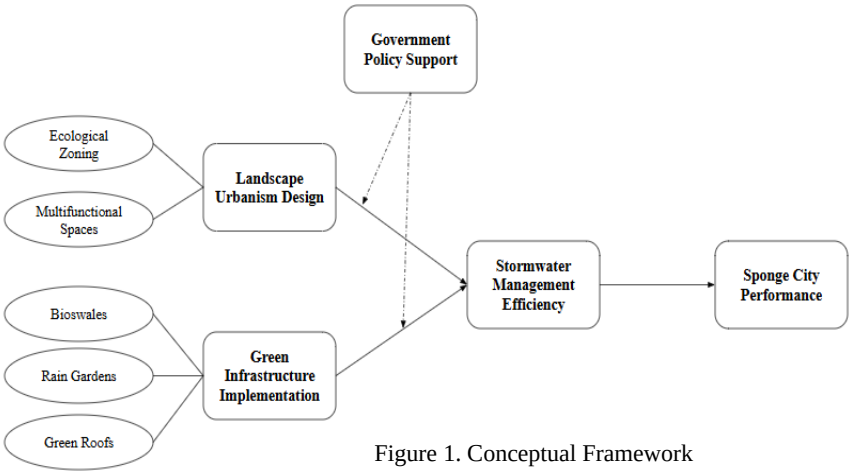


Figure 1. Conceptual Framework

METHODOLOGY

Research Design

In this research, a quantitative study design was used in an attempt to test hypothesized relationships between the main variables of sponge city performance in the context of the Asian Games Village 19th Hangzhou. More precisely, a cross-sectional survey design was used in collecting data from key stakeholders at one point in time. The application of quantitative methodology facilitated the empirical measurement of constructs such as landscape urbanism design, green infrastructure adoption, stormwater management effectiveness, and government policy enablement. Such a design facilitated the implementation of sophisticated statistical analyses to investigate direct, mediating, and moderating effects in the conceptual model proposed, hence conducting comprehensive empirical testing to corroborate or falsify the research hypotheses.

Population

The target population for this research consisted of individuals who were directly engaged in planning, designing, implementing, and governing the urban development projects of the Asian Games Village. They formed the group consisting of urban planners, landscape architects, civil and environmental engineers, sustainability advisors, and municipal policy makers possessing expert knowledge or experience in the context of sponge city initiatives, ecological urban design, and stormwater management practices. Such people have the necessary knowledge to give educated answers regarding the technical, design, and policy implications of sponge city development.

Sample Size and Sampling Technique

A purposive sampling method was utilized to choose respondents who were either directly engaged in the design, planning, or implementation of sponge city infrastructure within the Asian Games Village or possessed significant professional experience in related disciplines like landscape urbanism, environmental planning, or urban water management. The inclusion criterion demanded that participants: (1) work full-time in the fields of urban planning, landscape architecture, civil or environmental engineering, sustainability consulting, or local government, and (2) possess professional experience working on green infrastructure or stormwater management projects, preferably large-scale urban development. A list of organizations concerned, such as municipal departments, environmental departments, and private planning companies engaged in the Asian Games Village or comparable ventures, was made to select eligible respondents. 350 professionals were approached from this list, and 296 usable responses were obtained, giving an effective response percentage of 84.6%. The sample size is above the suggested limit for PLS-SEM, and it provides sufficient statistical power for analyzing complex

Data Collection

The data collection for the study was through a standardized, self-completed questionnaire that was meant to measure perceptions and experiences on landscape urbanism design, implementation of green infrastructure, effectiveness in stormwater management, government policy support, and performance of sponge cities. All the measurement items were taken from established instruments used in previous studies to ensure construct validity and reliability. Prior to the main data collection, a pilot test was applied to a sample of 15 urban planners, civil engineers, and sustainability consultants. Feedback from them was used to eliminate ambiguity in the questionnaire's language for contextualization and professional suitability, so that questions were both professionally suitable and comprehensible. Online and offline methods were adopted for data collection. The online questionnaire was circulated through email and professional platforms like LinkedIn to reach those associated with urban development and ecological infrastructure projects in China. Meanwhile, questionnaires based on paper were sent out during professional seminars, workshops of stakeholders, and project meetings concerning the development of sponge city in Hangzhou and surrounding areas. The three-month period for collecting data was used to cater to the diversified availability of professionals and provide adequate response time. The survey instrument included items measuring landscape urbanism design, green infrastructure implementation, stormwater management efficiency, government policy support, and sponge city performance, all rated on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree).

Data Analysis

Data analysis was conducted using SmartPLS 4.0, a software tool designed for Partial Least Squares Structural Equation Modeling (PLS-SEM). The analysis followed a two-step approach: assessment of the measurement model and evaluation of the structural model. The measurement model was first tested to confirm reliability (using Cronbach's alpha and composite reliability) and validity (through convergent validity via Average Variance Extracted and discriminant validity using the Fornell-Larcker criterion). Once the measurement model was validated, the structural model was analyzed to test the hypothesized relationships, including direct, mediating, and moderating effects. Bootstrapping with 5,000 subsamples was employed to evaluate the significance of path coefficients. Additionally, the model's explanatory power was assessed using R^2 values, and model fit was verified through the SRMR index. This rigorous analytical process ensured robust empirical testing of the conceptual framework and hypotheses. PLS-SEM has also been applied in Chinese urban research to evaluate multiple drivers of city development (Li & Dawood, 2016b).

RESULTS

Table 1 and Figure 2 shows the reliability and validity measures of the major latent constructs in the study. All the constructs are highly reliable, as evidenced by Cronbach's alpha levels above the cut-off of 0.70. The values are between 0.774 for sponge city performance to 0.893 for landscape urbanism design, implying acceptable to exemplary reliability.

Table 1. Variables reliability and validity

	Cronbach's alpha	CR	AVE
Green Infrastructure Implementation	0.882	0.913	0.677
Government Policy Support	0.878	0.911	0.674
Landscape Urbanism Design	0.893	0.922	0.702
Sponge City Performance	0.774	0.846	0.527
Stormwater Management Efficiency	0.861	0.900	0.643

Composite reliability (CR) scores also attest to this internal consistency with all the constructs having a score greater than the acceptable value of 0.70, ranging from 0.846 to 0.922.

In the area of convergent validity, the average variance extracted (AVE) for all the constructs exceeds the recommended value of 0.50, thereby asserting that a high percentage of variance is explained by the indicators. Most importantly, landscape urbanism design bears the largest AVE at 0.702, showing robust construct representation by its measurement items. The findings uphold the reliability and convergent validity of the measurement model.

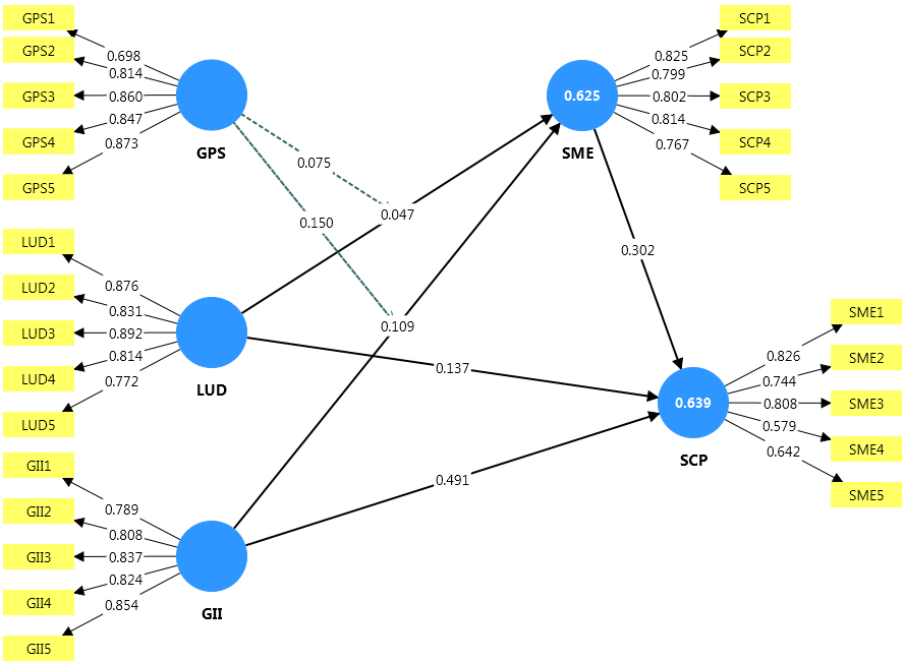


Figure 2. Estimated Model

Table 2 presents the outer loadings and variance inflation factor (VIF) values of all the measurement items for the five constructs. Outer loadings largely surpass the threshold of 0.70, depicting high item reliability and establishing that individual indicators noticeably contribute to their respective latent variables. One exception is SME4 for stormwater management efficiency, with a loading of 0.579, just below the desired cutoff but also in acceptable range for exploratory research. VIF values for all items are less than the critical value of 5, showing no serious multicollinearity problem among indicators. The set of VIF values (1.495 to 3.274) also attests to the fact that there is no possibility of collinearity to jeopardize the estimation process, and hence the measurement model is robust.

Table 2. Outer Loading and VIF

Variables	Items	Outer Loading	VIF	Variables	Items	Outer Loading	VIF
Green Infrastructure Implementation	GII1	0.789	2.724	Sponge City Performance	SCP1	0.825	2.064
	GII2	0.808	3.065		SCP2	0.799	1.811
	GII3	0.837	2.514		SCP3	0.802	1.916
	GII4	0.824	2.786		SCP4	0.814	1.980
	GII5	0.854	3.274		SCP5	0.767	1.793
Government Policy Support	GPS1	0.698	1.634	Stormwater Management Efficiency	SME1	0.826	2.247
	GPS2	0.814	2.158		SME2	0.744	1.772
	GPS3	0.860	2.609		SME3	0.808	1.888
	GPS4	0.847	2.543		SME4	0.579	1.495
	GPS5	0.873	2.800		SME5	0.642	1.696
Landscape Urbanism Design	LUD1	0.876	2.775				
	LUD2	0.831	2.167				
	LUD3	0.892	3.122				
	LUD4	0.814	2.124				
	LUD5	0.772	1.748				

Table 3. Discriminant Validity

	GII	GPS	LUD	SCP	SME
Green Infrastructure Implementation					
Government Policy Support	0.528				
Landscape Urbanism Design	0.631	0.697			
Sponge City Performance	0.838	0.787	0.815		
Stormwater Management Efficiency	0.532	0.704	0.634	0.762	

Table 4. R-square statistics Model Goodness of Fit Statistics

	R-square	R-square adjusted	Q2	SRMR
Sponge City Performance	0.639	0.636	0.631	0.074
Stormwater Management Efficiency	0.625	0.621	0.62	

Table 3 reports the Heterotrait-Monotrait (HTMT) ratios to test discriminant validity between the constructs. All HTMTs are far below the conservative value of 0.85 and indicate that every construct is empirically different from the others. For instance, the HTMT ratio for green infrastructure implementation versus stormwater management efficiency is 0.532, whereas the highest ratio attained is 0.838 between green infrastructure implementation and sponge city performance—still within an acceptable level. These results affirm that the constructs have strong discriminant validity, and they support the strength of the measurement model.

Table 4 presents the model's explanatory power and overall fit statistics. The R-square for sponge city performance is 0.639, reflecting that about 63.9% of the variance in this outcome is explained by the model variables. In a similar vein, R-square for stormwater management effectiveness is 0.625, indicating high predictive power. Adjusted R-square figures are slightly lower but above 0.60, again proving the model to be strong. The Q^2 figures for both endogenous constructs are more than 0.60, showing high predictive relevance. The SRMR value of 0.074 is less than 0.08, ensuring that the model meets an acceptable level of global fit. Collectively, these figures support the validity of the model to explain and predict the results of interest.

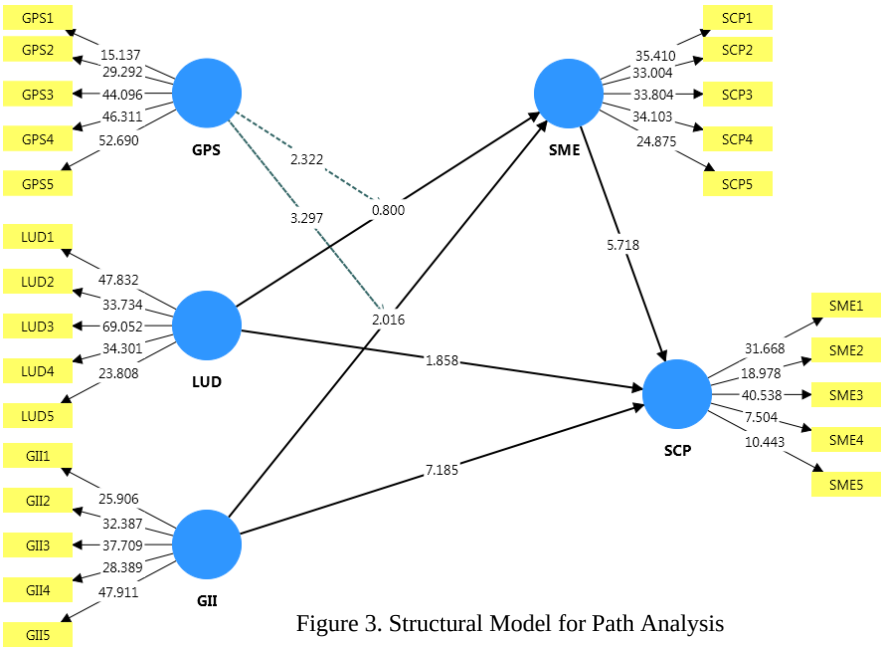


Figure 3. Structural Model for Path Analysis

Table 5 shows the outcome of the structural path analysis testing the direct, mediating, and moderating effects between the study constructs. The statistical significant path from landscape urbanism design (LUD) to sponge city performance (SCP) has a beta coefficient of 0.137, a t-value of 1.858, and a p-value of 0.032. This reflects a small but significant direct impact of landscape urbanism practice on the overall performance of sponge cities. Green infrastructure implementation (GII) reflects a high and highly significant direct impact on sponge city performance, with a beta of 0.491, t-value of 7.185, and p-value less than 0.001, indicating that green infrastructure has an important role in promoting ecological and hydrological performances in urban systems. Stormwater management effectiveness (SME) also illustrates a strong direct correlation with sponge city performance ($\beta = 0.302$, $t = 5.718$, $p < 0.001$), further establishing it as a critical working mechanism for connecting design and infrastructure with urban resilience. The mediating role of SME between LUD and SCP is statistically significant ($\beta = 0.023$, $t = 1.967$, $p = 0.025$), which indicates that stormwater efficiency partially conveys the impact of landscape design onto urban outcomes. Likewise, SME noticeably mediates green infrastructure to sponge city performance as evidenced by the beta of 0.207, t-value of 4.922, and p-value < 0.001. These findings confirm the dual mediating effect of stormwater efficiency in the hypothesized model. Additionally, government policy support (GPS) also has a significant moderating effect on the relationship between landscape urbanism and stormwater efficiency ($\beta = 0.075$, $t = 2.322$, $p = 0.010$), meaning that when policy support is high, the positive effect of landscape urbanism on

stormwater results is also heightened. The relationship between green infrastructure and GPS is also stronger ($\beta = 0.150$, $t = 3.297$, $p < 0.001$), indicating that support for policy increases the efficiency of green infrastructure implementation to enhance stormwater efficiency greatly. Generally, path analysis verifies the conceptual framework, offering empirical evidence supporting hypothesized direct, mediating, and moderating relations in the sponge city development model.

Table 5. Path Analysis

	Beta	T value	P value
LUD -> SCP	0.137	1.858	0.032
GII -> SCP	0.491	7.185	< 0.001
SME -> SCP	0.302	5.718	< 0.001
LUD -> SME -> SCP	0.023	1.967	0.025
GII -> SME -> SCP	0.207	4.922	< 0.001
GPS x LUD -> SME	0.075	2.322	0.010
GPS x GII -> SME	0.150	3.297	< 0.001

DISCUSSION

With the challenges of mounting urbanization and climatic volatility, the ability of cities to adapt, absorb, and regenerate characteristics embodied by the sponge city philosophy has never been more essential. The research was conducted within the vibrant setting of the Asian Games Village, which is a flagship development that features the latest urban resilience strategies. By means of an extensive examination of design paradigms, environmental infrastructure, operation mechanisms, and institutional settings, this study aimed at unearthing the ways through which integrated city planning principles are realized as quantifiable environmental performance. The subsequent discussion interlaces the empirical findings extracted from the tested hypotheses, providing an extended interpretation of landscape urbanism's multi-level relationships with green infrastructure, stormwater management, and policy support. All accepted hypotheses not only legitimize current theoretical assumptions but also shed light on new avenues for designing and managing resilient, hydrologically smart city spaces. The results of this research offer good empirical evidence in support of hypothesis 1, which verifies that landscape urbanism design does have a strong positive effect on the performance of sponge cities. This outcome is consistent with earlier research indicating that combining landscape architecture with ecological processes does augment hydrological functionality within cities (Mohebbi & Tahbaz, 2023).

In the Asian Games Village, the integration of landscape urbanism concepts enabled improved flood management, increased infiltration, and ecological connectedness. The composition of vegetated areas and permeable surfaces would have aided natural runoff infiltration and hence alleviated the load on traditional stormwater infrastructure. These findings confirm the potential of landscape urbanism as a design philosophy for generating robust city water cycles in demonstrating the validity of the argument that multifunctional landscape design can be both effective in fulfilling aesthetic and hydrological purposes in high-density urban settings (Grichting & Salama, 2024).

Further, this research adds to the theoretical basis of the socio-ecological systems framework by revealing that highly integrated urban landscape design interventions can be vital drivers of environmental performance and resilience, particularly within large-scale, high-profile developments like event villages.

The analysis also verifies hypothesis 2, and it is revealed that the implementation of green infrastructure has a strong positive impact on the performance of sponge cities. This is consistent with available literature highlighting green infrastructure as an effective nature-based solution for urban water problems (Hapriyanto & Azmi, 2025). In the Asian Games Village, the intentional use of green infrastructure increased stormwater uptake, lessened surface runoff, and filtered pollutants, thus strengthening the city's adaptive capacity to severe rain events. Such effects imply that engineered green systems interact synergistically with natural processes to alleviate urban flooding, manage microclimates, and enhance urban biodiversity all of which are aligned with the overall objective of sponge cities. The findings extend previous research by demonstrating that the technical effectiveness of green infrastructure is also spatial and systemic, especially when implemented coherently in a vast development area. In addition, the apparent gains in performance underscore the value of embracing decentralized water management strategies, wherein various green infrastructure components scattered across a city work in concert as a networked system (Zhang et al., 2025). From both policy and planning considerations, this makes the case for requiring green infrastructure in urban design codes and incorporating it into city-wide stormwater plans.

The evidence for hypothesis 3, which posits that stormwater management efficiency plays a significant role in determining sponge city performance, highlights the importance of effective water regulation systems to the realization of the benefits of interventions based on both design and infrastructure. This interaction proves that without efficient management strategies like flow regulation, sediment control, and retention measures, the hydrological and ecological benefits of landscape urbanism and green infrastructure can never be realized (Baghersad et al., 2025). Within the framework of the Asian Games Village, efficient stormwater management resulted from synergy between structural means (e.g., underground detention tanks, smart drainage systems) and ecological measures (e.g., vegetated swales, retention ponds), together providing the site with the capability to adapt dynamically to changeable weather conditions. The strong effect of stormwater management efficiency confirms its position as an operational center of sponge city function. It also improves our knowledge of the ways in which green technologies and spatial design help to build the resilience of cities. Theoretically, the results support the mediating role of hydrological efficiency in the socio-technical landscape of urban sustainability and indicate that it is not just the existence of green features or good design that is crucial, but also how well these elements are managed and connected to the city's larger water system (Stinshoff et al., 2025). This understanding is

especially applicable for engineers and urban planners, who need to see that stormwater infrastructure is not only environmentally integrated but technically optimized to accommodate climate variability as well as urban expansion stresses.

The findings are strongly in favor of hypothesis 4, which argued that stormwater management effectiveness mediates the impact of landscape urbanism design on sponge city performance. This conclusion outlines the essential process by which the spatial and ecological codes of landscape urbanism convert into measurable hydrologic benefits. While landscape urbanism injects permeable surfaces, ecological corridors, and multifunctional open spaces, it is the stormwater management systems in the end that control, direct, and put to use this spatial arrangement for water retention and absorption (Wang et al., 2025). The empirical evidence supporting this mediating relationship proves that design interventions are not enough unless supplemented by technically appropriate, operationally effective stormwater mechanisms. These findings are in line with systems-thought orientations towards sustainable urban planning, where it is held that performance results depend on the interaction between form (urban design) and function (infrastructure efficiency) (Balon et al., 2023). Landscape urbanism for the Asian Games Village was not cosmetic but functional in allowing efficient water capture, filtration, and slow release through skillfully aligned stormwater systems. Theoretically, this further justifies the case for integrated planning, under which spatial planning and hydrological engineering have to be balanced to produce the best sponge city results. It also emphasizes the importance of having urban design based on performance criteria, especially for flood-prone and high-density areas. Evidence in favor of hypothesis 5, which explored whether stormwater management effectiveness mediates the linkage between implementing green infrastructure and sponge city performance, also continues to expand knowledge on how ecological technologies perform within urban water cycles.

Although green infrastructure like bioswales, rain gardens, and green roofs are implemented to catch and treat stormwater at its origin, they perform better when part of a comprehensive, well-designed stormwater system. The mediating effect observed in the present study illustrates that the performance of green infrastructure is not merely dependent upon its existence but upon the manner in which it is managed, sized, and integrated into the general urban water infrastructure grid. This observation is aligned with previous studies that have established fragmented or degraded green infrastructure does not achieve intended stormwater control objectives (Huang et al., 2025). Within the Asian Games Village context, the green infrastructure elements were an integrated part of a greater, intelligently governed system that coordinated overflow management, sediment control, and water flow. Hence, the mediation effect validates the requirement for a hybridized model one that integrated soft ecological interventions with hard infrastructural controls (Yadav et al., 2025). Theoretically speaking, this discovery does support resilience-oriented models of urban water management, which promote adaptive systems that can function under changing conditions with ecological balance and service supply maintained.

The validation of hypothesis 6, where government policy support moderates the impact of landscape urbanism design on stormwater efficiency, supports the role of institutional and regulatory systems in ensuring efficient urban water management. The findings show that in settings where policy support is strengthened through financial rewards, planning requirements, and technical information the beneficial impacts of landscape urbanism on stormwater efficiency are greatly increased. This result resonates with the contention of (Adedeji & Lenz, 2023), who noted that the success of ecologically-oriented urban designs is highly contingent upon political will and regulative consistency. For the Asian Games Village, robust policy support allowed coordinated planning among urban designers, engineers, and environmental agencies such that landscape design was deliberately aligned with stormwater performance goals. The policy support moderating effect implies that even the most advanced landscape plans can fail without institutional support to guarantee implementation fidelity and cross-cutting integration (Tang et al., 2025). This also indicates that governance plays a part in turning sustainability principles into working realities. Theoretically, this finding highlights the usefulness of socio-institutional approaches to understanding urban resilience where governance is both driver and facilitator of ecological performance in complex urban systems.

Lastly, the hypothesis 7 confirmation to see if government policy support moderates the association between green infrastructure implementation and stormwater management effectiveness strengthens the argument further for policy as a strategic tool in the pursuit of sponge city objectives. The analysis indicates that when active support from local government, for example, subsidies for green roof construction, enforcement of permeable surface codes, or technical education for stormwater technicians is given, the effect of green infrastructure on stormwater effectiveness is more notable (Wang et al., 2023). This is in line with studies that emphasize policy as key in determining urban ecological change and overcoming institutional resistance. In the Asian Games Village, not only were there policies that required some of these green infrastructure components, but their correct maintenance and integration were also made possible through multi-agency coordination (Liang & Li, 2023). The moderating effect confirms that technical solutions alone cannot achieve dramatic changes unless the correct enabling environment is in place. It also supports the importance of cities following a governance-based perspective when incorporating green technologies. From a theoretical standpoint, the finding adds to adaptive governance discussion with a focus on responsive, collaborative, and strategically aligned policy systems as a necessary condition to scale up green infrastructure and realize long-term hydrological resilience in sponge cities.

In conclusion, the results for all seven hypotheses yield strong support for a multi-dimensional model in which spatial design, ecological infrastructure, operational efficiency, and policy alignment interact to define the success of sponge cities. Landscape urbanism and green infrastructure were found to directly and indirectly contribute to sponge city performance, through stormwater management efficiency as the mediating factor, and government policy support as the moderating factor. These cumulative interactions underscore that urban resilience is not the product of discrete interventions but of systemic thinking, integrative planning, and joined-up governance. The research reaffirms that cities need to transcend the reliance on piecemeal solutions and adopt a holistic approach one that acknowledges the interdependencies between form, function, and institution. By doing this, the likes of the Asian Games Village can be

living laboratories that exhibit how forward-looking urban design can balance with environmental demands and institutional requirements to create cities that are not just livable but adaptable and future-fit.

CONCLUSION

This research probed the complex dynamics of landscape urbanism and green infrastructure toward sponge city performance using the Asian Games Village as a case study. By empirically verifying seven hypotheses, the study confirmed that landscape urbanism design and green infrastructure implementation decisively improve sponge city performance, especially when facilitated by stormwater management efficiency and underpinned by effective government policy measures. The results highlight the importance of taking a systems-thinking approach one that is aware of the interdependency between spatial planning, ecological infrastructure, operational functionality, and institutional support. In affirming the mediating and moderating mechanisms involved, the research not only enriches the theoretical discussion on urban resilience and sustainable hydrological design but also provides actionable advice for practitioners and policymakers seeking to future-proof their cities against climate-driven water risks. The Asian Games Village is an example of best practice in that it shows how visionary urban planning, supported by policy and effective infrastructure, can also bring environmental and social returns. In the process, this study adds a solid conceptual and empirical basis for pushing the sponge city agenda forward, emphasizing integration, coordination, and innovation in building adaptive, resilient, and ecologically harmonious cities.

Implications

The results of this research provide crucial practical information for urban planners, city governments, architects, and environmental engineers engaged in sustainable city planning, especially in flood-affected and high-density areas. Most importantly, the proven effectiveness of landscape urbanism and green infrastructure in augmenting sponge city capability signifies the importance of their incorporation into urban master planning models right from the beginning, as opposed to afterthoughts or stand-alone green elements. As an example, rapidly developing or redeveloping cities can implement multifunctional green areas, ecological corridors, and rain gardens both to enhance the beauty of urban streets but to realize stormwater management and flood resilience. Additionally, the major mediating effect of stormwater management efficiency highlights the necessity of investing in technical capacity, smart drainage, and maintenance procedures in order for ecological design to reflect on actual hydrological performance. Local governments must also appreciate the significance of strong policy support, which was discovered to promote the effectiveness of landscape design and green infrastructure deployment. Through the provision of regulatory requirements, economic incentives, and interdepartmental cooperation, policymakers can establish an empowering environment in which sponge city measures can flourish. The Asian Games Village, being a flagship case, offers a replicable template to other city developments in striking a balance between aesthetics, livability, and climate resilience through nature-based solutions and integrated infrastructure planning.

Theoretically, the research adds to the expanding field of sustainable urbanism, urban hydrology, and environmental governance through the provision of an integrated conceptual model that relates spatial design, ecological infrastructure, functional performance, and institutional moderation. Results confirm and generalize socio-ecological systems and urban resilience theories by empirically illustrating how physical interventions (such as landscape urbanism and green infrastructure) are mediated by operational dynamics (efficiency of stormwater management) and moderated by governance variables (policy support) to yield sustainable results. Through their revelation of these nested relationships, the research contributes to theoretical knowledge on how design and infrastructure are channeled to environmental performance in complex urban systems. The established mediation and moderation effects enrich urban sustainability literature by implying that neither design nor technology operates autonomously both must be politically enabled and systemically regulated for them to be effective. Moreover, the study emphasizes the benefit of employing hybrid models that connect technical and social theories, situating cities as dynamic systems influenced by both built environment decisions and institutional pressures. These theoretical developments can guide future studies examining resilience frameworks, adaptive infrastructure planning, and governance structures in the context of climate-responsive urban development.

Limitations and Future Directions

Although this research provides useful insights into the interactions between landscape urbanism, green infrastructure, efficiency of stormwater management, and sponge city performance, some limitations must be noted. To begin with, the study is contextual, targeting the Asian Games Village as an isolated case study, which might restrict generalizability of findings to other cities with varying climatic, geographical, or regulatory conditions. The results might differ in lower resourced cities or cities without well-established policy frameworks. Second, the research was based mainly on cross-sectional data, limiting the capacity to measure long-term impacts and temporal variations in stormwater performance or infrastructure resilience. Longitudinal research could give more in-depth insights into the development and sustainability of sponge city systems over time. Third, although the model had included policy support as a moderating factor, it had not broken down the various policy dimensions (e.g., financial incentives vs. enforcement mechanisms) that might have different effects on implementation outcomes. Comparative analyses across multiple cities, incorporation of longitudinal or real-time monitoring data, and examination of further contextual factors like community engagement, maintenance practices, or public-private partnerships could be investigated in future research. Additionally, the incorporation of qualitative methods, i.e., stakeholder interviews or policy analysis, would provide an enriched understanding of institutional dynamics and implementation constraints. Such future directions would streamline and expand the theoretical model developed in this research as well as yield more in-depth strategies for sustainable urban water management.

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Abbreviations: AVE, Average Variance Extracted; CR, Composite Reliability; GII, Green Infrastructure Implementation; GPS, Government Policy Support; HTMT, Heterotrait-Monotrait Ratio; LUD, Landscape Urbanism Design; PLS-SEM, Partial Least Squares Structural Equation Modeling; SCP, Sponge City Performance; SME, Stormwater Management Efficiency; SRMR, Standardized Root Mean Square Residual; VIF, Variance Inflation Factor.

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THE IMPACT OF MEDICAL SERVICE QUALITY ON THE PURCHASE INTENTION OF INTERNATIONAL TOURISTS: THE MEDICAL HUMAN RESOURCES COMPETENCE AS A MEDIATOR

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Abstract : Medical tourism has emerged as a rapidly expanding sector within the global healthcare industry, intensifying competition among countries seeking to attract international patients. Although Jordan has established itself as a prominent regional destination for medical tourism, limited empirical research has examined the key determinants influencing international medical tourists' purchasing intentions toward Jordanian hospitals. In particular, the role of medical staff competence within the relationship between medical service quality and patients' behavioral intentions remains insufficiently explored. Accordingly, this study investigates the impact of medical service quality on international tourists' purchase intentions while examining the direct and mediating role of medical staff competence. A quantitative research design based on the descriptive–analytical approach was employed. The study population consisted of international medical tourists who visited Jordanian private hospitals for treatment, totaling approximately 92,500 patients during the first half of 2025. Using simple random sampling, 383 valid responses were collected through a structured questionnaire developed from prior literature. The data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) to test the proposed hypotheses. The findings reveal that medical service quality has a significant positive effect on international tourists' purchase intentions and significantly influences medical staff competence. However, medical staff competence did not demonstrate a direct effect on purchase intention nor a mediating role in the relationship between service quality and purchase intention. This study contributes theoretically by integrating healthcare service quality and human resource competence within a unified framework to explain international patients' behavioral intentions in the medical tourism context. Practically, the findings provide strategic insights for hospital administrators and policymakers by emphasizing the importance of service quality enhancement and patient experience management in strengthening Jordan's competitiveness as a global medical tourism destination.

Keywords: service quality, purchase intention, medical staff, international tourist, medical tourism, Jordan

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INTRODUCTION

In recent decades, the medical tourism sector has experienced significant expansion at both regional and global levels, largely driven by the growing demand for specialized healthcare services and increasing public awareness of health and wellness (Zhong et al., 2021). This growth has been further accelerated by structural deficiencies in healthcare systems in several countries, particularly with regard to high treatment costs, long waiting times, and inconsistencies in service quality (Karsana & Murhadi, 2021). As a result, medical tourism has progressively transformed from a peripheral activity into a well-established global industry. Beyond its healthcare dimension, the sector has become an important economic driver for many destinations due to the substantial direct and indirect revenues it generates, as well as its contribution to strengthening the international reputation and competitiveness of health destinations (Al-Nsour, 2020).

Recent market estimates highlight the rapid expansion of this industry. In 2025, the global medical tourism market was valued at approximately USD 273 billion, with an annual growth rate of 10.4%, while the number of international medical tourists reached nearly 21.1 million worldwide (Market.us Media, 2025). In addition to direct revenues generated by healthcare services, the sector has produced considerable spillover effects on the broader economy. In the same year, medical tourism contributed nearly USD 100 billion in indirect economic activity, increased government revenues by approximately 25%, supported employment growth of around 15%, and stimulated infrastructure investments estimated at USD 500 million (Market.us Media, 2025). At the national level, the sector generated direct revenues exceeding USD 1

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billion by attracting approximately 224.8 thousand medical tourists in 2024, representing an estimated 0.4% share of the global medical tourism market (MOTA, 2025). These figures underscore the growing strategic importance of medical tourism as a driver of economic diversification and international competitiveness within the healthcare sector (Demir et al., 2025).

However, in an increasingly competitive global marketplace, the ability of destinations to attract international medical tourists is no longer determined solely by the availability of medical services (Choi et al., 2020). Instead, patients' decisions are strongly influenced by their perceptions of healthcare service quality, which plays a central role in shaping health-related behaviors and medical travel choices (Elgarhy & Alharethi, 2024). From this perspective, healthcare service quality has emerged as a critical determinant of international patients' evaluation of their treatment experience (Meng et al., 2022).

This is largely due to the multidimensional nature of healthcare quality, which encompasses technical, functional, and interpersonal components, including the safety of medical procedures, the accuracy of diagnosis, and the effectiveness of treatment outcomes (Demir, 2025). Furthermore, the patient experience is significantly influenced by relational aspects of care, such as the level of attention provided, the clarity of communication, and the degree of respect and transparency demonstrated by healthcare professionals throughout the treatment journey (Ye et al., 2011).

Collectively, these dimensions shape patients' overall perceptions of service quality and ultimately influence their satisfaction, trust, and willingness to engage in medical travel. In the context of medical tourism, purchase intention refers to the behavioral willingness of international patients to select a particular hospital or medical destination for treatment. This intention extends beyond the initial decision to seek medical services and encompasses the likelihood of revisiting the destination for future treatment as well as recommending it to others (Al-Nsour, 2017). From a theoretical perspective, purchase intention is widely recognized as a strong predictor of actual behavior, as suggested by the Theory of Planned Behavior, which posits that behavioral intentions reflect an individual's level of confidence and commitment toward performing a particular action (Rahman et al., 2022). Within medical tourism, such intentions are particularly significant because healthcare decisions typically involve high levels of perceived risk, uncertainty, and personal involvement. Existing empirical research consistently demonstrates that perceived healthcare service quality exerts a direct and positive influence on international patients' purchase intentions. High-quality medical services enhance patients' willingness to select a medical destination, revisit the facility, and recommend it to other potential medical tourists (Choi et al., 2020).

Nevertheless, although service quality remains a fundamental determinant of behavioral intentions, relying solely on a direct relationship between these variables may not sufficiently explain the complexity of international patients' decision-making processes. Medical tourism involves not only clinical outcomes but also interpersonal interactions and trust-building processes, which play a crucial role in shaping patient perceptions and behavioral responses (Al-Nsour, 2022).

In this regard, the competence of medical staff emerges as a critical contextual factor that may influence how perceived service quality translates into purchase intention. Medical professionals—through their clinical expertise, professional experience, and communication abilities—serve as the primary interface between healthcare institutions and international patients (Alawneh et al., 2025). Consequently, their performance represents a key element in shaping patients' perceptions of service quality and their overall healthcare experience (Farid et al., 2025). Contemporary literature suggests that medical staff competence extends beyond technical proficiency and professional qualifications (Fetscherin & Stephano, 2016). It also includes relational capabilities such as the ability to build trust, communicate effectively, demonstrate empathy, and manage interactions with patients from diverse linguistic and cultural backgrounds (Zhong et al., 2021).

Empirical studies further indicate that international patients' perceptions of medical staff competence significantly enhance their trust in healthcare providers (Park et al., 2021). Such trust contributes to higher levels of patient satisfaction, which in turn strengthens behavioral intentions, including the willingness to revisit medical destinations and recommend them to others (Khan et al., 2023). Despite the growing body of research on medical tourism, however, a review of the literature reveals a notable gap concerning the explanatory mechanisms linking healthcare service quality to purchase intention. In particular, limited attention has been devoted to examining the moderating role of medical staff competence in this relationship, especially within the context of Arab and developing countries (Al-Nsour, 2022).

Moreover, much of the existing research has predominantly focused on mediating variables such as satisfaction and destination image, while offering limited insight into how and why service quality translates into behavioral intentions. Accordingly, this study seeks to address this gap by proposing an integrated explanatory model that examines the moderating role of medical staff competence in the relationship between healthcare service quality and the purchase intention of international medical tourists. By doing so, the study contributes to advancing the theoretical understanding of international patients' behavioral decision-making while also providing practical implications for healthcare and tourism policymakers seeking to enhance the competitiveness and attractiveness of medical tourism destinations.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Medical Tourism in Jordan

The global medical tourism market has experienced sustained expansion over the past two decades and is projected to continue its upward trajectory in the coming years. Recent estimates suggest that the global medical tourism market will reach approximately USD 41.8 billion in 2024 and may expand to nearly USD 160 billion by 2032 (World Travel & Tourism Council, 2025). Within this expanding global landscape, the Middle East and North Africa (MENA) region—particularly the Arab Gulf states—has emerged as a major source market for international medical travel. Countries within the Gulf region collectively spend nearly USD 20 billion annually on healthcare services abroad, accounting for approximately 7% of the global medical tourism market (www.Alarabiya, 2025). This substantial outbound demand has contributed significantly to the development of regional medical tourism destinations, among which Jordan has established

a prominent position. The origins of medical tourism in Jordan can be traced back to the 1970s, when the country began attracting patients from neighboring states due to the availability of qualified medical professionals and relatively advanced healthcare services. Since then, Jordan has experienced remarkable progress in its healthcare sector, enabling it to become one of the leading medical tourism destinations in the region. In 2024, Jordan received approximately 224,000 medical tourists, generating revenues estimated at nearly USD 1 billion. This represents a notable increase compared to approximately 191,500 medical tourists in 2022 and 202,600 in 2023. The upward trend has continued into 2025, with approximately 92,800 medical tourists visiting Jordan by May 2025 alone, reflecting a 16.5% increase compared with the same period in 2024 (Ministry of Health, 2024). These figures highlight the growing importance of medical tourism as a strategic sector contributing to Jordan's economic development. Jordan has become a preferred medical destination for patients from several neighboring countries, particularly those within the Gulf Cooperation Council and the wider Middle East region. The country attracts a large number of patients from Saudi Arabia, Iraq, Palestine, Syria, Yemen, and Libya (Ministry of Health, 2025). This reputation is largely attributed to the long-standing development of Jordan's healthcare system and the country's history of medical achievements. For instance, Jordan performed its first open-heart surgery in 1970 and its first kidney transplant in 1972, marking important milestones in the development of advanced medical care in the region. More recently, specialized institutions such as the King Hussein Cancer Center have achieved internationally recognized clinical outcomes. In 2022, the center performed approximately 250 bone marrow transplant procedures with a success rate of around 85%, exceeding many global benchmarks. Reflecting these achievements, the United Nations World Tourism Organization recognized Jordan in 2023 as a regional hub for medical tourism, reporting that the country received nearly one million medical tourists from 71 countries during the past five years (UNWTO, 2025).

Jordan's competitiveness in medical tourism is further strengthened by its ability to combine high-quality healthcare services with relatively affordable treatment costs. Research indicates that the cost of medical procedures in Jordan is approximately 40% lower than in the United States and many European countries. Moreover, when compared with other major international medical tourism destinations—such as India, Singapore, and Thailand—Jordan remains highly competitive, with price differences generally ranging between 5% and 10% (World Travel & Tourism Council, 2025).

In addition to cost advantages, the country benefits from the availability of natural therapeutic resources that contribute to the overall attractiveness of its medical tourism offerings. Locations such as the Dead Sea, situated approximately 400 meters below sea level, are globally recognized for their mineral-rich waters and therapeutic properties, with salinity levels reaching nearly 33%. Similarly, the Ma'in hot springs, where mineral-rich waters can reach temperatures of up to 60°C, are widely used for therapeutic treatments related to skin conditions, joint diseases, and circulatory disorders (Ministry of Tourism and Antiquities, 2025). The strength of Jordan's healthcare system also plays a crucial role in supporting the growth of medical tourism. The country currently hosts approximately 121 hospitals and medical centers, including 71 private healthcare facilities and 47 public hospitals. Many of these institutions hold internationally recognized accreditations from organizations such as the Joint Commission International and the Jordanian Health Care Accreditation Council, ensuring adherence to global standards of patient safety and healthcare quality (Ministry of Health, 2025). Prominent private hospitals include the Jordan Hospital, Abdali Hospital, Al-Kindi Hospital, Ibn Al-Haytham Hospital, the Arab Medical Center, and the King Hussein Cancer Center. At the same time, major public facilities such as Al-Hussein Medical City and Al-Bashir Hospital also serve a large number of international patients.

In addition to modern healthcare infrastructure, Jordan benefits from a highly skilled medical workforce comprising more than 30,000 physicians and medical specialists. These professionals provide a wide range of advanced medical treatments, including cardiovascular surgery, oncology care, orthopedic procedures, and fertility treatments. The absence of long waiting lists for many procedures, combined with the widespread availability of English-speaking medical personnel, further enhances international patients' confidence and comfort during their treatment journeys (Abd Manaf et al., 2015). Beyond its healthcare benefits, medical tourism represents an important pillar of Jordan's national economy.

The sector contributes significantly to job creation and stimulates growth across multiple supporting industries, including hospitality, transportation, and wellness services (Chuang et al., 2014). Studies suggest that medical tourists typically spend three to five times as much as conventional tourists, owing to longer stays and the need for additional healthcare and accommodation services (Gholipour et al., 2023). Jordan's well-developed hospitality sector plays a complementary role in supporting this industry. As of April 2025, the country hosts approximately 357 classified hotels, 73 unclassified hotels, and 176 hotel apartments and suites, providing a diverse range of accommodation options suitable for patients and their accompanying companions (Ministry of Tourism and Antiquities, 2025). Furthermore, research indicates that between 2008 and 2022, revenues generated from medical tourism significantly contributed to the expansion of healthcare sectors across 49 emerging and developed economies, suggesting that increasing investment in medical tourism can further strengthen national healthcare systems and broader economic development (Gholipour & Esfandiar, 2025).

Medical Service Quality

Medical service quality is widely recognized as one of the most complex constructs in service management literature, given its direct association with human health and life, which inherently entails higher perceived risk and uncertainty than most other services (Gao et al., 2024). Over time, the conceptualization of healthcare service quality has evolved from traditional medical frameworks toward more comprehensive perspectives that integrate marketing and service management approaches. These perspectives emphasize the patient not merely as a passive recipient of healthcare but as an active participant in the service delivery process (Han et al., 2021). One of the most influential theoretical frameworks for evaluating healthcare quality is Donabedian's (1988) model, which conceptualizes quality through three interrelated

dimensions: structure, process, and outcomes. The structural dimension refers to the material, human, and organizational resources available within healthcare institutions, such as the competence of physicians, the availability of medical equipment, and health information systems. The process dimension concerns how healthcare services are delivered, including diagnostic accuracy, adherence to treatment protocols, and communication between healthcare providers and patients (Mo et al., 2025). The outcome dimension focuses on the outcomes of healthcare services, including improvements in patients' health status, reductions in complications, and patient satisfaction (Al-Nsour, 2013). Despite the emergence of several alternative approaches, the Donabedian model continues to provide a fundamental theoretical foundation for evaluating healthcare quality, particularly in studies that integrate medical and service management perspectives (Al-Nsour, 2024).

Complementing this medical perspective, service management scholars have highlighted the experiential and perceptual dimensions of healthcare service quality. Grönroos (1984) introduced the technical and functional quality model, which distinguishes between the quality of clinical outcomes received by patients (technical quality) and the service quality delivery processes (functional quality). Technical quality concerns the effectiveness of treatment, diagnostic accuracy, and professional competence. In contrast, functional quality encompasses interpersonal aspects of care, such as communication, empathy, responsiveness, and the manner in which healthcare services are delivered. Contemporary research increasingly conceptualizes perceived healthcare quality as a multidimensional construct comprising technical, human, organizational, and psychological components that shape the overall healthcare experience of international patients (Fetscherin & Stephano, 2016). In medical tourism, the perceived quality of healthcare services is particularly critical, as international patients evaluate medical destinations not only on clinical outcomes but also through a comprehensive assessment of their overall treatment experience. Empirical studies indicate that international patients assess healthcare service quality through several indicators, including treatment safety, efficiency of medical procedures, reliability of outcomes, and the level of empathy and personalized care provided by medical staff. Trust in healthcare providers and the ability of medical personnel to communicate effectively across cultural and linguistic barriers also play crucial roles in shaping perceptions of healthcare quality (Elgarhy & Alharethi, 2024). Consequently, medical tourists' decisions are influenced by a broader evaluation of the healthcare environment in the host destination, including perceptions of safety, transparency of medical information, ease of procedures, respect for patient privacy, and treatment costs (Aboalganam, 2024; Rauf et al., 2024). High levels of perceived service quality have been shown to enhance trust, reduce perceived risks, and ultimately influence patients' behavioral intentions, including destination selection, revisit intentions, and recommendations to others (Khan et al., 2023).

In this regard, healthcare service quality represents a fundamental pillar in strengthening Jordan's competitive position as a leading destination for medical tourism at both regional and international levels (Gao et al., 2024). Over the past decades, Jordan has developed a strong reputation in the healthcare sector due to the presence of highly qualified medical professionals, advanced healthcare infrastructure, and the adoption of internationally recognized accreditation standards by many hospitals and medical centers. These factors have significantly enhanced the credibility of Jordanian healthcare institutions and increased the confidence of both domestic and international patients in the quality of services provided.

The literature consistently emphasizes that healthcare service quality is among the most influential determinants shaping patients' decisions when selecting medical tourism destinations, as perceptions of care quality and the professional competence of healthcare providers directly affect patient satisfaction and trust in healthcare institutions (Rahman et al., 2022). Jordan's healthcare sector has undergone significant development, supported by a highly skilled medical workforce, continuous technological advancement in medical equipment, and the expansion of specialized hospitals and healthcare facilities. Moreover, many Jordanian hospitals have obtained international accreditation from globally recognized organizations such as the Joint Commission International (JCI) and the Health Care Accreditation Council (HCAC), which strengthens international confidence in the quality and safety of healthcare services provided in the country (Al-Ababneh, 2020). Importantly, healthcare service quality extends beyond clinical competence to include broader dimensions of patient-centered care, such as effective communication between healthcare providers and patients, responsiveness to patient needs, the efficiency of nursing services, and the provision of a safe therapeutic environment (Abdul-Rahman et al., 2023).

These elements collectively enhance the patient experience, increase patient satisfaction, and encourage positive behavioral outcomes, such as repeat visits and referrals to other medical tourists (Abdullah et al., 2023). The relatively high quality of therapeutic services in Jordan, combined with treatment costs that are competitive with those of many developed healthcare systems, has played a crucial role in attracting international patients, particularly from the Middle East and North Africa. Patients travel to Jordan to receive specialized medical treatments across various fields, including cardiac surgery, orthopedic procedures, ophthalmology, cosmetic surgery, and rehabilitation medicine.

Empirical evidence suggests that the high level of medical expertise and the quality of healthcare services available in Jordan are among the most influential factors shaping patients' decisions to select the country as a preferred medical tourism destination (Shriedeh & Ghani, 2019). Accordingly, therapeutic service quality represents a central determinant of Jordan's competitiveness within the global medical tourism market.

Recent statistics further confirm Jordan's sustained attractiveness as a medical tourism destination. The Jordan Tourism Board reports that the number of medical and wellness tourism visitors reached approximately 224,740 in 2024, and 52,500 were recorded during the first half of 2025, reflecting continued demand for therapeutic services in regional markets (TTN Worldwide, 2025). In terms of healthcare capacity, the Jordanian health system comprises approximately 120 hospitals with nearly 15,999 beds, including 70 private hospitals with 5,529 beds, providing a robust operational base for serving international patients (Ministry of Health, 2024). Furthermore, the expansion of international accreditation within the healthcare sector—where seven hospitals have obtained Joint Commission International (JCI)

accreditation and numerous facilities are accredited by HCAC—serves as an important signal of quality assurance and patient safety for international medical tourists (Tamimi et al., 2024).

Purchase Intention of International Tourists

In studies of international medical tourism, purchase intention is frequently used as a proxy for actual purchase decisions because it is a more feasible and measurable indicator of potential consumer behavior. Purchase intention reflects an individual's willingness or likelihood to obtain a specific service in the future and is widely recognized as a strong predictor of actual behavior in both consumer behavior and healthcare service research (Meng et al., 2023). This concept serves as an important link between individuals' perceptions and evaluations, on the one hand, and their actual behavioral decisions, on the other (Demir et al., 2025). Behavioral frameworks such as the Theory of Planned Behavior (TPB) emphasize that behavioral intention constitutes the most immediate determinant of actual behavior, as it reflects individuals' readiness to perform a particular action based on their attitudes, perceived social norms, and perceived behavioral control (Putra et al., 2024). Consequently, purchase intention has become a widely adopted construct for predicting future healthcare consumption and medical travel decisions (Yilmaz et al., 2021).

Within the context of medical tourism, the concept of purchase intention assumes greater complexity compared with traditional tourism or other consumer services. The decision is not limited to purchasing a single product or service; rather, it involves selecting an integrated healthcare system that includes the treatment destination, hospital, physician, and supporting healthcare services, often within a different cultural and linguistic environment (Zhong et al., 2021). As a result, international patients typically undergo a complex decision-making process that involves extensive information search, evaluation of healthcare quality, assessment of perceived risks, comparison of treatment costs, and consideration of alternative medical destinations before making a final treatment decision. Because these processes occur before the actual treatment stage, measuring the real purchase decision during data collection is often difficult. Therefore, purchase intention provides a more appropriate construct for capturing patients' behavioral tendencies during the evaluation and planning stages of medical travel (Gao et al., 2024). In medical tourism literature, purchase intention is generally conceptualized as a multidimensional behavioral construct comprising several interconnected outcomes, such as the intention to select a particular medical destination, the intention to revisit the destination for future treatment, and the intention to recommend the destination to others (Esfandiar & Hadinejad, 2026). These behavioral outcomes collectively reflect the degree of confidence and trust that patients place in healthcare providers and treatment facilities (McCartney & Wang, 2024)

Empirical studies indicate that international patients' intentions to seek treatment abroad are strongly influenced by perceived healthcare service quality, trust in medical professionals, destination reputation, and expected treatment outcomes (Fetscherin & Stephano, 2016; Khan et al., 2023). Medical tourism decisions are typically characterized as high-involvement and high-risk, as they entail potential health, psychological, and financial consequences (Rauf et al., 2024). The high perceived risk encourages international patients to conduct intensive information searches, compare alternative treatment options, and rely heavily on external sources such as prior patient experiences, reputation signals, and institutional credibility (Al-Nsour et al., 2021). Consequently, purchase intention becomes highly sensitive to the perceived quality of the overall treatment experience rather than merely the final medical outcomes (Rauf et al., 2024; Seow et al., 2024).

Furthermore, existing research suggests that the relationship between perceived service quality and purchase intention is not necessarily direct or linear. Instead, it is often influenced by several mediating and contextual factors, such as patient satisfaction, trust in healthcare providers, and perceptions of medical staff competence (Lee et al., 2021). When international patients perceive high service quality, combined with a strong sense of security and trust in healthcare institutions, they are more likely to exhibit positive behavioral responses, including intentions to revisit medical destinations and recommend them to others (Wong et al., 2024). This finding reinforces the notion that purchase intention emerges from a complex interpretive process involving multiple psychological and experiential factors (Al-Nsour & Al-Sahli, 2024). In the Jordanian context, medical tourists' purchase intention appears to be shaped by several overlapping factors, including the country's medical reputation, the perceived quality of healthcare services, the ease of administrative procedures, and the professional competence of medical staff (Al-Nsour & Al-Sahli, 2024).

Some studies have also highlighted revisit intention as a key indicator of the long-term success and sustainability of medical tourism destinations (Al-Nsour et al., 2025). Despite these contributions, the literature still lacks sufficient empirical models that comprehensively explain how perceived healthcare quality translates into purchase intention, particularly through the influence of human-related factors such as medical staff competence. Accordingly, further research is required to develop integrated explanatory models that clarify the mechanisms through which service quality perceptions are transformed into positive behavioral intentions among international medical tourists (Aladwan et al., 2024).

Medical Staff Efficiency

The conceptual overlap between human resource efficiency and medical service quality has been widely discussed in healthcare management literature. Addressing this overlap requires a clear distinction between the two constructs from both theoretical and methodological perspectives (Aiken et al., 2018). Human resource efficiency refers to the level of competencies, professional skills, clinical expertise, training, and performance capabilities possessed by healthcare personnel that enable them to perform their roles effectively within healthcare organizations (Al-Nsour, 2019). In contrast, medical service quality reflects the overall standard of healthcare delivered to patients and the extent to which healthcare services meet recognized quality dimensions such as patient safety, effectiveness of treatment, accessibility, and continuity of care (Lake et al., 2019). Accordingly, human resource efficiency should be conceptualized as a determinant or

influencing factor of healthcare service quality rather than a component of it. From a methodological perspective, empirical research typically maintains this distinction by treating human resource efficiency as an independent variable that influences healthcare service outcomes, while therapeutic healthcare service quality is treated as a dependent variable.

Separate measurement indicators are applied to each construct to reduce conceptual overlap and improve analytical clarity (Aiken et al., 2018). Human resource efficiency may be assessed through indicators such as staff competence, professional training, productivity, and continuous professional development, whereas healthcare service quality is commonly evaluated through indicators including patient safety outcomes, treatment effectiveness, and patient satisfaction (Ramar et al., 2025). This conceptual separation allows researchers to better analyze how workforce capabilities influence healthcare service outcomes and organizational performance within healthcare systems (Lake et al., 2019).

Within this framework, medical staff competence represents a key dimension of human resource efficiency in healthcare institutions. Medical competence refers to an integrated combination of scientific knowledge, clinical expertise, professional skills, behavioral abilities, and cumulative experience possessed by physicians, nurses, and healthcare technicians that enables them to provide safe and effective treatment services consistent with professional and ethical standards (World Health Organization, 2024). Importantly, medical competence extends beyond the technical aspects of diagnosis and treatment to include interpersonal communication skills, empathy toward patients, responsiveness to patient needs, and the ability to work effectively within multidisciplinary healthcare teams (Khaleel et al., 2022). These competencies play a crucial role in strengthening patients' trust and shaping their perceptions of healthcare service quality. Recent research confirms that higher levels of medical staff competence contribute significantly to improving treatment outcomes, reducing medical errors, and enhancing patient safety within healthcare institutions (Al-Nsour, 2019).

These improvements are reflected in increased patient satisfaction and stronger behavioral intentions toward healthcare providers, including willingness to revisit and recommend healthcare institutions to others (Mikulić et al., 2021). In the context of medical tourism, the competence of medical personnel becomes even more critical, as international patients often rely heavily on the professional reputation of physicians and hospitals when deciding to travel abroad for treatment (Zhong et al., 2021). This reliance is particularly important in situations characterized by cultural, linguistic, and institutional differences that may increase perceived uncertainty among international patients (Yilmaz et al., 2021). Empirical studies indicate that competent medical staff not only enhance the perceived quality of treatment services but also play an important role in translating perceptions of service quality into positive behavioral outcomes among international patients, including purchase intention and destination loyalty (Naqrash et al., 2025). Consequently, the efficiency and competence of medical personnel represent strategic variables within healthcare performance evaluation models, particularly in competitive healthcare environments seeking to position themselves as leading destinations for medical tourism, such as Jordan (Alawneh et al., 2025).

The importance of human resource efficiency is clearly reflected in the healthcare workforce structure in Jordan. According to national statistics, the density of physicians in Jordan reaches approximately 31.7 physicians per 10,000 people, while the density of nurses is approximately 37.5 per 10,000 people (Ministry of Health, 2022). These levels support the healthcare sector's capacity to deliver treatment services based on high levels of clinical expertise and professional competence. They also help explain the strong regional reputation of Jordanian medical personnel, particularly in managing complex medical cases and addressing the needs of patients from diverse cultural backgrounds (World Health Organization, 2024). From a broader economic and tourism perspective, the growing role of healthcare services is also reflected in Jordan's tourism performance. Reports from the Ministry of Tourism and Antiquities indicate that total tourism revenues reached approximately JD 5.132 billion in 2024, with medical treatment activities contributing to the expansion of tourism-related economic activities in recent years (Ministry of Tourism and Antiquities, 2025). These trends suggest that medical tourism represents a relatively resilient component of the tourism value chain, particularly during periods of economic uncertainty in international tourism markets. In this context, medical service quality in Jordan should not be viewed solely as a technical outcome of clinical performance but rather as the result of an integrated healthcare system in which institutional accreditation, healthcare capacity, workforce competence, and patient experience interact to create a sustainable competitive advantage in the regional medical tourism market (Naqrash et al., 2025).

Developing Research Hypotheses

The Impact of the Medical Services Quality on the Purchase Intention of International Tourists

Numerous empirical studies have demonstrated a positive relationship between the perceived quality of medical services and patients' purchase intentions in medical tourism contexts. High levels of perceived service quality enhance patients' confidence in healthcare providers and reduce perceived risks associated with seeking treatment abroad, thereby increasing the likelihood of making a medical travel decision (Yilmaz et al., 2021). In particular, research conducted in regional medical tourism destinations, including Jordan, indicates that factors such as the accuracy of diagnosis, the efficiency of medical procedures, and the level of human care and attention provided by healthcare professionals represent key determinants influencing purchase intentions among patients from Arab countries (Farid et al., 2025; Raoofi et al., 2024). However, the relationship between healthcare service quality and purchase intention is not always direct.

Several studies suggest that service quality may influence purchase intention indirectly through mediating variables such as patient satisfaction, destination image, and trust in healthcare institutions (Abubakar & Ilkan, 2016; Chahal & Kumari, 2012). From this perspective, international patients' decisions to seek treatment abroad are shaped by a broader evaluation process that includes not only clinical quality but also additional contextual factors such as treatment cost, the physical healthcare environment, ease of travel, and the availability of logistical support services. Moreover, some empirical evidence indicates that the direct impact of medical service quality on purchase intention may become

insignificant in certain contexts where healthcare providers offer relatively similar levels of service quality. In such situations, international patients may rely on alternative signals when selecting medical destinations, including physician reputation, institutional credibility, and destination attractiveness (Ye et al., 2011; Malkawi et al., 2025). These findings highlight the importance of complementary factors—particularly those related to the professional reputation and competence of physicians—in motivating purchasing behavior and shaping international patients' medical travel decisions.

H1: Medical service quality positively influences purchase intention in medical tourism.

The Impact of the Jordanian Medical Service Quality on the Medical Staff Competence

Several empirical studies have reported a positive relationship between medical service quality and the competence of medical staff. In particular, local studies suggest that the implementation of comprehensive healthcare quality standards—such as clinical risk management systems and patient-centered care practices—can contribute to improving the professional performance and competence of medical personnel (Naqrash et al., 2025). For example, research conducted in internationally accredited private hospitals found that the adoption of integrated quality management systems positively influences medical staff competence by encouraging adherence to standardized medical procedures, reducing clinical errors, and strengthening multidisciplinary collaboration among healthcare teams (Raoofi et al., 2024).

However, the relationship between medical service quality and medical staff competence remains conceptually complex and has produced mixed empirical findings. Some scholars argue that the relationship may operate in the opposite direction, as medical staff competence constitutes a fundamental input in achieving high-quality healthcare services rather than being an outcome of service quality itself (Chahal & Kumari, 2012). From this perspective, attributing improvements in staff competence solely to healthcare quality initiatives may lead to misleading interpretations, particularly in healthcare systems characterized by limited resources or high patient volumes. In such contexts, the implementation of strict quality standards may increase administrative workload and procedural requirements for healthcare professionals, potentially restricting their professional flexibility and negatively affecting perceptions of their competence (Ye et al., 2011). Furthermore, several studies have reported inconclusive or insignificant relationships between treatment service quality and the competence of medical staff, especially in healthcare institutions where professional performance relies heavily on the accumulated experience and expertise of physicians and nurses (Mikulić et al., 2021). In these cases, the professional competence of healthcare workers is largely shaped by factors such as continuous medical education, long-term clinical experience, and established professional cultures, which may operate independently of formal institutional quality policies. Therefore, the relationship between healthcare service quality and medical staff competence should be viewed as a dynamic and potentially reciprocal interaction rather than a simple linear relationship. This perspective highlights the importance of examining contextual and organizational factors that may influence how healthcare quality systems interact with workforce capabilities within healthcare institutions.

H2: Medical service quality positively influences medical staff competence.

The Impact of Medical Staff Competence on Purchase Intention of International Tourists

Some studies suggest that the competence of medical staff does not necessarily represent a decisive factor in shaping purchase intention among international medical tourists. In many cases, medical competence is perceived as a basic requirement rather than a distinguishing attribute, particularly in countries that already enjoy a strong reputation for highly qualified healthcare professionals and advanced educational systems. Under such circumstances, international patients tend to focus more on the overall treatment experience, including aspects such as the hospital's physical environment, the efficiency of administrative procedures, the availability of support services, and the comparative cost of treatment relative to competing destinations. Consequently, the competence of medical staff may be viewed as an implicit or expected attribute that does not significantly differentiate between healthcare providers during the decision-making process (Connell, 2013; Al-Hadid & Al-Salaymeh, 2019). Similarly, several studies have reported that the influence of medical staff competence on purchase intention may occur indirectly rather than through a direct relationship. In these cases, the competence of healthcare professionals contributes to strengthening mediating variables such as patient trust, satisfaction, and the perceived image of the medical destination, which in turn influence patients' behavioral intentions toward seeking treatment abroad (Yilmaz et al., 2021). In contrast, other studies—particularly recent research conducted in the Jordanian context - emphasize the critical role of medical staff competence in shaping international patients' purchase intentions. Given the high level of perceived risk associated with traveling abroad for medical treatment, international patients often rely on signals related to physicians' professional expertise, clinical experience, and the competence of nursing staff when evaluating healthcare institutions.

For example, the study conducted by Khaleel et al. (2022) found that international patients' awareness of physicians' expertise and the professional competence of nursing staff significantly enhances trust in healthcare providers and reduces uncertainty, thereby positively influencing purchase intention. Similarly, Karsana & Murhadi (2021) reported a direct positive effect of medical staff competence on purchase intention in Jordanian private hospitals. Additional evidence provided by Abu Alhaija et al. (2024) indicates that the professional reputation and sub-specialization of Jordanian physicians represent key competitive advantages for the country in the regional medical tourism market.

Furthermore, a recent study by Al-Nsour (2022) demonstrates that the competence of medical staff contributes to strengthening the international image of Jordanian hospitals, which in turn positively affects medical tourists' purchase intentions and loyalty toward healthcare institutions. Based on the above discussion, the following hypothesis is proposed:

H3: Medical staff competence has a positive effect on purchase intention among international medical tourists.

The Mediator Role of Medical Staff Competence in the Relationship between the Jordanian Medical Service Quality and the Purchase Intention of International Tourists

Several studies have highlighted the mediating role of medical staff competence in the relationship between medical service quality and purchase intention. These studies are based on the premise that the perceived quality of medical services does not automatically translate into positive behavioral intentions among international patients.

Rather, the effect of service quality is often realized through patients' direct interaction with competent medical professionals, where clinical expertise, human interaction, and the establishment of trust become critical elements in shaping patients' perceptions and behavioral responses (Yilmaz et al., 2021). In this perspective, healthcare service quality represents a structural input within the healthcare system, while medical staff competence functions as an explanatory mechanism that transfers the influence of perceived service quality into positive behavioral outcomes such as revisit intentions and recommendations. Empirical evidence further suggests that the competence of medical personnel enhances international patients' understanding of the value of healthcare services and reduces the perceived risks associated with seeking treatment abroad. By strengthening clinical trust and confidence in healthcare providers, competent medical staff can significantly increase patients' willingness to travel for treatment and their future purchase intentions (Mikulić et al., 2021). In the Jordanian context, previous studies indicate that several core dimensions of medical service quality—such as reliability, empathy, and assurance—are closely linked to the performance of physicians and nursing staff. This observation supports the assumption that medical staff competence may function as an intermediary mechanism through which service quality influences patients' behavioral intentions (Shriedeh & Ghani, 2017).

However, other scholars have raised conceptual concerns regarding the mediating role of medical staff competence. Some studies argue that the competence of medical personnel should be treated as an integral component of healthcare service quality rather than as an independent mediating variable (Chahal & Kumari, 2012). From this perspective, introducing medical staff competence as a mediator may lead to construct overlap, thereby weakening the explanatory power of causal models examining service quality and behavioral outcomes (Al-Qahtani & Al-Nsour, 2025).

Empirical evaluations of private hospitals in Jordan also suggest that elements such as physicians' professional skills, nurses' behavior, and response speed are often included within service quality measurements themselves, which means that their influence on purchase intention may occur directly through perceived service quality rather than through a separate mediating pathway (Alkhatib & Aloqaily, 2024). Furthermore, some studies have reported weak or insignificant mediating effects of medical staff competence, even when healthcare service quality demonstrates a direct influence on purchase intention. This may occur because other explanatory mediators—such as destination image, institutional trust, or perceived reputation—play a stronger role in shaping medical tourists' behavioral intentions (Demir, 2025). These findings suggest that international patients' decisions are influenced not only by clinical interactions with healthcare professionals but also by broader contextual factors, including the international reputation of medical institutions, treatment costs, ease of travel, and the availability of supporting services.

Despite these differing perspectives, examining the mediating role of medical staff competence remains important for understanding the mechanisms through which healthcare service quality influences international patients' behavioral intentions. Accordingly, the following hypothesis is proposed:

H4: Medical staff competence mediates the relationship between medical service quality and purchase intention among international medical tourists.

METHODOLOGY

1. Research Design: Research design refers to the structured framework that guides the process of data collection, measurement, and analysis to address the research problem effectively and enable the generalization of findings from the sample to the target population (Pandey & Pandey, 2015). In this study, a descriptive–causal research design was adopted to examine the relationships between the study variables. This design allows the researcher to describe the characteristics of the phenomenon under investigation and to analyze the causal relationships between variables. Specifically, the study aims to investigate the effect of medical service quality in Jordanian private hospitals on international medical tourists' purchase intention, while examining the mediating role of medical staff competence in this relationship.

2. Research Approach: According to Malhotra (2021), research approaches can generally be classified into qualitative and quantitative methods. Qualitative research focuses on gaining an in-depth understanding of phenomena through methods such as interviews, focus groups, and open-ended questions. In contrast, quantitative research aims to analyze relationships among variables using numerical data and statistical techniques. Since the primary objective of this study is to collect measurable data from a large group of respondents and test the relationships between variables, a quantitative research approach was employed. This approach involves collecting data through structured questionnaires, converting responses into numerical values, and applying statistical analyses to test the study hypotheses and draw conclusions (Malhotra, 2021).

3. Research Population: The population of the study consists of all international medical tourists receiving treatment in private hospitals in Jordan. According to the Jordanian Ministry of Health, the number of medical tourists reached approximately 92,500 visitors as of May 2025 (Ministry of Health, 2025). Based on standard sample size calculation formulas with a 95% confidence level, a 5% margin of error, and a population proportion of 50%, the recommended minimum sample size for this population is 383 respondents (calculator.net).

4. Sampling Method: To ensure representativeness, the study employed a simple random sampling technique, which is one of the most widely used probability sampling methods. In this method, each member of the population has an equal

chance of being selected, thereby reducing sampling bias and improving the reliability and validity of the results (Malhotra, 2021). A total of 383 medical tourists were randomly selected from patients receiving treatment in Jordanian private hospitals. Data regarding international patients were obtained through the Foreign Patients Offices located in the hospitals, which are supervised by the Jordanian Ministry of Health. These offices facilitated the identification and counting of medical tourists during the data collection period. All distributed questionnaires were successfully returned, resulting in a 100% response rate (383 questionnaires) used for final analysis. The data collection period took place in June 2025, which coincided with a period of increased demand for medical services in Jordan. Several factors contributed to this increase, including seasonal growth in international tourism during the summer months, school and university holidays in many source markets, and the return of Jordanian expatriates to the country during the summer season.

5. Unit of Analysis: The unit of analysis in this study consists of individual international medical tourists receiving treatment in Jordanian private hospitals. Through coordination with the Foreign Patients Offices in hospitals, questionnaires were distributed to medical tourists whose health conditions allowed them to participate in the survey and respond to the questionnaire items.

6. Data Collection Sources: The study relied on two main sources of data. Secondary data were obtained through a comprehensive review of the relevant literature, including academic books, peer-reviewed journal articles, university theses, official reports, and statistical data published by local and international institutions related to medical tourism and healthcare services. Primary data were collected through a structured questionnaire specifically developed to measure the study variables and to obtain responses directly from international medical tourists receiving treatment in Jordanian private hospitals.

7. Measurement Scale: The study variables were measured using a five-point Likert scale, which is widely used in social science research to measure attitudes and perceptions. The scale ranged from 1 (very low) to 5 (very high) to indicate the level of agreement with each statement. The Likert scale was used to measure the independent variable (medical service quality), the dependent variable (purchase intention), and the mediating variable (medical staff competence).

8. Research Instrument: The primary data collection instrument used in this study was a structured questionnaire. The questionnaire consisted of a series of statements designed to measure respondents' perceptions regarding the study variables. The survey was administered to medical tourists receiving treatment in the selected private hospitals. In some cases, respondents requested to complete the questionnaire at a later time; therefore, the researcher also provided electronic versions of the questionnaire through WhatsApp, Messenger, and email. The questionnaire was developed using Google Forms, allowing for easier distribution and data collection. To ensure the validity and clarity of the measurement instrument, the initial questionnaire was reviewed by a panel of academic and professional experts in healthcare management and tourism studies. Their feedback was used to refine the questionnaire items and ensure that the instrument accurately reflects the study constructs and research objectives.

After reviewing and discussing the existing literature, the main hypothesis of the study can be formulated as follows:

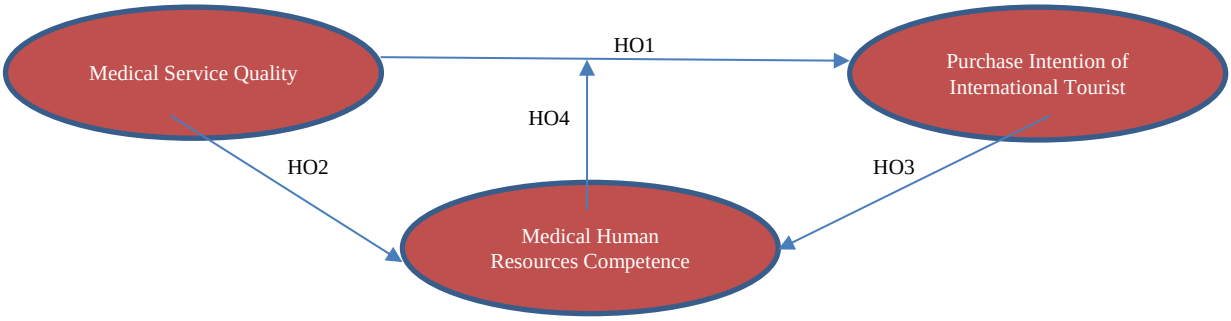


Figure 1. The Conceptual Model

Figure 1 illustrates the proposed research model, which conceptualizes medical service quality as the independent variable, purchase intention as the dependent variable, and human resource competencies as the mediating variable. This model is theoretically grounded in the service marketing and healthcare management literature, which consistently emphasizes that perceived service quality is one of the most influential determinants of consumer behavior and purchasing decisions. Previous studies in service marketing demonstrate that customers' perceptions of the quality of services provided significantly influence their behavioral intentions, including purchase intention and the intention to continue using a particular service provider (Farid et al., 2025; Parasuraman et al., 1988).

Within the healthcare context, the perceived quality of medical services plays a crucial role in strengthening patients' trust in healthcare institutions and increasing the likelihood that they will seek services from the same provider in the future. High levels of service quality contribute to improving patients' confidence in healthcare providers, which ultimately enhances their willingness to utilize healthcare services and recommend them to others (Kotler & Keller, 2016). Therefore, medical service quality can be considered a primary factor influencing international patients' behavioral intentions when selecting medical tourism destinations. At the same time, healthcare services are characterized by a high degree of human interaction, which makes human resource competencies a critical factor in translating service quality into positive patient experiences.

The competence of healthcare professionals—including their clinical expertise, communication skills, and professional behavior—plays a vital role in shaping patients' perceptions of healthcare quality and their overall treatment experience. Effective interaction between medical staff and patients enhances trust, reduces perceived risks, and strengthens patients'

confidence in the healthcare institution (Tran et al., 2025). Accordingly, human resource competencies may function as a mediating mechanism that explains how perceived medical service quality influences patients' purchase intentions. Through their professional competence and interaction with patients, healthcare personnel contribute to transforming perceived service quality into positive behavioral outcomes, such as the intention to seek treatment, revisit the healthcare institution, or recommend it to others. This mediating role is particularly important in medical tourism contexts, where international patients rely heavily on the competence and professionalism of healthcare staff when making treatment decisions in foreign destinations.

DESCRIPTIVE FREQUENCIES OF THE RESEARCH MODEL

Table 1 shows the descriptive statistics that determine respondents' perceptions regarding the study variables, including Jordanian medical service quality, purchase intention, and medical staff competence.

1. Jordanian Medical Services Quality (Independent Variable): The variable was measured using nine items. The results indicate that seven items were rated at a very high level and two items at a high level. The overall mean score was 4.309 (SD = 0.861), indicating a very high perceived level of medical service quality among international medical tourists. Approximately 82.7% of respondents expressed agreement with the statements related to this construct, suggesting that respondents generally perceive Jordanian medical services as highly reliable and effective.
2. Purchase Intention (Dependent Variable): Purchase intention was measured using four items. The findings show that three items were rated at a high level, while one item (B1) reached a very high level. The variable recorded a mean score of 4.165 (SD = 0.906), reflecting a high level of purchase intention among respondents. About 78.4% of participants expressed positive agreement with the items measuring their intention to seek treatment in Jordan.
3. Medical Staff Competence (Mediating Variable): Medical staff competence was assessed using four items, with two items rated at a high level and two items at a very high level. The variable achieved a mean score of 4.265 (SD = 0.787), indicating a very high perception of the competence of Jordanian medical personnel. Approximately 84.3% of respondents agreed with the statements measuring this construct.

Overall, the descriptive analysis indicates high to very high perceptions across all study variables, with relatively moderate standard deviations, suggesting acceptable variability in respondents' evaluations.

Table 1. Descriptive Statistics for the IV, DV, and Mediator

Item	Responses %					S. D	Mean	Application Degree
	VH	H	M	L	VL			
Q1	50.6	30.3	14.6	1.1	3.4	0.98	4.24	**Very High**
Q2	59.6	24.7	13.5	2.2	0	0.81	4.42	**Very High**
Q3	67.4	25.8	6.7	0	0	0.61	4.61	**Very High**
Q4	38.2	33.3	13.5	6.7	2.2	0.99	4.04	**High**
Q5	47.2	30.3	12.4	4.5	0	0.86	4.31	**Very High**
Q6	56.2	29.2	10.1	3.4	1.1	0.88	4.36	**Very High**
Q7	42.7	39.3	12.4	4.5	1.1	0.90	4.18	**High**
Q8	50.6	36	9	3.4	1.1	0.86	4.31	**Very High**
Q9	52.8	30.3	12.4	4.5	0	0.86	4.31	**Very High**
Medical Service Quality	**51.7**	**31.02**	**11.62**	**3.367**	**0.989**	**0.861**	**4.3089**	**Very High**
B1	47.2	30.3	20.2	1.1	1.1	0.89	4.21	**Very High**
B2	41.6	38.2	15.7	4.5	0	0.86	4.17	**High**
B3	42.8	37	15.7	4.5	0	0.86	4.17	**High**
B4	44.9	31.5	15.7	5.6	2.2	1.016	4.11	**High**
Purchase Intention	**44.125**	**34.25**	**16.825**	**3.925**	**0.825**	**0.9065**	**4.165**	**High**
ST1	46.1	30.3	16.9	4.5	2.2	1.002	4.13	**High**
ST2	65.2	23.6	6.7	3.4	1.1	0.86	4.48	**Very High**
ST3	60.7	22.5	11.2	5.6	0	0.90	4.36	**Very High**
ST4	25.8	62.9	6.7	3.4	1.1	0.75	4.09	**High**
Staff Competence	**49.45**	**34.825**	**10.375**	**4.225**	**1.1**	**0.878**	**4.265**	**Very High**

Medical Service Quality, Purchase Intention, and Human Resources Competencies Validity and Reliability

Individual Item Validity (Outer Loadings)

Figure 2 demonstrates that the individual item validity of the measurement model was evaluated by examining the outer loadings of all items associated with the study constructs. According to Hair et al. (2024), indicator loadings of 0.70 or higher are considered acceptable, as they indicate that the item adequately represents its underlying construct.

The initial assessment included all measurement items across the study variables. However, two items related to the independent variable (Q1 = 0.636 and Q4 = 0.619) recorded loadings below the recommended threshold of 0.70. Consequently, these items were removed from the model to improve the reliability and validity of the measurement structure. After the removal of these items, the measurement model consisted of 17 indicators, while the independent variable retained seven valid items in the final model. The subsequent analysis showed that all remaining indicators achieved higher loadings on their respective constructs than on other constructs, thereby satisfying the requirements for discriminant validity. Overall, the refined measurement model demonstrated improved indicator reliability and confirmed the discriminant validity of the constructs, indicating that the retained items adequately represent their respective variables in the structural model.

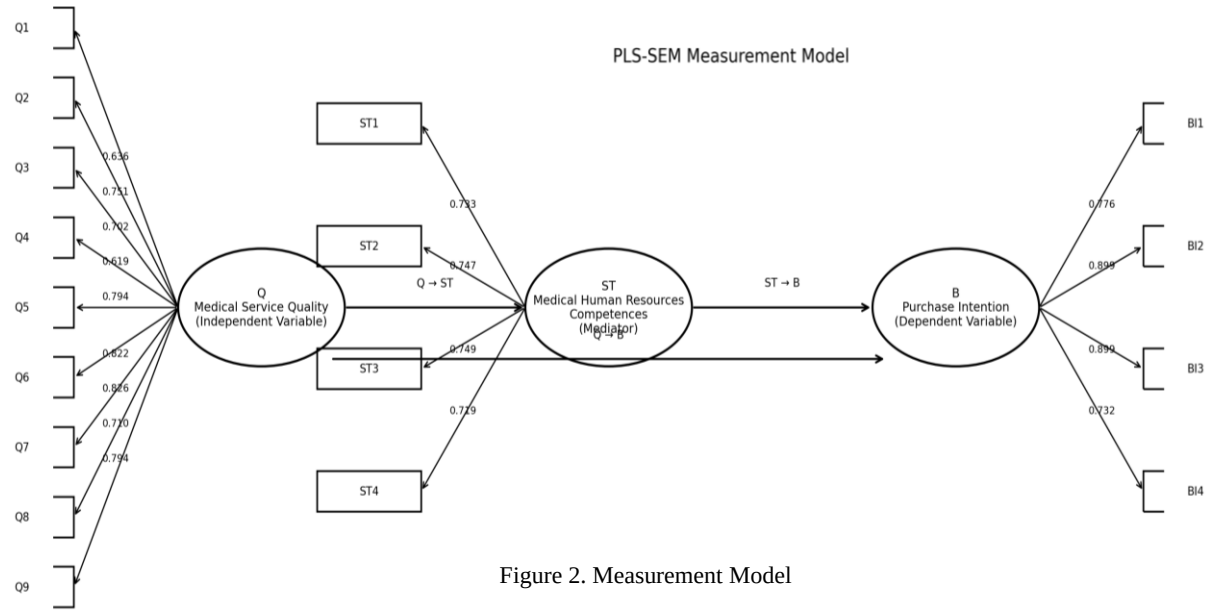


Figure 2. Measurement Model

Reliability and Convergent Validity of the Measurement Model

Figure 2 illustrates the assessment of the measurement model's internal consistency reliability using Composite Reliability (CR). According to Hair et al. (2021), CR values exceeding 0.70 indicate acceptable reliability, demonstrating that the indicators consistently measure their respective constructs. As presented in Table 2, all study constructs recorded CR values above the recommended threshold of 0.70, confirming a satisfactory level of internal consistency among the measurement items. In addition, convergent validity was evaluated using the Average Variance Extracted (AVE). According to Ringle et al. (2024), an AVE value of 0.50 or higher indicates that a construct explains at least half of the variance of its indicators. The results reported in Table 2 show that the AVE values for all study variables exceed the minimum recommended value of 0.50, indicating adequate convergent validity for the measurement model. Furthermore, rho_A reliability was calculated as an additional measure of construct reliability. Statistical guidelines suggest that rho_A values greater than 0.70 indicate acceptable reliability (Panahi et al., 2022). The results presented in Table 2 demonstrate that all constructs achieved rho_A values above this threshold. Overall, the findings indicate that the measurement model meets the recommended criteria for internal consistency reliability and convergent validity, confirming that the constructs used in the study are statistically reliable and valid for further structural model analysis.

Table 2. Cross Loading, CR, AVE, CR & VIF

Factor	Items	Cross Loading	CR	AVE	Rho_A
Medical Service Quality	Q1	0.636	0.879	0.596	0.866
	Q2	0.751			
	Q3	0.702			
	Q4	0.619			
	Q5	0.794			
	Q6	0.822			
	Q7	0.826			
	Q8	0.710			
	Q9	0.794			
Purchase Intention	BI1	0.776	0.898	0.688	0.887
	BI2	0.899			
	BI3	0.899			
	BI4	0.732			
Staff Competence	ST1	0.733	0.826	0.543	0.895
	ST2	0.747			
	ST3	0.749			
	ST4	0.719			

Discriminant Validity (Fornell–Larcker Criterion)

Finally, discriminant validity was assessed using the Fornell–Larcker (1981) criterion, which is widely applied in structural equation modeling to evaluate the distinctiveness of latent constructs. This method involves comparing the square root of the Average Variance Extracted (AVE) for each construct with the correlations between that construct and other constructs in the model. According to Fornell & Larcker (1981), the square root of the AVE for each latent variable should be greater than its correlations with other latent variables. This condition indicates that the construct explains more variance in its own indicators than it shares with other constructs in the model. As presented in Table 3, the square root of the AVE

for each study variable exceeds the corresponding inter-construct correlation coefficients. These results confirm that each construct demonstrates stronger relationships with its own measurement items than with other constructs, thereby satisfying the requirements for discriminant validity. Overall, the findings indicate that the study constructs—medical service quality, medical staff competence, and purchase intention—are empirically distinct from one another. This confirms the adequacy of the measurement model and supports its suitability for subsequent structural model analysis.

Table 3. Fornell-Larcker Criterion

Construct	Medical Service Quality	Purchase Intention	Staff Competence
Medical Service Quality	0.772	0.756	0.731
Purchase Intention	0.725	0.830	0.642
Staff Competence	0.731	0.642	0.737

RESULTS

Direct Impact Analysis

Table 4 presents the results of the structural model used to test the direct hypotheses while considering the mediating variable (medical staff competence). The relationships between the study variables were evaluated using the path coefficient (β), standard deviation (STDEV), t-value, and p-value, which determine the strength and statistical significance of each hypothesized relationship. H1: The first hypothesis examined the relationship between Jordanian medical service quality and purchase intention among international tourists. The results show strong support for this hypothesis. The path coefficient (β = 0.899) indicates a strong positive relationship between the two variables. In addition, the t-value (5.082) exceeds the critical value of 1.96, and the p-value is less than 0.001, confirming that the relationship is statistically significant at $\alpha \leq 0.05$. These findings suggest that the perceived quality of medical services is a key determinant influencing international tourists' intention to seek treatment in Jordan. H2: The second hypothesis tested the relationship between Jordanian medical service quality and medical staff competence.

The results provide strong support for this hypothesis as well. The path coefficient (β = 0.899) indicates a strong positive relationship between the two variables. The t-value (4.196) exceeds the critical value of 1.96, while the p-value (0.001) confirms the statistical significance of the relationship. This finding indicates that higher levels of perceived medical service quality are associated with greater perceived competence of medical staff in the studied hospitals. H3: The third hypothesis examined the relationship between medical staff competence and purchase intention among international medical tourists. The results show that this relationship is not statistically significant. The path coefficient (β = 0.115) indicates a weak relationship, while the t-value (0.779) is below the critical threshold of 1.96. Furthermore, the p-value (0.838) exceeds the significance level of 0.05. Accordingly, H3 is not supported, suggesting that the perceived competence of medical staff does not directly influence the purchase intention of international medical tourists. To further assess the strength of the relationships in the model, effect size (f^2) was calculated based on Cohen's (1988) criteria (0.02 = small, 0.15 = medium, 0.35 = large). The results indicate that Jordanian medical service quality has a substantial effect on both medical staff competence and purchase intention, while the effect of medical staff competence on purchase intention is very weak, which is consistent with the insignificant path identified in H3.

In addition, the coefficient of determination (R^2) was used to evaluate the explanatory power of the model. The results show that medical service quality explains 68.4% of the variance in medical staff competence ($R^2 = 0.684$), indicating a strong explanatory capacity for this relationship. Similarly, the combined effect of medical service quality and medical staff competence explains 54.8% of the variance in international tourists' purchase intention ($R^2 = 0.548$).

This value is considered acceptable and indicates a moderate level of explanatory power within marketing and tourism research contexts. Overall, the structural model results confirm the strong influence of medical service quality on both medical staff competence and purchase intention, while the direct effect of medical staff competence on purchase intention appears to be statistically insignificant in this study context.

Table 4. Direct Path Analysis

H	Relationship	Std. Beta	T-Value	P-Value	f^2	**Effect Size**	Decision	R^2	Q^2
H1	Quality → Purchase Intention	0.899	5.082	0.000	0.84	High	Supported	0.548	0.490
H2	Quality → Staff Competence	0.899	4.196	0.001	2.17	Very High	Supported	0.684	---
H3	Staff Competence → Purchase Intention	0.115	0.779	0.838	0.007	Very Weak	Not Supported		0.491

Significant at $P_0* < 0.01$; Significant at $P_0** < 0.05$

Mediation Analysis

This study examined the mediating role of medical staff competence in the relationship between Jordanian medical service quality and international tourists' purchase intention. The mediation analysis was conducted using path analysis within the Structural Equation Modeling framework (PLS-SEM). The bootstrapping technique was applied to test the indirect effects, as it provides a robust method for mediation testing without requiring the assumption of normal data distribution (Hair et al., 2021). Testing indirect effects is essential in studies involving mediating variables, as it allows researchers to determine whether the influence of an independent variable on a dependent variable occurs directly,

indirectly through the mediator, or through a combination of both. The results presented in Table 5 show that the indirect effect of Jordanian medical service quality on international tourists' purchase intention through medical staff competence was ($\beta = 0.114$). However, this effect was not statistically significant, as indicated by the Z-value (0.778) and p-value (0.437), which exceeds the acceptable significance level of $\alpha \leq 0.05$.

These results indicate that the mediating role of medical staff competence cannot be statistically confirmed. In evaluating the mediation decision, the total effect of medical service quality on purchase intention is primarily explained by the direct relationship between the two variables, rather than by the indirect path through the mediating variable. Furthermore, the direct effect of medical staff competence on purchase intention was also found to be statistically insignificant, while the direct effect of medical service quality on purchase intention remained significant.

Accordingly, the results suggest that medical staff competence does not function as a statistically significant mediator in the relationship between medical service quality and purchase intention in the present model. Although the indirect path represents approximately 11.3% of the total effect, its contribution is relatively weak. From an interpretive perspective, these findings imply that international medical tourists base their purchase decisions primarily on their perceptions of overall medical service quality, rather than on direct evaluations of medical staff competence. Elements such as efficient administrative procedures, effective coordination, rapid service response, and professional service delivery appear to play a more prominent role in shaping purchase intentions. Nevertheless, medical staff competence may still act as a supporting mechanism that enhances the overall perception of service quality, even though it does not independently influence purchasing decisions. This finding is consistent with the nature of medical tourism as a high-involvement service, where patients prioritize the overall quality of healthcare services when selecting treatment destinations, while the competence of medical staff contributes indirectly by reinforcing trust and confidence in the healthcare system.

Table 5. Direct Path Analysis

H	Relationship	Std. Beta	T-Value	P-Value	Decision	R^2	Q^2	Indirect B	Direct B	Total
H4	Quality → Purchase Intention → Medical Staff Competence	0.114	0.778	0.437	Not Supported	0.374	0.271	0.114	0.899	1.013

Predictive Relevance and Model Fit Assessment

Finally, the predictive relevance of the research model was evaluated using the Stone–Geisser Q^2 value. According to Chin (2010), a model demonstrates predictive relevance when the Q^2 value is greater than 0.00. As presented in Table 6, the Q^2 value for purchase intention of international tourists reached 0.584, indicating a strong predictive capability of the model in explaining variations in the dependent variable. In addition, the overall model fit was assessed using several goodness-of-fit indices based on the PLS-SEM methodology. These indices help determine the extent to which the proposed model adequately represents the observed data. The Standardized Root Mean Square Residual (SRMR) is considered the primary indicator of model fit, where values below 0.08 indicate a satisfactory fit between the model and the data. Furthermore, the d_ULS and d_G indices were used to evaluate the discrepancy between the empirical correlation matrix and the model-implied correlation matrix. The results show that the values of these indicators are lower than their respective critical values (HI95), suggesting an acceptable level of model fit. Additionally, the Chi-Square statistic was reported primarily for model comparison purposes. Meanwhile, the Normed Fit Index (NFI) reflects the degree of improvement of the proposed model compared with a null model. According to established guidelines, NFI values above 0.90 indicate a good model fit. Overall, the results of the predictive relevance test and model fit indices confirm that the proposed structural model demonstrates adequate predictive power and a satisfactory level of fit with the observed data, supporting its suitability for interpreting the relationships between the study variables.

Table 6. GOF Value

Variable	**Estimated Model**	**Decision**	**Q^2 (=1-SSE/SSO)**
SRMR	≤0.08	Acceptable / Unacceptable	0.584
d_ULS	≤H195	acceptable	
d_G	H195	acceptable	
Chi Square	Comparison between models		
NFI	≥0.090	Good / Weak	

DISCUSSION

The results of the current study reveal a statistically significant positive effect of the quality of medical services provided in Jordanian hospitals on the purchase intention of international medical tourists. This finding highlights the critical role of healthcare service quality in shaping purchasing behavior within the medical tourism sector. It aligns with the broader health marketing literature, which consistently identifies service quality as a primary determinant influencing international patients' decisions to travel abroad for medical treatment, particularly given the high level of perceived risk associated with healthcare services (Yilmaz et al., 2021; Connell, 2013). In the context of medical tourism, patients' perceptions of service quality extend beyond clinical outcomes alone. International medical tourists evaluate healthcare services through a comprehensive assessment of the treatment experience, including the efficiency of administrative procedures, clarity of communication with healthcare providers, responsiveness of medical staff, and

the overall quality of care throughout the treatment journey. These elements have been shown to significantly enhance patients' confidence and strengthen their purchase intentions when selecting a hospital or medical destination (Abu-Alhaija & Gillespie, 2024). The findings of the present study are also consistent with recent research conducted in the Jordanian healthcare context. Previous studies have emphasized that the quality of medical services represents a major competitive advantage that strengthens the position of Jordanian hospitals in the regional and international medical tourism market. Higher perceived service quality contributes to increased trust in the Jordanian healthcare system and improves the institutional image of hospitals, which in turn positively influences international tourists' purchase intentions. This effect becomes particularly evident when Jordanian healthcare services are compared with alternative medical destinations that may offer higher treatment costs or lower perceived service quality (Al-Nsour, 2024).

The second major finding of the study indicates a significant positive relationship between medical service quality and the competence of medical staff in Jordanian hospitals. This result is consistent with the principles of Total Quality Management (TQM) in healthcare, which suggest that the implementation of quality standards and accreditation systems contributes to improving the professional performance of healthcare personnel. The adoption of structured quality systems helps standardize clinical procedures, enhance adherence to treatment protocols, and foster a culture of continuous improvement and organizational learning within healthcare institutions (Donabedian, 1988; Al-Dmour et al., 2025).

From this perspective, healthcare quality should not be viewed merely as an outcome but rather as an organizational and operational framework that directly influences the competence and professional capabilities of healthcare providers. Evidence from Jordanian hospitals indicates that the adoption of international accreditation systems, such as Joint Commission International (JCI) standards, is strongly associated with improvements in medical staff performance, enhanced coordination among multidisciplinary medical teams, and a reduction in medical errors.

These improvements ultimately contribute to strengthening the perceived competence of healthcare professionals from both patients' and institutional perspectives (Abu Alhaija et al., 2024). Based on these findings, the results suggest that medical service quality functions as an antecedent variable influencing the competence of medical staff.

A healthcare environment that emphasizes quality management practices creates conditions that empower healthcare professionals, enhance their professional skills, and improve the effectiveness of service delivery (Aboalganam, 2024). Overall, the current study provides empirical support for the theoretical relationships between medical service quality, medical staff competence, and purchase intention within the context of medical tourism. The findings confirm that medical service quality represents a fundamental pillar in shaping the medical experience of international patients. It influences purchase intentions both directly, by enhancing perceptions of healthcare value, and indirectly, by improving the competence and performance of medical staff. Consequently, strengthening service quality remains essential for enhancing the competitive position of Jordanian hospitals in the rapidly expanding global medical tourism market.

On the other hand, the results of the current study indicate no statistically significant direct effect of medical staff competence on the purchase intention of international tourists seeking treatment in Jordanian hospitals. This finding contributes to the ongoing debate in the medical tourism literature regarding the actual role of medical competence in shaping international patients' purchasing decisions. This result is consistent with several previous studies suggesting that in medical destinations with a well-established professional reputation, the competence of medical staff is often perceived as a basic and expected requirement rather than a differentiating factor influencing patients' decisions (Connell, 2013; Al-Sharif et al., 2024). In such contexts, international patients tend to assume that healthcare professionals possess the necessary expertise and qualifications, which reduces the explanatory power of staff competence in predicting variations in purchasing behavior. Furthermore, research in medical tourism indicates that patients' decisions are rarely based on a single factor. Instead, international patients typically evaluate the overall healthcare experience, which includes service quality, administrative efficiency, hospital facilities, ease of procedures, and treatment costs.

Han et al. (2021) argue that broader aspects of the service experience often play a more influential role in shaping behavioral intentions than perceived competence among individual healthcare professionals.

When the medical destination already enjoys a strong reputation and high professional standards, patients may rely more heavily on these broader service attributes when making treatment decisions. Evidence from studies conducted in the Jordanian healthcare context supports this interpretation. Previous research suggests that the strong reputation of Jordanian healthcare professionals reduces international patients' sensitivity to differences in medical staff competence across hospitals, as competence is generally assumed to be consistently high throughout the healthcare system (Karsana & Murhadi, 2021). From a theoretical perspective, the current findings also align with models suggesting that medical staff competence influences purchase intention indirectly rather than directly. In such models, staff competence contributes to strengthening mediating factors such as patient trust, satisfaction, and the perceived image of the hospital or medical destination, which subsequently influence behavioral intentions. Studies have shown that international patients' perceptions of healthcare professionals' competence help build trust and reduce perceived risk associated with medical travel. However, these perceptions may not translate into purchase intention unless they are supported by a comprehensive and satisfactory service experience that meets patients' expectations (Karsana & Murhadi, 2021).

Nevertheless, the results of the current study differ from some previous research that identified a direct influence of medical staff competence on purchase intention, particularly in emerging medical tourism markets or relatively unknown healthcare destinations. In such environments, professional competence often serves as a crucial signal of credibility that helps reduce uncertainty and perceived risks associated with seeking treatment abroad (Yilmaz et al., 2021). The differences between these findings may be explained by variations in the maturity level of medical tourism markets, healthcare system reputation, and contextual characteristics of the study setting.

In more established medical tourism destinations such as Jordan, where healthcare professionals already enjoy strong regional credibility, patients may place greater emphasis on the overall quality of healthcare services and institutional reputation rather than on individual assessments of medical staff competence. Consequently, the Jordanian context provides an important explanatory framework for interpreting the current results.

Finally, the results of the current study indicate no statistically significant mediating effect of medical staff competence on the relationship between Jordanian medical service quality and international tourists' purchase intention. This finding reflects the complex and multidimensional nature of decision-making among international medical tourists when selecting a treatment destination. Specifically, the results suggest that medical service quality directly influences purchase intention, without the need for the effect to pass through medical staff competence as a mediating variable. This outcome is consistent with previous studies indicating that in well-established medical tourism destinations, medical staff competence is often perceived as a fundamental and expected characteristic rather than a distinct channel through which service quality influences purchasing behavior (Al-Nsour, 2020).

In such contexts, international patients assume a high level of professional competence among healthcare providers, which reduces their explanatory role in mediating the relationship between perceived service quality and behavioral intentions. From a theoretical perspective, this finding aligns with models suggesting that international patients evaluate medical destinations through a comprehensive assessment of the overall treatment experience. In this evaluation process, healthcare service quality represents a broader construct encompassing organizational efficiency, service delivery, administrative procedures, responsiveness, and the overall treatment environment. These elements collectively shape patients' perceptions and directly influence purchase intentions, independent of the perceived technical competence of healthcare professionals (Yilmaz et al., 2021). Accordingly, medical service quality can be viewed as a holistic construct that directly affects purchasing behavior without necessarily requiring mediating mechanisms.

In this context, medical staff competence may still play an indirect and supportive role in shaping the healthcare experience by contributing to factors such as trust, satisfaction, and institutional image, rather than acting as a direct mediator between service quality and purchase intention. Recent studies suggest that the influence of medical staff competence becomes more evident when it is examined within more complex models that incorporate additional mediating or moderating variables, such as institutional trust, hospital reputation, or destination image (Karsana & Murhadi, 2021).

These factors may serve as more powerful explanatory mechanisms linking service quality perceptions to behavioral intentions in medical tourism contexts. At the same time, the findings of the present study differ from some research that has identified a significant mediating role of medical staff competence, particularly in emerging medical tourism markets or relatively less established healthcare destinations. In such contexts, professional competence functions as a critical signal that helps reduce uncertainty and perceived risk among international patients (Karsana & Murhadi, 2021). The differences between these findings may be attributed to contextual variations and the maturity of the medical tourism market in Jordan. Jordan has developed a strong regional reputation for high-quality healthcare services and well-qualified medical professionals. As a result, professional competence may be perceived as a standard expectation rather than a differentiating factor capable of mediating the effect of service quality on purchase intention.

Overall, the results of the current study contribute to the medical tourism literature by providing empirical evidence from the Jordanian context, indicating that medical staff competence does not function as a mediating variable in the relationship between medical service quality and purchase intention. Instead, it operates as part of a broader system of factors shaping the overall healthcare experience of international patients. These findings also highlight the need to reconsider traditional explanatory models and encourage future research to explore more comprehensive frameworks that incorporate multiple mediating or moderating variables. Such approaches may better capture the dynamic and multidimensional nature of international medical tourists' decision-making processes and provide deeper insights into the mechanisms through which healthcare service quality influences behavioral intentions.

Based on the findings of the current study, several managerial implications can be proposed to enhance the competitiveness of Jordanian hospitals in the international medical tourism market:

1. Improving medical service quality: Hospitals should prioritize enhancing clinical and administrative service processes, including treatment efficiency, simplified procedures, and effective multilingual communication, as service quality strongly influences international patients' purchasing behavior.
2. Adopting international quality standards: Implementing internationally recognized healthcare accreditation systems, along with investing in modern healthcare infrastructure and hospital environments, can strengthen service quality and enhance the global reputation of Jordanian hospitals.
3. Integrating medical staff competence into patient experience: Medical competence should be incorporated within a comprehensive patient experience strategy that emphasizes coordination among medical teams, effective communication, and personalized care throughout the treatment journey.
4. Strengthening institutional trust and destination image: Building institutional trust, enhancing the international image of Jordanian hospitals, and increasing the perceived value of healthcare services are essential for encouraging international patients to choose Jordan as a medical tourism destination.

Finally, the findings of this study provide important theoretical insights, alongside critical policy and managerial implications, for strengthening Jordan's position in the regional and global medical tourism market. The results confirm that medical service quality is the most influential determinant of international patients' purchase intentions, highlighting the need for policymakers and healthcare administrators to prioritize quality-driven strategies within the national medical

tourism agenda. In this context, service quality should be treated not merely as an operational issue at the hospital level but as a strategic policy instrument capable of enhancing Jordan's competitiveness in the international healthcare market.

From a practical and policy perspective, the results suggest that Jordan's comparative advantage in medical tourism lies primarily in its reputation for reliable healthcare services and cost-effective treatment, rather than solely in the professional competence of individual physicians. While Jordanian doctors are widely recognized for their expertise in specialties such as oncology, cardiology, and orthopedic surgery, the study indicates that international patients perceive this competence as a baseline expectation rather than a decisive competitive differentiator. Consequently, public and private stakeholders should shift their strategic focus from promoting individual medical expertise to strengthening the institutional quality of the healthcare system, including administrative efficiency, patient coordination mechanisms, and service integration across healthcare facilities. Furthermore, the findings imply that medical tourism policy in Jordan should increasingly emphasize system-level service quality rather than isolated clinical excellence. This includes developing standardized international patient pathways, improving hospital accreditation systems, and enhancing coordination between healthcare providers and tourism institutions. Such measures can help position Jordan not only as a destination for high-quality medical treatment but also as a comprehensive healthcare experience destination.

The results also highlight the importance of leveraging Jordan's unique therapeutic and wellness assets as part of a broader medical tourism value proposition. Destinations such as the Dead Sea, internationally recognized for its therapeutic properties, and specialized institutions such as the King Hussein Cancer Center represent strategic assets that can strengthen Jordan's international positioning in the medical tourism market. Integrating these assets into a coordinated national medical tourism strategy would enable Jordan to move from a hospital-centered model of medical tourism toward an integrated healthcare and wellness ecosystem. At the strategic level, sustaining Jordan's competitiveness requires a policy framework that integrates healthcare quality, tourism infrastructure, and international marketing efforts. This involves strengthening collaboration between the Ministry of Health, the Ministry of Tourism and Antiquities, private hospitals, and international medical facilitators. Such coordination can improve Jordan's global visibility as a trusted destination for medical treatment while ensuring that service quality standards remain consistent across the healthcare system. Overall, the study demonstrates that Jordan's future success in medical tourism will depend less on promoting isolated elements of healthcare competence and more on developing an integrated, high-quality healthcare system capable of delivering a reliable and seamless patient experience for international medical tourists.

CONCLUSION

This study examined the factors influencing international tourists' purchase intention to obtain medical services from Jordanian hospitals, focusing on medical service quality and medical staff competence within an integrated analytical framework. The results indicate that medical service quality is the most influential factor shaping international tourists' purchase intention. This finding highlights the importance of perceived service quality in high-risk service environments such as medical tourism, where patients evaluate the overall treatment experience, including clinical outcomes, administrative efficiency, communication, and service organization. The study also found a significant positive relationship between medical service quality and medical staff competence, suggesting that healthcare quality standards and accreditation systems contribute to improving professional performance within healthcare institutions. However, the results showed no direct or mediating effect of medical staff competence on purchase intention, indicating that in well-established medical destinations such as Jordan, medical competence is perceived as a basic prerequisite rather than a differentiating factor influencing patient decisions. Overall, the findings emphasize that medical service quality directly drives purchase intention, while medical staff competence contributes indirectly by supporting the quality environment. From a practical perspective, strengthening Jordan's competitiveness in medical tourism requires continued investment in healthcare service quality, institutional reputation, and the overall international patient experience.

Research Limitations and Future Research Directions

Despite its contributions, this study has several limitations that provide directions for future research. The findings showed no statistically significant mediating role for medical staff competence in the relationship between medical service quality and purchase intention, suggesting the need to explore alternative mediating variables such as institutional trust, patient satisfaction, destination image, and perceived value to better explain international medical tourists' purchasing behavior. Future studies may also incorporate moderating variables related to patient characteristics, including nationality, type of treatment, length of stay, and perceived health risk, as these factors may influence how international patients evaluate healthcare services and form their purchase intentions. In addition, since the study focused primarily on private hospitals in Jordan, comparative research between public and private hospitals or between Jordan and competing medical tourism destinations could enhance the generalizability of the findings. Future research may also benefit from adopting mixed-method or longitudinal approaches to provide deeper insights into international medical tourists' experiences and to examine how purchase intentions evolve into actual treatment decisions over time.

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Abbreviations List: Medical Service Qulaity: MSQ; Purchase Intention: PI; International Tourists: IT; Human Resources Copmetence: HRC;

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TOURISM SITUATION IN THAILAND AND APPROPRIATE STRATEGIC ADJUSTMENTS

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Abstract: Tourism serves as a vital engine for the Thai economy, contributing significantly to national wealth; however, persistent disparities exist in income distribution between primary and secondary provinces. This study aims to analyze the current tourism situation in Thailand and identify appropriate strategic adjustments to enhance the industry's resilience and sustainability. By evaluating the concentration of visitors and revenue, the research seeks to provide a roadmap for more equitable economic growth through tourism. This research utilizes secondary time-series data from 2012 to 2023 obtained from the Tourism Authority of Thailand (TAT). Descriptive statistics and box plot analyses were performed using SPSS to observe data distribution across 77 provinces. Furthermore, the study employs Mapping Strategy Groups and heat maps to classify provincial tourism characteristics into distinct tiers. Finally, a SWOT and TOWS Matrix analysis was conducted to evaluate the internal strengths and external competitive environment, formulating strategic recommendations for policymakers. The findings reveal that tourism revenue and arrivals are heavily concentrated in a few major provinces, specifically Bangkok, Phuket, and Chonburi, which consistently act as "Maxi-Outliers." While domestic tourism shows a slightly more balanced distribution, it generates significantly lower income compared to international tourism. The COVID-19 pandemic disproportionately affected primary provinces, whereas secondary provinces remained stagnant due to a pre-existing lack of infrastructure and clear destination identity. Interpretation suggests that Thailand must shift toward a decentralized strategy. This involves expanding transportation infrastructure to secondary cities and leveraging unique local cultural landmarks to create distinct value. Implementing a more diverse tourism model will not only attract repeat international visitors but also encourage high-spending Thai tourists, who usually travel abroad, to explore domestic destinations. Ultimately, addressing these structural imbalances is essential for reducing economic inequality and ensuring long-term tourism growth.

Keywords: Thai tourism, strategic management, major provinces tourism, first-tier provinces tourism, second-tier provinces tourism, inequality

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INTRODUCTION

Thailand has an overall population of approximately 71.7 million and received around 315.5 million tourists in 2023. This includes 249.08 million Thai visitors (people traveling for tourism and other purposes, such as visiting friends or relatives, both overnight and non-overnight) and 66.46 million foreign visitors (foreigners who traveled to Thailand before the immigration checkpoint was closed and resided in various provinces). This tourism generated income for the country of approximately 2.17 trillion baht, divided into income from Thai tourists of 0.858 trillion baht and foreign tourists of 1.31 trillion baht (TAT, 2023). Moreover, tourism has been proven to contribute to the economic growth of Thailand in the long term and helps promote economic activity both regionally and macro-economically, especially in developing countries (Sungkaew, 2020). For example, food tourism that impacts the regional economy of Thailand, particularly in areas with a strong food identity such as the Central, Southern, Eastern, and Northern regions, will be positively affected by the expansion of tourism (Thongkaw et al., 2024). In addition, stimulating tourism in second-tier provinces had a significant impact on economic growth in those provinces (Chanthawong & Choibamroong, 2020).

On the other hand, although many studies confirm that tourism contributes to economic growth and increases income for local people, and that tourism promotion policies have a positive effect on the country's economy, there are still some limitations that prevent tourism from having a positive effect on the country's economy in all dimensions such as income distribution. From the study by (Wattanakuljarus & Coxhead, 2008); it was found that tourism growth increases overall household income but worsens income distribution. This is because the tourism sector is not labor-intensive in the Thai context, and tourism expansion creates general equilibrium effects that reduce the profitability of the trade sectors on which the poor depend for their income. In addition, promoting tourism in 55 second-tier provinces in Thailand is a policy aimed at reducing poverty and income inequality. The 22 first-tier provinces can reduce the poverty rate, but overall income inequality increases. However, increasing domestic tourism can slightly decrease income inequality (Sudsawasd et al., 2022). As with a study of tourism in 13 countries, it was found that tourism growth did not reduce

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poverty or income inequality, but it did narrow the poverty gap (Mahadevan & Suardi, 2019). As for the tourism situation in Thailand, it was found that the tourism industry is an important engine that drives the country's economy and increases the wealth of its people. However, tourism is unable to influence better income distribution, especially in second-tier provinces that benefit less from the tourism sector than first-tier provinces.

Past tourism statistics from the Tourism Authority of Thailand (TAT) have found that tourism is concentrated only in first-tier provinces such as Bangkok and Chonburi, while second-tier provinces receive significantly fewer tourists compared to these major provinces. Although, second-tier provinces have planned tourism strategies to attract tourists such as: Sakon Nakhon Province promotes cultural tourism by leveraging its unique identity to attract visitors (Panich et al., 2014). The strategic linkage between rural villages in Tom Lod, Mae Hong Son Province, and high-potential tourism in Chiang Mai Province can significantly enhance the economic impact of rural tourism (Lacher & Nepal, 2010).

Nong Khai Province employs a religious tourism strategy, capitalizing on its numerous famous religious ritual sites to draw tourists (Maneenetr & Tran, 2014). Additionally, Chanthaburi Province uses marketing strategies focused on creating the right image and awareness to attract tourists (Srisangkaew, 2017). Recent studies also highlight the importance of faith-based and cultural attractions in promoting tourism distribution to secondary provinces, such as Nakhon Si Thammarat, which can generate significant local economic impact (Waiyasusri, 2025).

However, it has not succeeded in elevating the level of tourism in these provinces as expected. Therefore, it is necessary to reassess the tourism situation in Thailand to develop strategies that are appropriate for each tourism area.

Previous literature emphasizes the significant effect of tourism on economic development in rural areas and second-tier cities. A comprehensive study of tourism in China found that tourism impacts 341 cities and suggested that cities should leverage the tourism influence of neighboring cities. By establishing inter-city tourism organizations or agencies, cities can enhance the efficiency of tourism development (Yang & Wong, 2012).

Moreover, the development direction of rural tourism in China is guided by government policies that focus on investing in infrastructure, upgrading tourist attractions, and increasing local income to attract tourists. Additionally, future planning is influenced by the rural tourism development blueprints of developed countries. This includes promoting the culture and identity of rural communities to create unique experiences for visitors and attract more tourists. It also involves implementing tax reduction measures to encourage tourism (Wang et al., 2013). A study in Japan found that the development of high-speed rail (Shinkansen) played an important role in attracting tourists to non-major city prefectures and influenced regional economic activities (Kurihara & Wu, 2016). As with rural tourism in France, tourism in general has not significantly improved the local economy because tourists tend to spend less on tourism activities. Visitors' stays in three rural regions during the summer season often involve visits to friends or relatives. However, more expensive stays are the most common, involving activities aimed at experiencing the outdoors or enjoying local sights, based on natural and cultural amenities mainly located in regional natural parks. The main forms of accommodation are campsites and rural cottages. Gastronomic tourism has also emerged as an activity that attracts higher-spending visitors (Bel et al., 2015).

On the other hand, the tourism situation in Indonesia demonstrates that tourism can significantly stimulate the economy and generate impressive income for primary tourism provinces. However, the results in second-tier provinces are disappointing. It is the duty of the government to continue promoting tourism policies in these provinces (Rahmayani et al., 2022). Similar to South Africa, where tourism is concentrated in major cities while secondary cities rely heavily on domestic tourism, this leads to uneven development, making these areas prone to high poverty and low development (Rogerson, 2015).

From the review of foreign tourism literature, it was found that promoting tourism in secondary cities requires the development of transportation infrastructure, accommodation, and various facilities before issuing policies to promote tourism in these areas. Moreover, in developing countries, tourism in secondary cities primarily comes from domestic tourists and has not yet generated sufficient income to develop the local economy as expected. In addition, uncertainties such as the COVID-19 pandemic and geopolitical issues have significantly affected the tourism sector. Thailand should analyze the data to determine appropriate tourism strategies for each area, addressing the problems and promoting tourism effectively. Furthermore, recent literature highlights the significance of transportation infrastructure (Srikhwan & Choibamroong, 2025) and tourist behavior in ecotourism (Praprom & Laipaporn, 2025) as crucial factors for developing sustainable tourism destinations in Thailand.

MATERIALS AND METHODS

This study uses time-series secondary data between 2012 to 2023 from the Tourism Authority of Thailand (TAT). And considered from observation of the distribution of data by descriptive statistic explore method form SPSS program. Tourism data such as number of total visitors, number of foreign visitors, number of domestic visitors, total tourism revenue, foreign revenue, and domestic revenue of 77 provinces are arranged in a graph (Box plot) to show the distribution of data as shown in Figure 1. The concentration of tourists will cause the data for first-tier provinces to fall into the Maxi Outlier range, indicating that these provinces benefit significantly from tourism.

In contrast, second-tier provinces do not benefit as much from tourism promotion. Moreover, all data will be plotted on a graph to illustrate the differences in tourism activity across each province. This will help visualize the dynamics of tourism data and assess the impact of tourism promotion policies and uncertain events. The data obtained will then be analyzed to create a Mapping Strategy Group. The Mapping Strategy Groups, shown in Figure 2, illustrate the number of tourists and tourism income for each province. These groups classify the character of tourism in each province by considering overall tourism, international tourism, and domestic tourism. This classification helps identify gaps and problems in the country's tourism sector and serves as a tool for policy making and strategy determination. Finally, the study results will be subjected to a SWOT analysis to evaluate the competitive situation of tourism in Thailand.

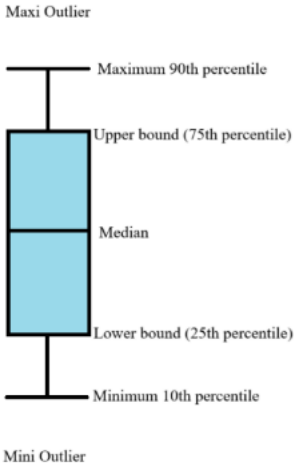


Figure 1. The Box plot shows the distribution of data

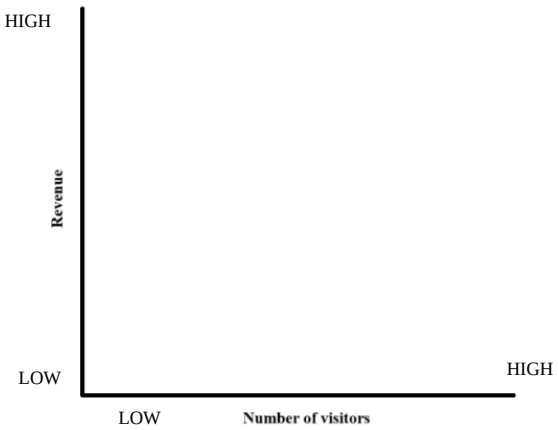


Figure 2. Strategic Positioning Map based on Number of Visitors (Low–High) and Revenue (Low–High)

RESULTS AND DISCUSSION

The results of this study will be classified into overall tourism, international tourism, and domestic tourism, considering the number of tourists and tourism revenue, as well as the uncertainty caused by the COVID-19 outbreak. The overall data on tourists by province revealed that many of Thailand's 77 provinces fell into the Maxi-outlier range. Bangkok (BKK) was the most significant Maxi-outlier, standing out the most from other provinces. Following Bangkok were Chon Buri (Chon), Kanchanaburi (KAN), Phuket, Prachuap Khiri Khan (PACHOB), Phetchaburi (PECHBURI), Chiang Mai, Nakhon Ratchasima (Nakornrajsrima), and Phra Nakhon Si Ayutthaya (Ayuthaya), all of which were clustered in the Maxi-outlier range. While there remains a significant difference in the number of tourists between first tier and second-tier provinces, this disparity is evident across the data range, including the maximum, upper bound, lower bound, and minimum levels, as shown in Figure 3. Figure 3 illustrates the impact of tourist adjustments on nine specific provinces, with Bangkok being the most affected. In contrast, the overall number of tourists in provinces outside these nine have remained relatively nearly stable from 2012 to 2023. In addition, the COVID-19 outbreak during 2020-2021 significantly impacted the overall number of tourists in the country. Bangkok experienced the most substantial decline, while the other eight provinces were less affected. The outbreak led to a decrease in tourist numbers across 68 other provinces, resulting in no significant difference between the upper-bound and lower-bound ranges of tourist numbers, which exhibited similar values as shown in Figure 4.

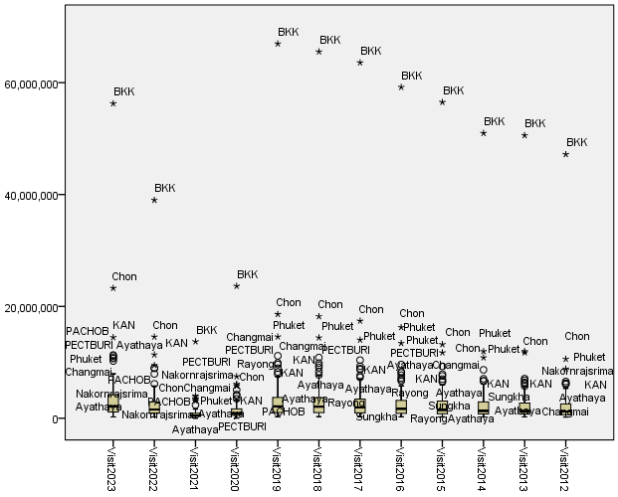


Figure 3. The box plot shows the distribution of tourism visitor data for each province from 2012 to 2023
(Source: Compiled by the author based on TAT data)

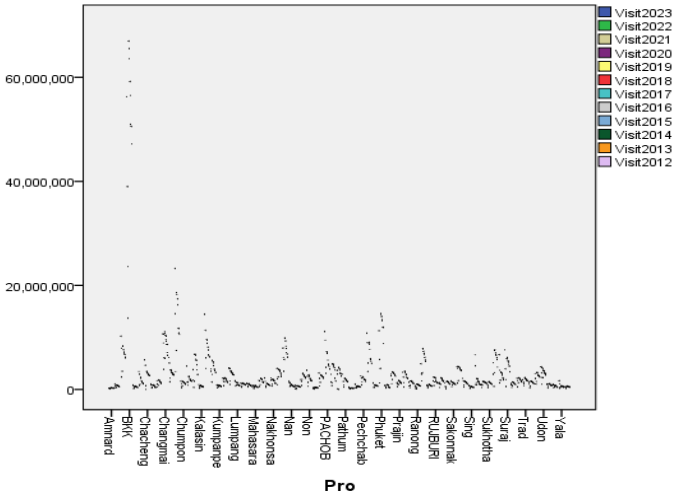


Figure 4. The data plot shows the number of tourists in each province from 2012 to 2023
(Source: Compiled by the author based on TAT data)

Figure 5 presents data on the number of foreign tourists across various provinces. Bangkok, Chonburi, and Phuket are identified as Maxi-outliers, exhibiting significantly higher numbers of foreign tourists compared to other provinces. Bangkok remains the province with the highest influx of foreign tourists. Other provinces within the Maxi-outlier range, such as Surat Thani, Chiang Mai, Songkhla, Krabi, Rayong, Chiang Rai, and Ayutthaya, display clustering patterns distinct from the top three provinces. In contrast, the distribution of foreign tourist data in the other provinces (especially in second-tier provinces) is stable and does not show significant variation. Figure 6 confirms that the distribution of tourists is concentrated in first-tier provinces, whereas several second-tier provinces have not experienced a significant increase in tourist numbers. The spread of COVID-19 has significantly impacted the number of foreign tourists.

The outbreak has directly affected first-tier major provinces, whereas second-tier provinces have remained largely unaffected due to the already low number of foreign tourists under normal circumstances as shown in Figure 5 and 6.

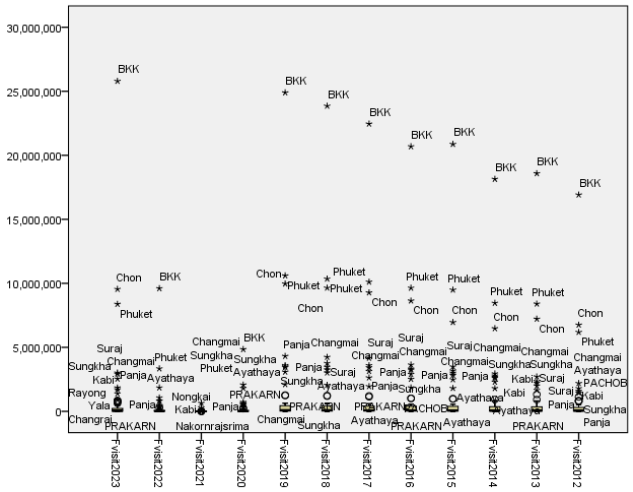


Figure 5. The box plot shows the distribution of foreign tourism visitor data for each province from 2012 to 202
(Source: Compiled by the author based on TAT data)

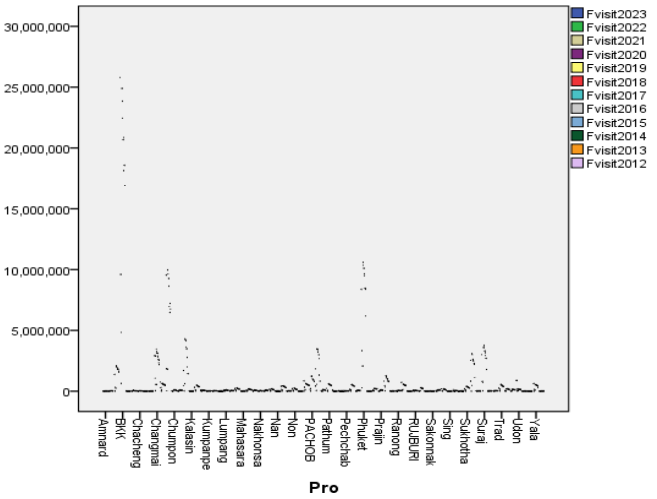


Figure 6. The data plot shows the number of foreign tourists in each province from 2012 to 2023
(Source: Compiled by the author based on TAT data)

The data on the number of domestic tourists reveals that Bangkok remains the province with the highest number of tourists, significantly outpacing other provinces. It is followed by Kanchanaburi, Chonburi, Prachuap Khiri Khan, Ayutthaya, Chiang Mai, Nakhon Ratchasima, Rayong, and Phetchaburi, among others. These provinces are categorized as Maxi-Outliers. Furthermore, an analysis of the data range, including the maximum, upper bound, lower bound, and minimum, indicates a significant difference in the number of domestic tourists between primary and secondary provinces, as shown in Figure 7. Figure 8 illustrates the distribution of foreign tourists across various provinces. The data reveals that most tourists concentrate in major first-tier provinces such as Bangkok. While secondary provinces also experience fluctuations in tourist numbers, these changes are not as pronounced as those in the main provinces. Nonetheless, the number of tourists in secondary provinces still shows significant variation. The COVID-19 pandemic has significantly impacted tourist numbers across various provinces, particularly in major first-tier countries. In other provinces, a noticeable decline in tourist numbers has resulted in a lower than normal for 2020 and 2021. This is evident from the maximum and upper bound values shrinking to approach the lower bound and minimum values, compared to other years.

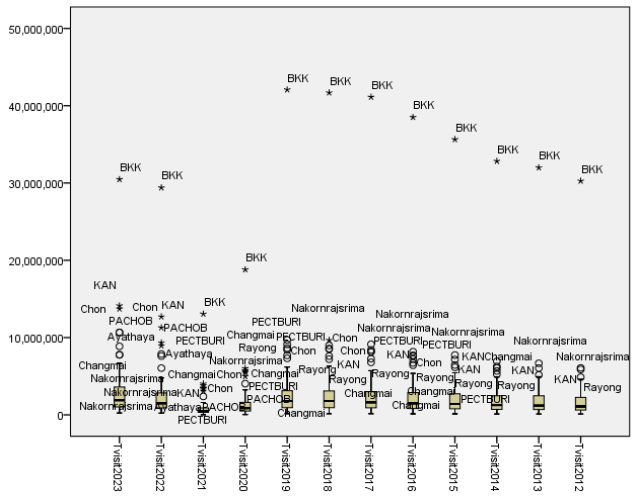


Figure 7. The box plot shows the distribution of domestic tourism visitor data for each province from 2012 to 2023
(Source: Compiled by the author based on TAT data)

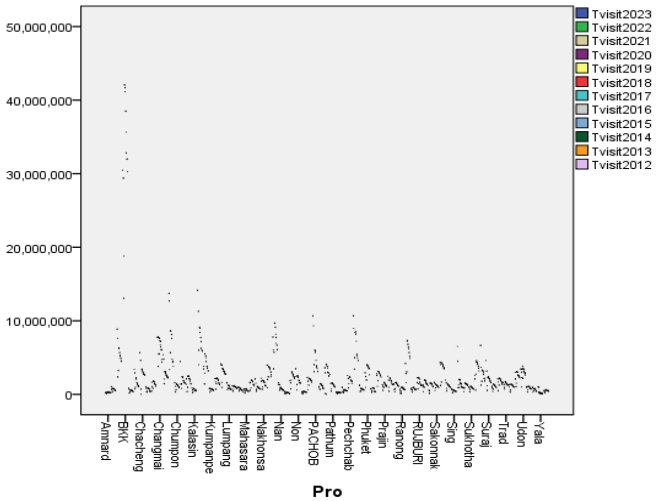


Figure 8. The data plot shows the number of domestic tourists in each province from 2012 to 2023
(Source: Compiled by the author based on TAT data)

The analysis of tourism income across 77 provinces revealed that Bangkok generated the highest revenue from tourism, significantly surpassing other provinces. Following Bangkok, the provinces of Phuket, Chon Buri, Surat Thani, Krabi, Chiang Mai, Chiang Rai, Songkhla, Phang Nga, Kanchanaburi, Prachuap Khiri Khan, and Phetchaburi also exhibited high income levels, classified as Maxi-outliers. In contrast, the remaining 65 provinces displayed relatively uniform tourism income levels, as illustrated in Figure 9. This pattern aligns with the distribution of tourism income, which is heavily concentrated in the primary provinces, leading to notable disparities in the data. Consequently, the other 65 provinces did

not experience significant annual variations in total tourism income as shown in Figure 10. While the COVID-19 outbreak has disproportionately impacted the income of the 12 major provinces, data presented in Figures 10 and 11 indicate that its effect on tourism in the remaining 65 provinces has been comparatively less severe. Furthermore, the situation in these 65 provinces does not significantly deviate from what would be expected under normal circumstances without an outbreak.

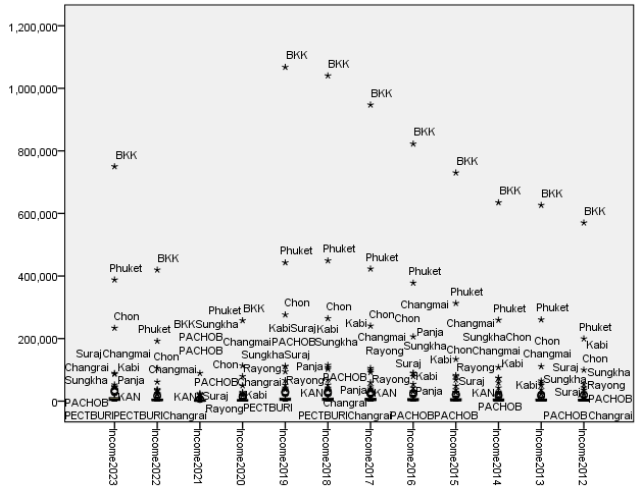


Figure 9. The box plot shows the distribution of income from tourism for each province from 2012 to 2023
(Source: Compiled by the author based on TAT data (2025)

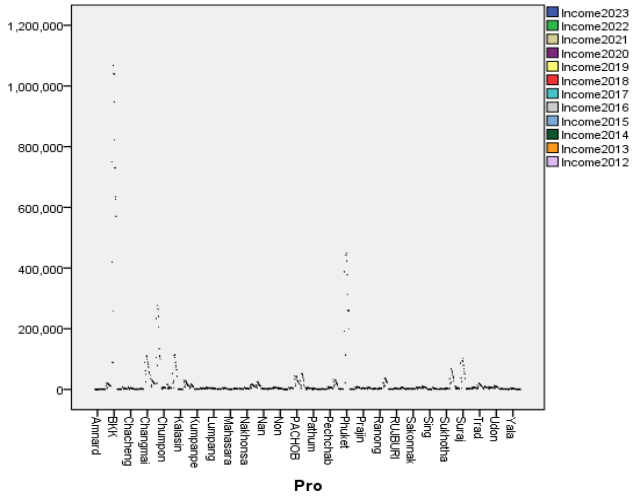


Figure 10. The data plot shows income from tourism in each province from 2012 to 2023
(Source: Compiled by the author based on TAT data)

In terms of income from domestic tourism, major provinces such as Bangkok continue to generate the highest revenue, significantly surpassing other provinces. Conversely, provinces like Chonburi, Chiang Mai, Prachuap Khiri Khan, Chiang Rai, Phuket, Surat Thani, and Krabi are notable for receiving higher income from foreign tourists, as indicated by their classification within the Maxi-outlier range. Additionally, the remaining 69 provinces exhibit minimal variation in tourism income, as illustrated by the data distribution in Figure 11 and the characteristics of the data in Figure 12.

The Covid-19 outbreak has significantly impacted income from domestic tourists, as well as overall tourism revenue. However, the recovery of income from domestic tourists has been more adversely affected than the total tourism income, particularly in the Bangkok area, as illustrated in Figure 11.

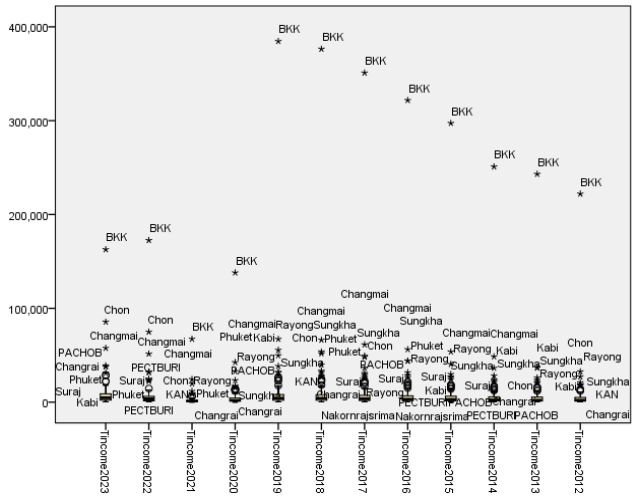


Figure 11. The box plot shows the distribution of income from domestic tourists data for each province from 2012 to 2023
(Source: Compiled by the author based on TAT data)

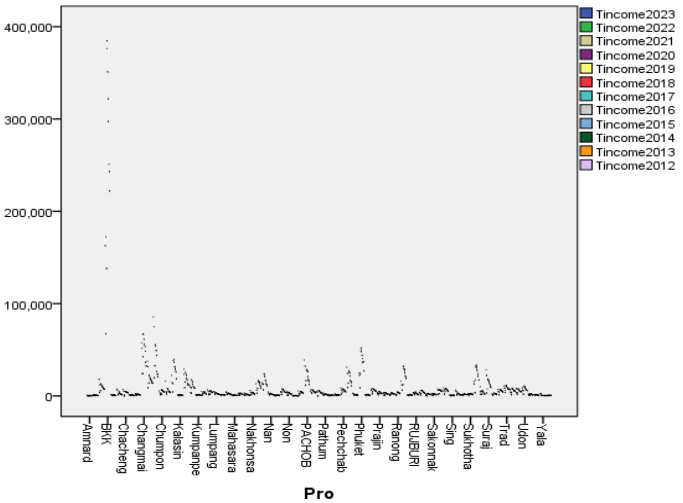


Figure 12. The data plot shows income from domestic tourists in each province from 2012 to 2023
(Source: Compiled by the author based on TAT data)

Income from foreign tourists shows that Bangkok remains the province with the highest income, followed by Chonburi. Additionally, Surat Thani, Songkhla, Chiang Rai, Rayong, Krabi, Phang Nga, Prachuap Khiri Khan, Chiang Mai, and Trat are provinces that receive significant income from tourists. In contrast, the remaining 65 provinces do not exhibit substantial changes in income from foreign tourists, as illustrated in Figures 13 and 14.

The spread of COVID-19 has directly impacted income from foreign tourists in major provinces more than in secondary provinces, particularly in Bangkok and Phuket. However, the recovery of income from foreign tourists has been rapid, with many major provinces nearing pre-outbreak income levels.

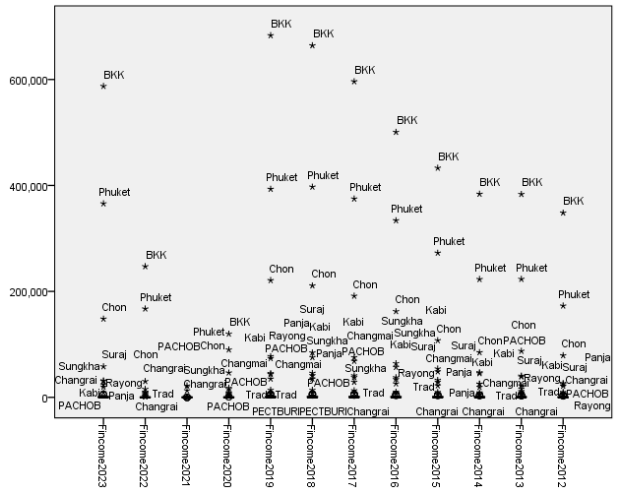


Figure 13. The box plot shows the distribution of income from foreign tourists' data for each province from 2012 to 2023
(Source: Compiled by the author based on TAT data)

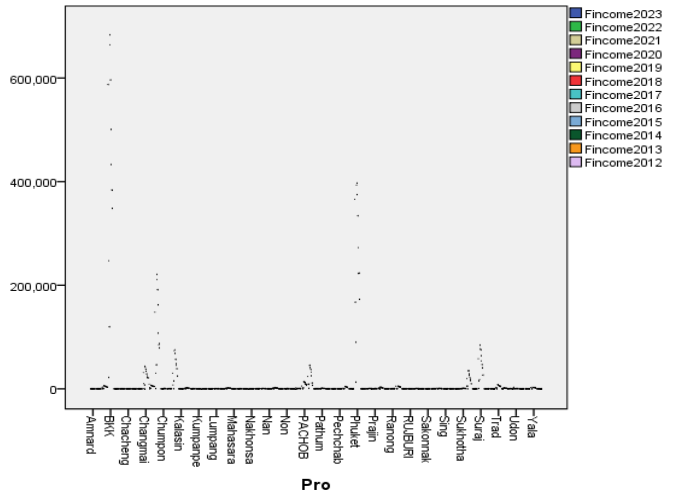


Figure 14. The data plot shows the income from foreign tourists in each province from 2012 to 2023
(Source: Compiled by the author based on TAT data)

Based on the above information, a heat map of Thailand can be created to display the number of tourists. This map will classify tourists into domestic and international categories, as well as show overall tourism, as illustrated in Figure 15 to 20.

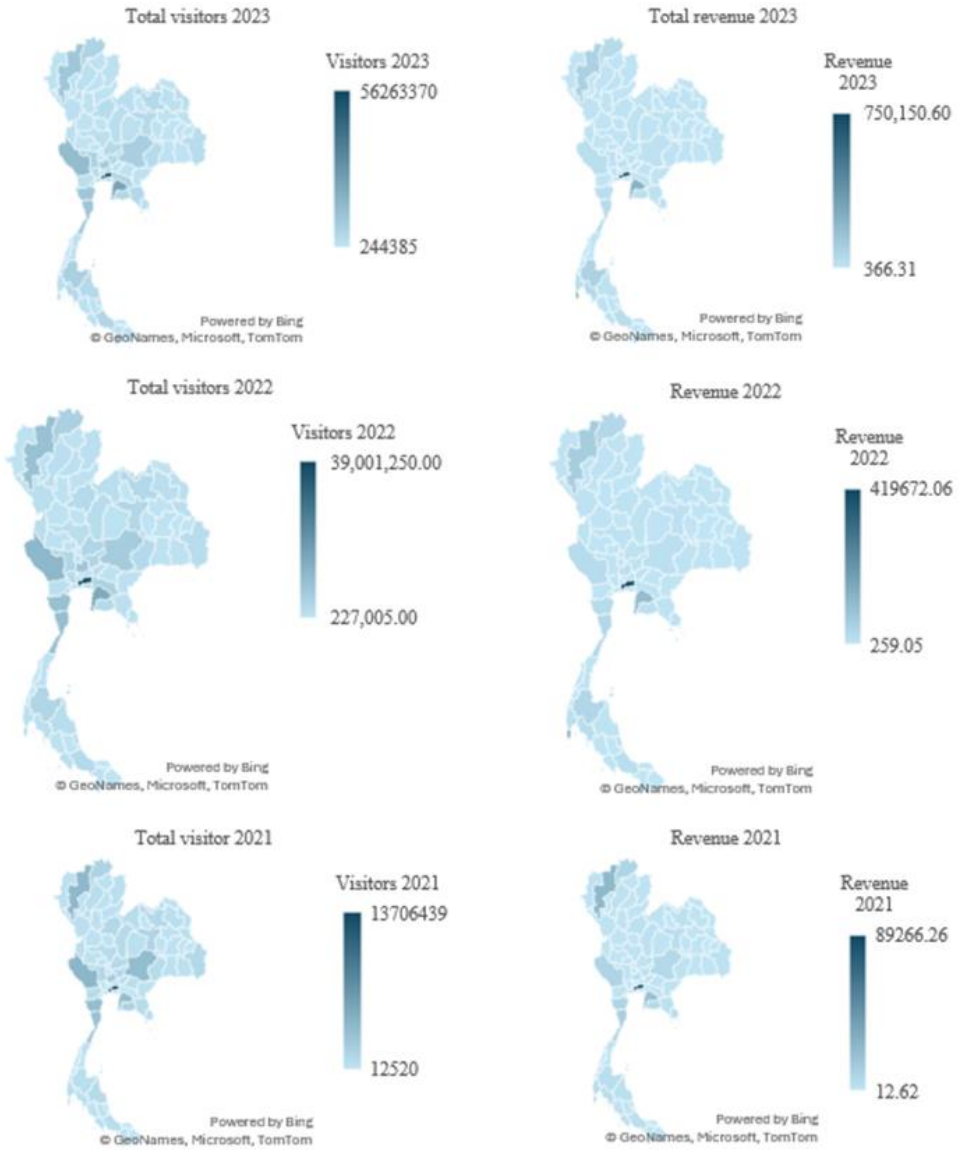


Figure 15. Heat map shows the total tourism visitors and total tourism revenue from 2023, 2022, 2021
(Source: Compiled by the author based on TAT data)

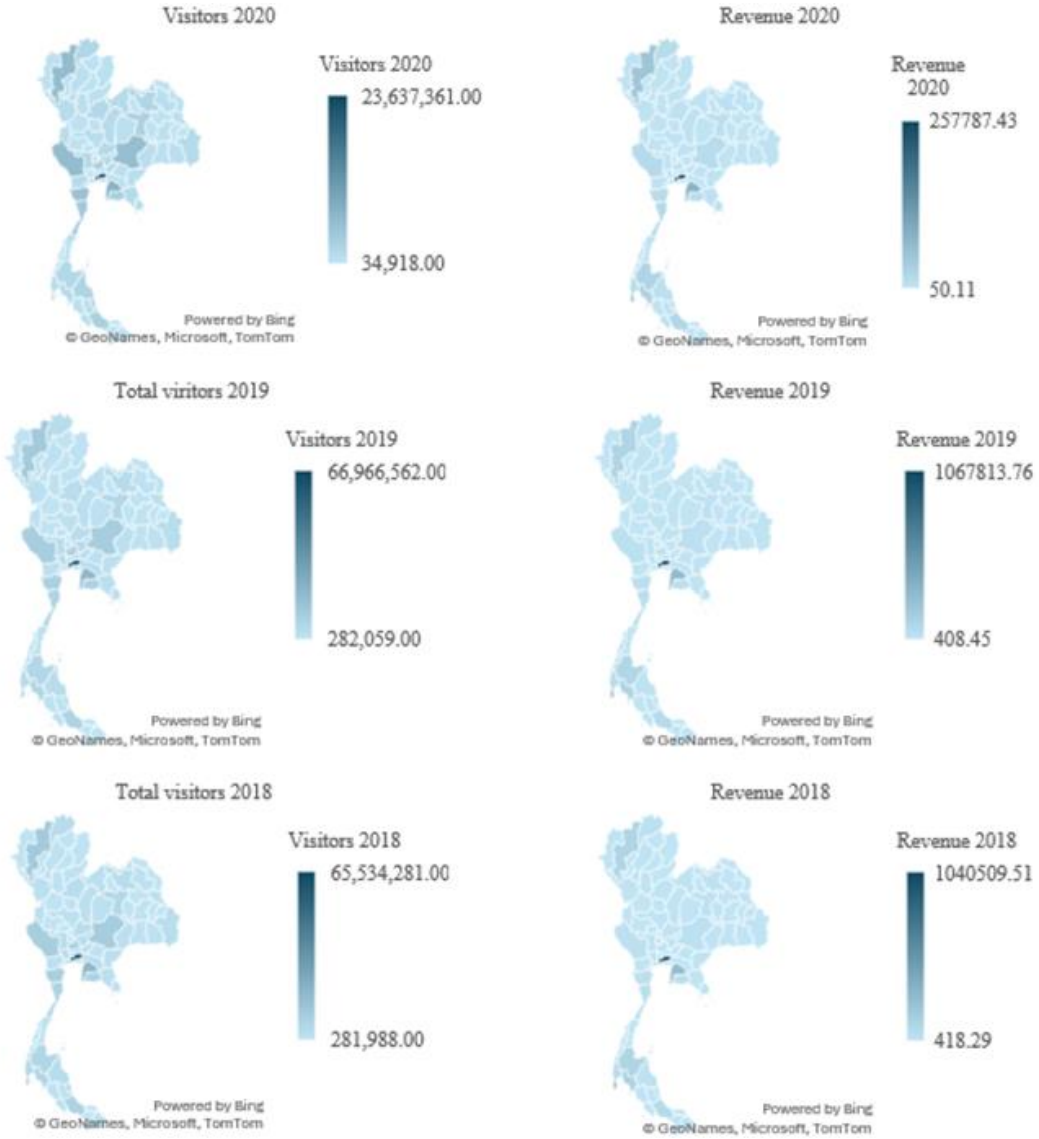


Figure 15. Heat map shows the total tourism visitors and total tourism revenue from 2020, 2019, 2018
(Source: Compiled by the author based on TAT data)

The findings indicate that: For overall tourism in the country, it was found that both income and the number of tourists are concentrated in a few main provinces, particularly Bangkok. Bangkok has the highest number of tourists and tourism income, significantly surpassing other provinces. In contrast, secondary provinces have a much lower number of tourists and tourism income compared to the main provinces, as illustrated in Figure 15. When analyzing the data using the Mapping Strategy Groups tool, as shown in Figure 16, it was found that Bangkok ranks among the top provinces in terms of the number of tourists and tourism income. Several factors contribute to this dominance. As the only metropolis in the country, Bangkok boasts the most extensive infrastructure and facilities, as well as the greatest cultural diversity. It serves as the central hub for job opportunities, business ventures, and various other prospects, making it difficult for other provinces to replicate its success.

Phuket, on the other hand, generates the second-highest tourism income after Bangkok and attracts a comparable number of tourists to other leading provinces. Its unique geographical features and infrastructure, such as a large port capable of accommodating tourists and supporting the construction of hotels, resorts, and luxury residences amidst beautiful natural scenery, draw a significant number of high-income tourists. This is another factor that is challenging for other provinces to imitate. Chonburi is also a notable tourism province, ranking just behind Bangkok in terms of tourist attractions.

Although it does not generate as much tourism income as Phuket, Chonburi benefits from its coastal location and proximity to Bangkok. Its infrastructure is similar to that of Bangkok, which has helped it become a frequent destination for tourists. This advantage sets it apart from other major tourism provinces that struggle to compete with Bangkok, Phuket, and Chonburi. In contrast, many secondary provinces are often overlooked by tourists due to their significantly fewer supporting factors compared to the leading provinces. In terms of domestic tourism, it was found that the number of tourists and income from domestic tourists were better distributed compared to overall tourism. The heat map indicates that the number of tourists and income from tourism were more evenly spread across various provinces. However, when all the data were analyzed using Mapping Strategy Groups, Bangkok remained the province with the highest number of tourists and income from domestic tourism, due to a lock-in factor that prevented other provinces from replicating its success.

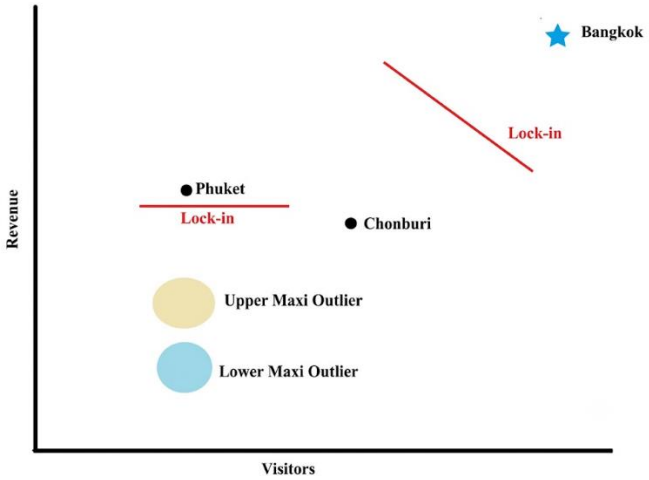


Figure 16. Mapping Strategy Groups for tourism in Thailand (Source: Compiled by the author based on TAT data)

Meanwhile, provinces such as Chonburi, Chiang Mai, Prachuap Khiri Khan, Phetchaburi, Kanchanaburi, Ayutthaya, and Nakhon Ratchasima had competitive advantages stemming from infrastructure and natural resources that attracted tourists. Despite these advantages, they did not possess a unique factor that prevented other provinces from imitating them. Therefore, tourism promotion policies could still play a significant role in enhancing tourism in secondary and neighboring provinces as shown in Figure 17 and 18.

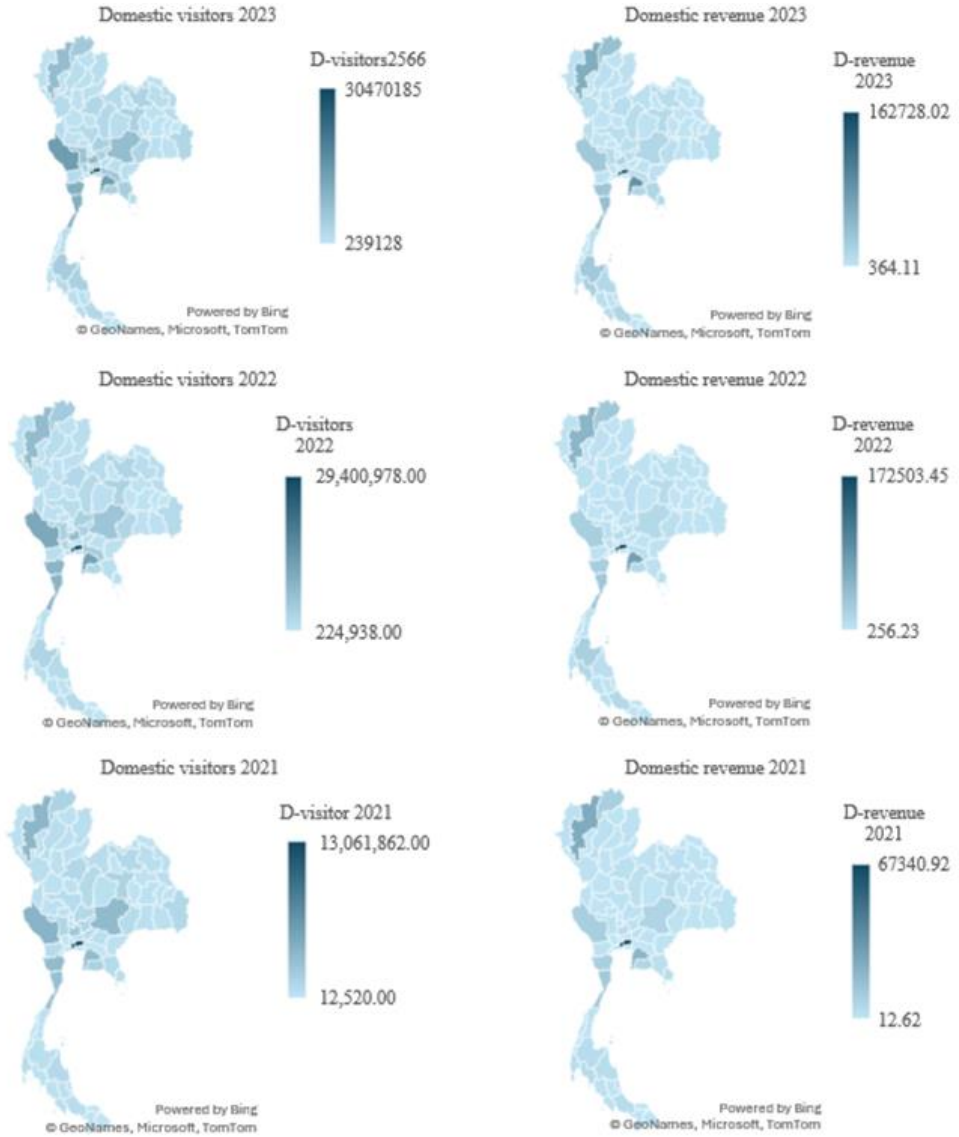


Figure 17. Heat map shows the domestic tourism visitors and domestic tourism revenue from 2023, 2022, 2021 (Source: Compiled by the author based on TAT data)

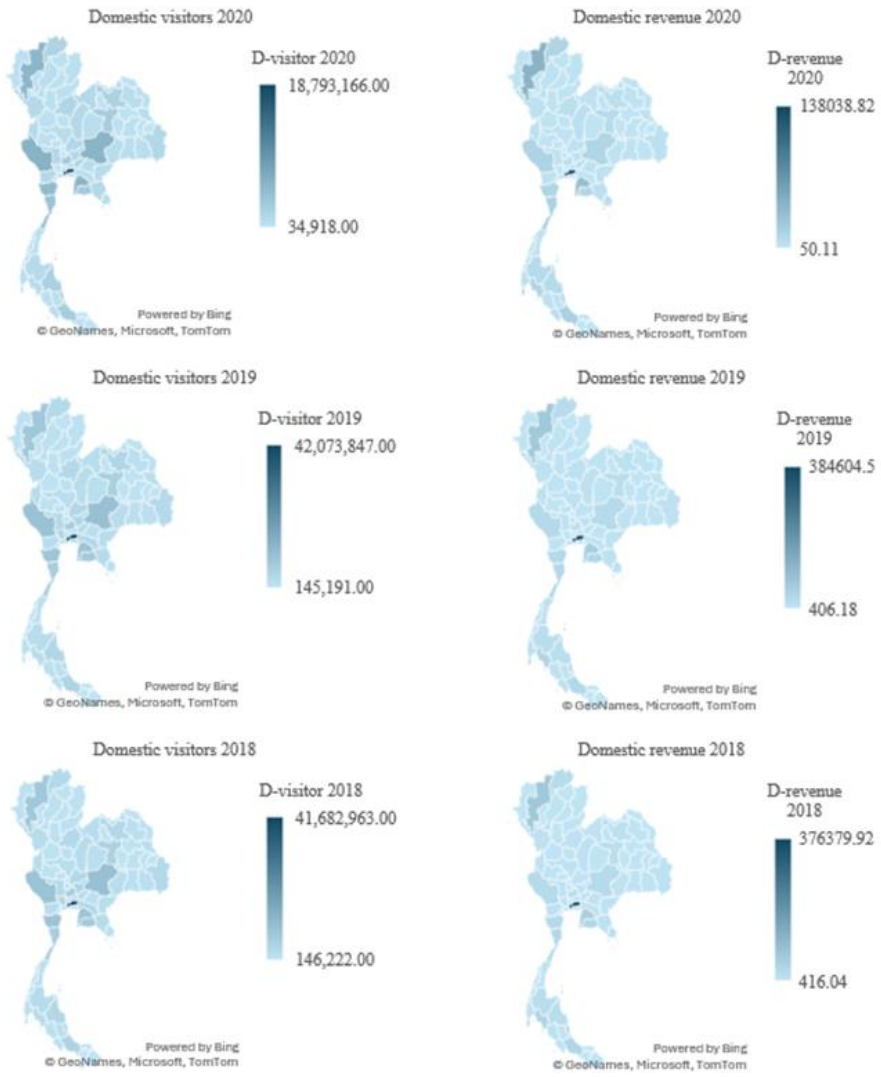


Figure 17. Heat map shows the domestic tourism visitors and domestic tourism revenue from 2020, 2019, 2018 (Source: Compiled by the author based on TAT data)



Figure 18. Mapping Strategy Groups for tourism form domestic tourist in Thailand (Source: Compiled by the author based on TAT data)

In the tourism sector, it was found that the provinces with the highest number of foreign tourists and tourism income were Bangkok, Phuket, and Chonburi, respectively. In contrast, other provinces failed to attract any tourists, as indicated by the data presented in the heat map in Figure 19. Further analysis using Mapping Strategy Groups revealed that Bangkok, Phuket, and Chonburi possess advantages in infrastructure and resources that facilitate and attract foreign tourists. Conversely, other provinces have fewer advantages in these factors, resulting in a clear competitive disadvantage (lock-in). Additionally, provinces such as Krabi, Surat Thani, Songkhla, and Chiang Mai have some infrastructure and natural resources that could attract tourists. However, there remains a significant disparity compared to the three main provinces shown in Figure 20.

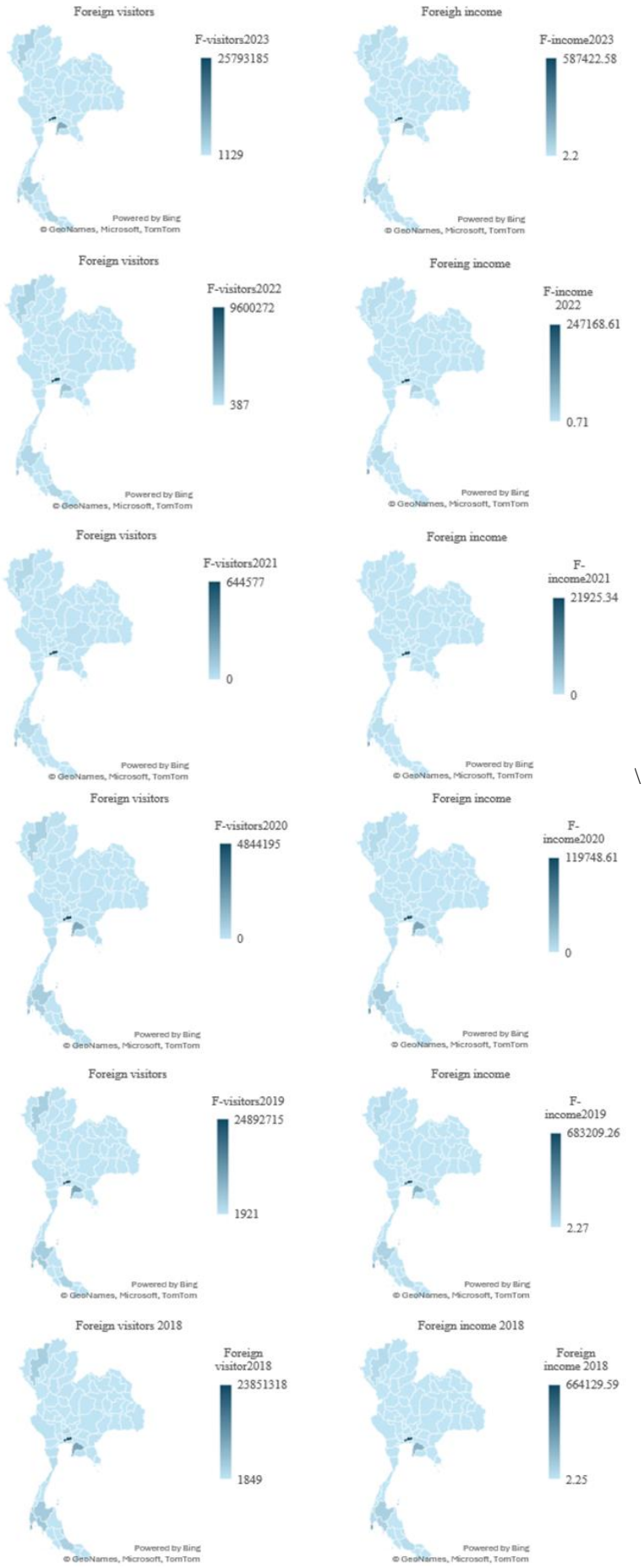


Figure 19. Heat map shows the foreign tourism visitors and revenue from foreign tourist 2018 to 2022 (Source: Compiled by the author based on TAT data)

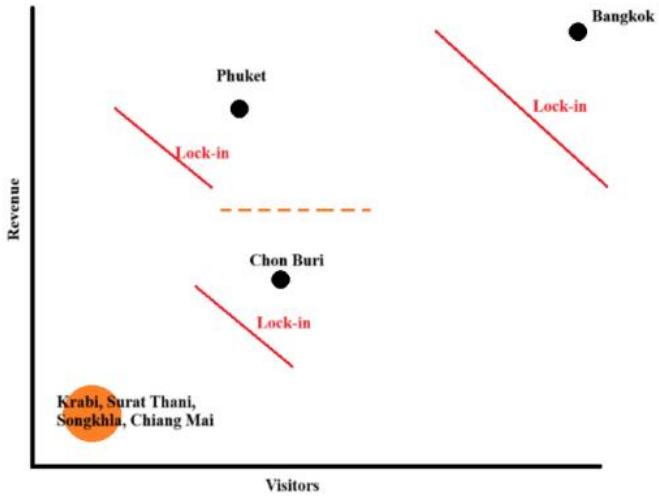


Figure 20. Mapping Strategy Groups for tourism form foreign tourist in Thailand (Source: Compiled by the author based on TAT data)

According to tourism data in Thailand from 2012-2023, tourism in Thailand remains concentrated in a few key provinces. When separating domestic tourism from foreign tourism, it is evident that foreign tourism continues to focus on major provinces such as Bangkok, Chonburi, and Phuket. However, domestic tourism has expanded to a wider variety of provinces, including Krabi, Surat Thani, Songkhla, and Chiang Mai.

Other secondary provinces attract some Thai tourists, but the overall picture of Thai tourism shows that Bangkok, Chonburi, and Phuket are the three main provinces. Chiang Mai, Prachuap Khiri Khan, Phetchaburi, Kanchanaburi, Ayutthaya, and Nakhon Ratchasima have a fair number of tourists but cannot compete in terms of income with the three main provinces. Based on the above data, we can analyze the SWOT and define the TOWS Matrix strategy as follows. The analysis of the external environment enables us to identify and categorize the opportunities and threats facing Thai tourism as follows:

Opportunities: Increased travel and flights, the rise in the number of foreign tourists (including new groups from China and India), government tourism promotion policies, and public and private sector promotions have all contributed to the growth of the tourism industry.

Treat: Countries with significant potential for tourism in ASEAN include Vietnam, Malaysia, Indonesia, the Philippines, and Singapore. These nations face various challenges such as geopolitical issues, trade wars, fluctuations in the global economy, and uncertain events. Additionally, alongside global uncertainties, local environmental challenges such as air pollution continue to negatively affect the overall number of tourists and the pace of recovery in Thailand (Nonthapot et al., 2024). For the analysis of the internal environment, the strengths and weaknesses of the country's tourism can be classified as follows:

Strength: The cost of tourism is low, and the infrastructure is quite comprehensive, particularly in large cities. Accommodation and food are abundant and diverse, with excellent service and beautiful natural resources.

Weakness: Convenient and comprehensive infrastructure is predominantly available in the Bangkok area, while other provinces have limited public transportation options. Accommodation, shops, and service businesses are concentrated mainly in the primary tourist areas of these provinces. Natural resources that attract tourists are concentrated in only a few provinces. The lack of a unique identity in secondary provinces makes tourists perceive them as less worthwhile destinations. Additionally, tourism relies heavily on income from foreign tourists.

From the SWOT analysis, we can derive strategies using the TOWS Matrix as follows:

Maxi-Maxi Strategy (SO): Develop packages and campaigns to attract tourists by enhancing the potential of transportation systems. Improve connections to airports and various tourist attractions to make them more convenient, thereby drawing more visitors to key landmarks. Enhance the quality-of-service systems to create a memorable experience and engage with tourists. Additionally, maintain and improve the aesthetics of tourist attractions and natural resources, ensuring they remain clean and beautiful at all times.

Maxi Mini Strategy (ST): Monitor competitors and adjust response strategies to build confidence, improve service quality, and optimize tourism costs, thereby creating competitive advantages. Ensure equal acceptance of tourists, regardless of race, religion, or language. Establish joint ventures and strategic alliances in various countries to promote tourism and mitigate geopolitical issues. Advocate for government implementation of neutral policies to maintain Thailand's political neutrality.

Mini Maxi Strategy (WO): To promote tourism in secondary cities for foreign tourists, several strategies can be implemented:

1. Organize Tours: Develop and offer organized tours that highlight the unique attractions of secondary cities.
2. Improve Transportation: Enhance both inter-provincial and intra-provincial travel and transportation channels to make these destinations more accessible.
3. Promote Local Businesses: Support and promote potential shops and accommodations in secondary provinces to boost local economies.

4. Highlight Unique Identities: Emphasize the distinct identities and charms of each province to attract tourists. Furthermore, integrating smart tourism technologies like augmented reality with local art routes can significantly enhance tourist engagement in secondary destinations like Songkhla (Trakulmaykee et al., 2025).

5. Create Attractive Packages: Develop tourism packages that include secondary provinces alongside main provinces, offering them at attractive prices to increase awareness.

6. Utilize Media: Publicize secondary provinces through various media channels to ensure foreign tourists are aware of these destinations

Mini Mini Strategy (WT): Promote tourism among high-income and high-spending domestic tourists to encourage more travel within Thailand. Enhance confidence, improve the environment, and develop infrastructure and facilities to attract potential foreign tourists to settle down.

CONCLUSION

From the literature review, data analysis, and SWOT analysis, it was found that the tourism sector is a key driver of the economy, generating economic circulation and effectively distributing income across various sectors. This is particularly true in developed countries, which benefit from robust infrastructure, facilities, and a variety of attractive tourist attractions and landmarks. In contrast, the situation in developing countries differs, particularly in terms of income distribution.

In these countries, tourism income is often concentrated in major urban areas and large business groups, rather than being distributed to communities. This is due to a lack of comprehensive basic facilities and the absence of attractive tourist attractions and significant landmarks in secondary provinces. As a result, these countries struggle to attract repeat visitors or regular tourists, as there is a lack of variety and uniqueness in each area. This makes tourism experiences in these regions monotonous, often leading to a one-time visit being sufficient for travelers.

Similar to the tourism situation in Thailand, income and tourists are concentrated in only a few important provinces, particularly Bangkok, Phuket, and Chonburi. Other provinces receive significantly less income from tourism due to insufficient infrastructure and facilities, as well as a lack of identity and charm to attract tourists. These factors prevent other provinces from competing equally with Bangkok, Phuket, and Chonburi (Pattaya).

When considering SWOT analysis along with basic information, it is evident that Thailand lacks distributed facilities and infrastructure beyond Bangkok and its vicinity. This results in tourists and tourism income being concentrated in Bangkok, with some distribution to Chonburi due to its beaches, tourist facilities, and numerous leading hotels. Chonburi's proximity to Bangkok (only an hour and a half by car) also contributes to this concentration. Meanwhile, Phuket attracts tourists with its beautiful natural resources, including beaches and mountains, as well as important ports and yacht piers that serve as gateways to islands and tourist beaches along the Andaman coast.

Additionally, Phuket's many luxury hotels and resorts appeal to high-income tourists. Data indicates that Thailand's tourism industry relies heavily on these three provinces. Other provinces are secondary destinations for tourists who have already visited Bangkok, Phuket, or Chonburi. Consequently, tourists, especially foreigners, are less likely to return to Thailand multiple times due to the lack of sufficient attractions.

Domestic tourism generates relatively little income compared to foreign tourism.

To address this, Thailand must adjust its tourism strategies by focusing on distributing infrastructure and facilities to other important and secondary tourism provinces. Strategies should also include promoting and encouraging tourists to explore other provinces. Additionally, promoting the uniqueness and landmarks of each area can create awareness and value among tourists. A more distributed and diverse tourism approach will attract repeat visits from foreign tourists and high-income Thai tourists who typically travel abroad. Thailand's beautiful natural resources, excellent service, diverse hotels, accommodations, and food (especially street food), along with low travel costs, are attractive to tourists. However, this advantage is not sustainable and can be easily challenged by competitors from neighboring ASEAN countries such as Vietnam or Malaysia, as well as countries with high tourism potential like Japan. Therefore, Thailand needs to adjust its tourism strategy to create a competitive advantage and generate more economic benefits.

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TRANSPORT ACCESSIBILITY AND TOURIST EXPERIENCE AS DRIVERS OF SUSTAINABLE DESTINATION: A CASE STUDY OF KOSOVO

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Abstract: Transport infrastructure represents a fundamental spatial component shaping tourist mobility patterns and the sustainability of destinations. Despite extensive research on tourism development, limited attention has been given to the relationship between transport accessibility and tourist experience in emerging destinations. This study analyzes how transport infrastructure influences visitor satisfaction and sustainable tourism development, with a case study focusing on Kosovo. The research applies a quantitative approach based on a structured questionnaire administered to 97 tourists visiting different destinations. Descriptive and comparative statistical analyses were used to evaluate perceptions of road infrastructure, public transport accessibility, alternative mobility options and information availability. The methodological approach follows similar quantitative designs applied in recent tourism studies in Kosovo. The findings indicate that transport quality significantly affects tourist satisfaction, particularly road conditions and travel comfort, accessibility, safety, and overall travel convenience. While limited public transport accessibility and insufficient information reduce destination attractiveness. The results also show moderate interest in sustainable mobility, suggesting that improving alternative transport infrastructure can enhance both visitor experience and environmental sustainability. The study highlights that accessibility is not only a logistical factor but also a strategic component of destination competitiveness. Furthermore, the findings emphasize that better integration of transport planning with tourism policies, improved multimodal connectivity, and greater investment in sustainable mobility solutions can strengthen destination accessibility, enhance visitor satisfaction, increase tourism competitiveness, and contribute to the long-term sustainable development of tourism in Kosovo and other emerging destinations. Integrating transport planning with tourism policies is essential for balancing tourism growth and environmental protection in emerging destinations.

Keywords: transport accessibility, tourist experience, sustainable tourism, mobility, destination competitiveness, Kosovo

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INTRODUCTION

Tourism development is strongly dependent on spatial accessibility, which determines the ability of visitors to reach, explore and experience destinations. Among the different components of destination competitiveness, transport infrastructure represents a critical factor influencing tourist mobility patterns, travel comfort and overall satisfaction. Accessibility conditions not only shape the attractiveness of destinations but also influence the distribution of tourist flows and the intensity of tourism activities. Recent tourism research increasingly links mobility systems with sustainable development, emphasizing that transport affects environmental pressure, spatial concentration of visitors and the socio-economic benefits generated for local communities. Efficient and integrated transport networks facilitate movement between attractions, reduce travel uncertainty and improve the perceived quality of the tourism product, while inadequate infrastructure may limit visitation and negatively affect destination image. Although the relationship between transport and tourism has been widely discussed, limited empirical research has examined how accessibility conditions influence tourist experience in emerging destinations, particularly in Southeast European transition economies.

In these contexts, rapid tourism growth is often not accompanied by coordinated transport planning, creating imbalances between development and environmental sustainability. To address this gap, this study investigates the influence of transport infrastructure on tourist experience and sustainable destination development using a quantitative approach based on visitor perceptions. The research evaluates road infrastructure quality, public transport accessibility, alternative mobility

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options and information availability as determinants of satisfaction and destination competitiveness. The findings aim to support integrated planning strategies linking transport policy and tourism development in order to achieve sustainable territorial growth. Based on the identified research gap, this study aims to evaluate the relationship between transport accessibility and tourist satisfaction, identify the main accessibility barriers affecting tourist mobility within destinations, and assess the contribution of sustainable mobility options to destination competitiveness and sustainability.

Accordingly, the study addresses the following research questions: **(RQ1)** How does transport accessibility influence tourist satisfaction and the overall travel experience? **(RQ2)** What accessibility barriers limit tourist mobility within destinations? **(RQ3)** Do sustainable mobility options contribute to perceived destination sustainability? Based on these research questions, three hypotheses were formulated: **H1:** Higher perceived quality of transport infrastructure is positively associated with tourist satisfaction. **H2:** Limited transport accessibility negatively affects tourists' perceived ease of movement within the destination. **H3:** The availability of sustainable mobility options, including public transport and alternative transport modes, positively influences perceived destination sustainability.

Transport constitutes a fundamental component of the tourism system because it determines the physical accessibility of destinations and the possibility of experiencing tourism products. Accessibility connects tourist-generating regions with destination areas and enables participation in tourism activities (Page, 2009). Consequently, the quality of transport infrastructure influences not only visitation levels but also visitors' perceptions of destination attractiveness and their intention to revisit. Transport functions as an interface between tourists and destinations, shaping first impressions through travel time, comfort, safety, and cost (Prideaux, 2000). Therefore, the travel phase should be considered an integral part of the tourism experience rather than merely a logistical stage preceding the visit. Recent studies emphasize that the tourist experience begins before arrival at the destination, during the planning and travel stages. Difficult, unsafe, or uncomfortable transport conditions may generate negative perceptions even when the destination itself offers high-quality attractions (Dileep & Kurien, 2021). As a result, mobility conditions influence tourist satisfaction and post-visit behavioural intentions (Thompson & Schofield, 2007).Empirical evidence from emerging tourism destinations indicates that visitor perceptions and destination competitiveness are strongly shaped by infrastructure quality and supporting development strategies (Tahiri et al., 2025). These findings highlight the importance of accessibility conditions in forming the overall tourism experience. Furthermore, digitalisation has expanded the role of mobility systems in tourism.

Access to online booking systems, real-time transport information, and navigation applications reduces travel uncertainty and improves destination usability. Mobility convenience has therefore become an increasingly important competitive factor in destination choice, particularly for younger generations of tourists (UNWTO, 2022). Overall, the literature demonstrates that perceived transport quality directly affects tourist satisfaction and behavioural intentions, supporting the assumption that accessibility constitutes a key determinant of the tourist experience.

Transport infrastructure and sustainable tourism development

Sustainable tourism development requires balancing economic growth with environmental protection and social well-being. Within this framework, transport infrastructure plays a strategic role because it simultaneously enables tourism activity and generates environmental pressures. Accessibility improvements increase visitation and economic benefits, while intensive motorised mobility contributes to emissions, congestion and spatial pressure on destinations (Dickinson & Robbins, 2008). Consequently, transport planning has become a central component of sustainability-oriented destination management. Public transport is widely recognised as a mechanism for improving both sustainability and social equity in tourism. Reliable and affordable services therefore contribute not only to mobility efficiency but also to the attractiveness and quality of the tourist experience (Parahoo et al., 2014). Unlike private car dependency, collective transport systems facilitate broader access to attractions, support spatial distribution of visitors and reduce environmental impact. Regular, reliable and affordable services therefore contribute not only to mobility efficiency but also to the equitable distribution of tourism benefits among different social groups (Beirão & Cabral, 2007).

Recent tourism strategies increasingly incorporate alternative and low-carbon mobility solutions, including walking infrastructure, cycling routes and shared mobility services. These approaches reduce environmental externalities while simultaneously enhancing the experiential quality of destinations by supporting slower and place-based forms of tourism. Technological innovations such as smart mobility systems, real-time information platforms and renewable energy transport solutions further reinforce the transition toward sustainable travel behaviour (UNEP, 2022).

In emerging destinations, the effectiveness of sustainable mobility depends on coordinated governance and policy implementation. Empirical research in Kosovo highlights the importance of integrated development strategies and institutional engagement in supporting sustainable tourism outcomes (Tahiri et al., 2025).

Overall, the literature indicates that sustainable destination development depends not only on transport infrastructure quality but also on the availability of alternative mobility options and policy coordination, supporting the assumption that sustainable transport contributes to perceived destination sustainability.

Public policies and investments in transport for sustainable tourism

The development of transport infrastructure in tourism destinations depends largely on public policy frameworks and long-term strategic investments. Governments play a central role in coordinating land-use planning, transport networks and environmental protection measures in order to support sustainable destination development (Hall, 2008). Integrated policies align mobility systems with tourism growth, preventing uncontrolled spatial expansion and environmental degradation. Effective transport planning also requires continuous monitoring and evaluation. Infrastructure should not be considered a

completed intervention after construction but a dynamic process requiring performance assessment over time (Li et al., 2021). Indicators such as emission reduction, accessibility improvement, visitor satisfaction and local economic impact are essential for evaluating the sustainability of transport investments (Kovaçi et al., 2023). Contemporary policy approaches increasingly incorporate digitalisation and smart mobility solutions (Myrovali et al., 2025). Real-time transport information, shared mobility services and integrated payment systems improve operational efficiency while reducing congestion and environmental pressure (UNEP, 2022). These measures demonstrate that governance quality and institutional coordination are critical determinants of sustainable tourism outcomes, particularly in developing destinations.

Overall, the literature indicates that transport sustainability depends not only on infrastructure provision but also on policy effectiveness and institutional capacity to manage mobility systems. The development of transport infrastructure in tourism destinations depends largely on public policy frameworks and long-term strategic investments (Khadaroo & Seetanah, 2007). Sustainable tourism development requires balancing economic growth with environmental protection and social well-being. Within this framework, transport infrastructure plays a strategic role because it simultaneously enables tourism activity and generates environmental pressures. Improvements in accessibility increase visitation and economic benefits, while intensive motorised mobility contributes to emissions, congestion, and spatial pressure on destinations (Dickinson & Robbins, 2008). Consequently, transport planning has become a central component of sustainability-oriented destination management. Public transport is widely recognised as a mechanism for improving both sustainability and social equity in tourism. Reliable and affordable services contribute not only to mobility efficiency but also to the attractiveness and quality of the tourist experience (Parahoo et al., 2014). Unlike private car dependency, collective transport systems facilitate broader access to attractions, support the spatial distribution of visitors, and reduce environmental impacts.

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Overall, the literature indicates that sustainable destination development depends not only on transport infrastructure quality but also on the availability of alternative mobility options and effective policy coordination, supporting the assumption that sustainable transport contributes to perceived destination sustainability. The development of transport infrastructure in tourism destinations depends largely on public policy frameworks and long-term strategic investments. Governments play a central role in coordinating land-use planning, transport networks, and environmental protection measures to support sustainable destination development (Hall, 2008). Integrated policies align mobility systems with tourism growth, preventing uncontrolled spatial expansion and environmental degradation. Effective transport planning also requires continuous monitoring and evaluation. Infrastructure should not be considered a completed intervention after construction but rather a dynamic process requiring regular performance assessment over time (Li et al., 2021).

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Transport infrastructure also represents a structural component of the tourism product because it shapes the visitor experience throughout all travel stages, from trip planning to on-site mobility (Page, 2009). Accessibility conditions influence perceived convenience, travel effort, and the ability to participate in tourism activities within the destination (Chen et al., 2025). Visitor satisfaction is strongly associated with transport attributes such as travel time, comfort, safety, reliability, and service frequency (Swarbrooke & Horner, 2006). When these conditions are favourable, tourists tend to engage in more activities and develop positive perceptions of the destination.

Recent studies show that tourists increasingly value environmentally friendly mobility systems (Kim et al., 2024). The availability of sustainable transport options, including cycling infrastructure, shared mobility, and clean vehicles, enhances destination image and aligns with visitors' environmental attitudes (ETC, 2018). Consequently, transport quality contributes both to experiential value and to perceived destination responsibility. Moreover, the rapid digital transformation of the tourism sector has created new opportunities to enrich tourist experiences through technologies such as Virtual Reality (VR) and Artificial Intelligence (AI). For example, research from Vietnam demonstrates that digital innovations, including virtual destination previews and AI-powered travel assistants, are transforming the way tourists plan, experience, and evaluate their journeys (Dang & Duong, 2025). These developments indicate that modern transport systems are increasingly integrated with digital technologies to improve accessibility, convenience, and visitor satisfaction. Building upon this body of literature, the present study examines the role of transport infrastructure and mobility conditions in shaping tourists' experiences, satisfaction, and perceptions of destination accessibility and sustainability in Kosovo.

METHODOLOGY

Research design and data collection

This study applies a quantitative research design to examine the relationship between transport infrastructure and tourist experience. Primary data were collected through a structured questionnaire administered to tourists visiting several destinations in Kosovo. The survey approach was selected because visitor perception represents a key indicator for evaluating accessibility conditions and experiential quality in tourism research. The questionnaire included items measuring perceived transport infrastructure quality, accessibility, travel comfort, travel time and the use of sustainable mobility options. Responses were recorded using a five-point Likert scale, allowing the measurement of attitudes and satisfaction levels related to mobility conditions within destinations. Collected data were analysed using descriptive and inferential statistical methods. Descriptive statistics were used to evaluate general perception patterns, while association analysis was applied to examine relationships between transport accessibility and tourist satisfaction.

This methodological approach enables empirical testing of the proposed hypotheses regarding the influence of transport infrastructure on visitor experience and perceived sustainability.

Sample and measurement variables

The study is based on a field survey conducted among tourists visiting multiple destinations in Kosovo. A total of 97 valid questionnaires were collected and used for analysis. Respondents were selected using a random intercept approach in tourism areas in order to capture diverse visitor profiles and travel behaviours.

The questionnaire consisted of closed-ended questions measured on a five-point Likert scale (1 = very low to 5 = very high). The instrument included three groups of variables:

- Transport infrastructure quality (road conditions, safety, travel time, comfort)
- Accessibility and mobility (ease of movement, public transport availability, information availability)
- Sustainable mobility perception (use of alternative transport modes and environmental awareness)

Data were processed using SPSS statistical software. Descriptive statistics were used to examine overall perception patterns, while association analysis was applied to evaluate the relationship between transport accessibility and tourist satisfaction and to test the proposed hypotheses.

Ethical considerations

Participation in the survey was voluntary and anonymous. Respondents were informed about the purpose of the study and their right to withdraw at any time. No personally identifiable information was collected, ensuring confidentiality and compliance with standard research ethics guidelines.

RESULTS

Sample characteristics

The study included 97 respondents. In order to improve the visibility of the demographic data, the sample characteristics are presented separately according to gender, age group, origin and education level. As shown in Figure 1, the gender distribution of the sample was relatively balanced. Female respondents represented 53.6% of the sample, while male respondents represented 46.4%. This balance provides a more inclusive overview of tourist perceptions across both gender groups. Figure 2 shows that the largest age group was 26–35 years, representing 36.1% of respondents. This was followed by the 18–25 age group, which accounted for 28.9%.

Respondents aged 36–50 represented 21.6%, while those over 50 formed the smallest share, with 13.4%. Overall, the sample is mainly composed of young and middle-aged tourists.

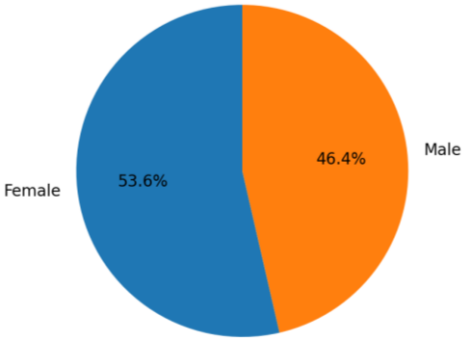


Figure 1. Gender distribution of respondents (n= 97) (Source: Author's own survey data)

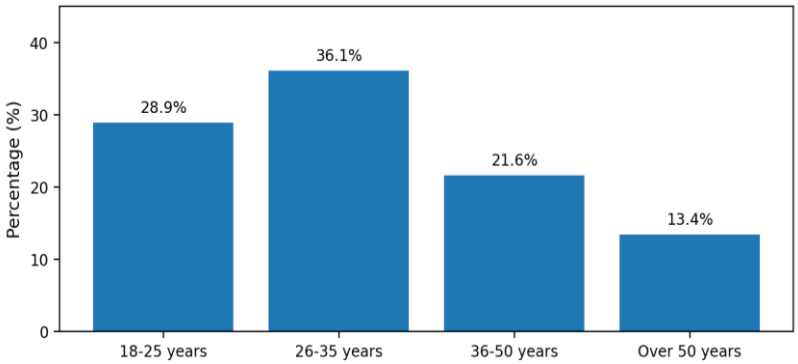


Figure 2. Age distribution of respondents (n= 97) (Source: Author's own survey data)

As presented in Figure 3, international visitors made up 56.7% of the sample, while domestic tourists represented 43.3%. This indicates that the study includes perspectives from both foreign and local tourists, which is important for understanding how transport infrastructure and accessibility are perceived by different types of visitors. Figure 4 shows that most respondents had a higher education background. Nearly half of the sample held a Bachelor's degree, while 32.0% had

a Master's degree or higher. The remaining 18.5% belonged to other education levels. This suggests that the sample is relatively well educated and likely able to provide informed evaluations of transport quality, accessibility and sustainable mobility conditions. Overall, the sample reflects a diverse group of respondents in terms of gender, age, origin and education. These characteristics are relevant for the study because tourists' demographic profiles may influence how they perceive transport infrastructure, mobility conditions and destination accessibility in Kosovo.

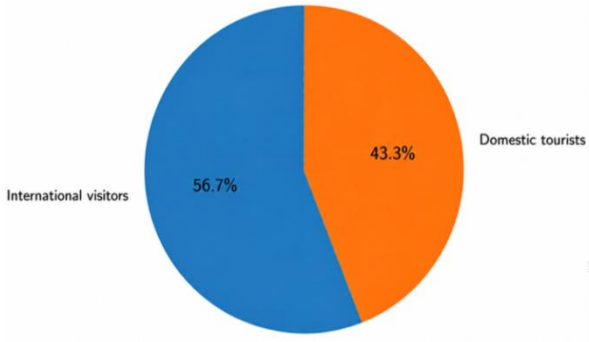


Figure 3. Origin of respondents (n= 97)
(Source: Author's own survey data)

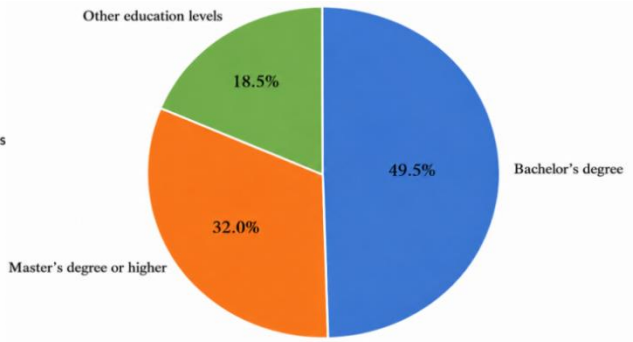


Figure 4. Education level of respondents (n= 97)
(Source: Author's own survey data)

Transport infrastructure perception

Tourists reported a moderately positive perception of road infrastructure, with a mean value of 3.7/5 and 62% of respondents expressing satisfaction. These findings indicate an acceptable basic level of accessibility, although infrastructure quality still leaves room for improvement in terms of destination competitiveness.

Public transport accessibility received lower evaluations, with a mean value of 3.4/5 and only 57% of respondents considering it easily accessible. The results suggest the existence of mobility barriers within destinations, particularly related to information availability, service frequency and connectivity between tourist attractions.

Overall, the results indicate that while primary access to destinations is relatively satisfactory, internal mobility remains a limiting factor for the tourist experience and may reduce the potential for sustainable travel behaviour.

Transport quality and sustainable mobility perception

Respondents strongly confirmed the importance of transport quality for the tourism experience. In order to improve the visibility of the results, the main findings related to transport quality and sustainable mobility are presented in Figure 5.

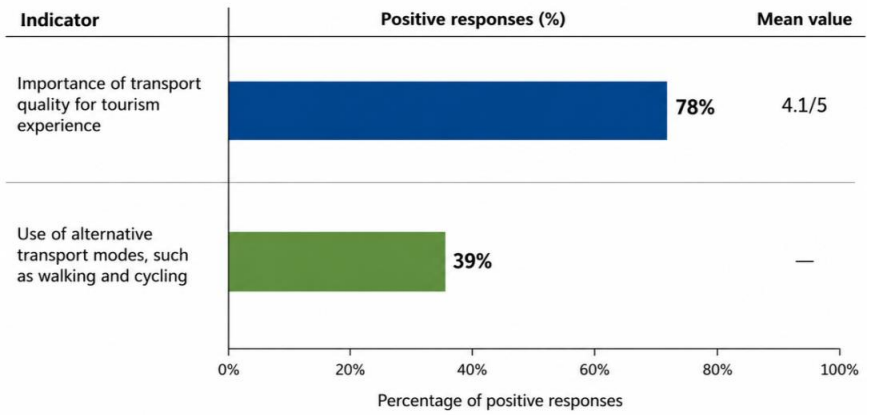


Figure 5. Perceptions of transport quality and sustainable mobility (Source: Author's own survey data)

As shown in Figure 5, transport quality was evaluated as an important factor in shaping the tourism experience, with a mean value of 4.1/5 and 78% positive responses. This indicates that mobility conditions represent one of the main determinants of visitor satisfaction and directly influence the perceived attractiveness of destinations.

Regarding sustainable mobility, 39% of tourists reported using alternative transport modes such as walking and cycling. Although this shows a noticeable interest in low-impact travel behaviour, the relatively moderate share suggests that limitations in infrastructure may still restrict the wider use of sustainable mobility options.

Overall, the findings suggest that improving transport service quality may increase visitor satisfaction, while expanding alternative mobility infrastructure could enhance both tourist experience and environmental sustainability.

Policy awareness and information accessibility

Tourists demonstrated relatively low awareness of sustainable tourism policies. To make the results clearer for readers, the main findings related to policy awareness and information accessibility are presented in Figure 6.

As shown in Figure 6, awareness of sustainable tourism policies received a mean evaluation of 3.0/5, with only 45% of respondents perceiving the existence of such measures. This suggests that sustainability initiatives may either be limited or insufficiently communicated to visitors, reducing their potential influence on tourist behaviour and destination image.

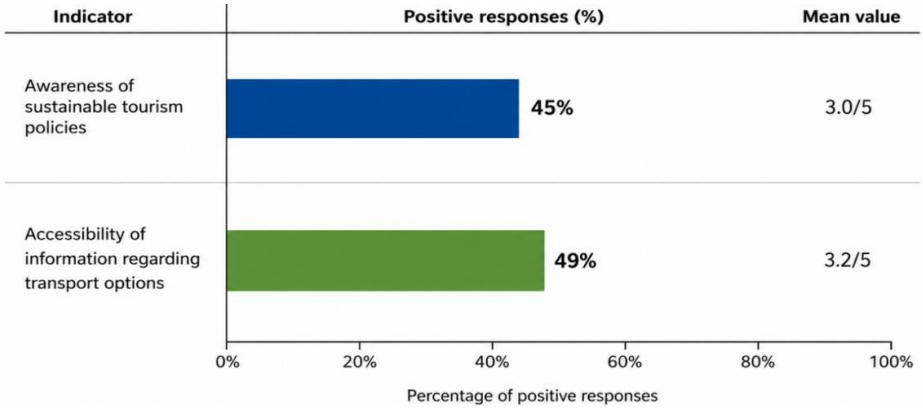


Figure 6. Policy awareness and information accessibility (Source: Author's own survey data)

Similarly, information accessibility regarding transport options received modest evaluations, with a mean value of 3.2/5 and 49% positive responses. These results indicate that visitors may face difficulties in obtaining clear mobility information, including routes, schedules and available transport modes.

Overall, the findings reveal that beyond physical infrastructure, informational and institutional aspects of mobility also affect tourist experience and the perceived sustainability of destinations.

DISCUSSION

The findings confirm that transport accessibility constitutes a central component of the tourist experience. The positive relationship between perceived transport quality and visitor satisfaction supports previous research emphasizing accessibility as a determinant of destination attractiveness (Page, 2009; Prideaux, 2000). The strong influence of mobility conditions on overall experience indicates that tourists evaluate destinations not only through attractions but through the entire travel process. This reinforces the argument that transport infrastructure should be considered part of the tourism product rather than a supporting service.

At the same time, the results reveal the presence of internal mobility constraints. Limited accessibility between attractions and insufficient transport information reduce tourists' ability to explore destinations effectively. These findings align with accessibility-based destination development theories, which emphasize that poor connectivity restricts tourism participation and spatial distribution of visitors (Hall, 2008). Therefore, even when primary access to destinations is acceptable, weak internal mobility may limit tourism competitiveness.

The study also highlights the role of sustainable mobility and policy visibility. Moderate use of alternative transport modes combined with low awareness of sustainability policies suggests that environmental strategies are not fully integrated into visitor experience. Similar observations have been reported in emerging destinations where institutional implementation lags behind infrastructure development (Tahiri et al., 2025). This indicates that sustainability depends not only on physical infrastructure but also on communication and governance mechanisms.

Overall, the results demonstrate that transport influences tourism through three interconnected dimensions: accessibility, experience quality and perceived sustainability. The contribution of this study lies in showing that improving infrastructure alone is insufficient without integrated mobility management and policy communication. This means that transport development should be understood as part of a wider tourism governance system, where physical infrastructure, public transport services, visitor information and sustainability policies work together. The findings suggest that tourists' experiences are shaped not only by the possibility of reaching a destination, but also by the quality, clarity and convenience of mobility within the destination. In the case of Kosovo, this highlights the need to combine infrastructure investment with improved public transport accessibility, better information about routes and schedules, and stronger visibility of sustainable mobility options. Therefore, a more coordinated approach to transport and tourism policy could contribute to higher visitor satisfaction, a stronger destination image and more sustainable tourism development.

CONCLUSIONS

This study examined the relationship between transport infrastructure, tourist experience and sustainable destination development using visitor perception data. The results confirm that accessibility conditions significantly influence tourist satisfaction and perceived destination attractiveness. Transport quality affects not only mobility convenience but also behavioural outcomes such as destination evaluation and revisit intention.

The findings further indicate that internal mobility represents a critical limitation. While primary access to destinations is relatively acceptable, insufficient public transport accessibility and limited information availability restrict visitor movement within destinations. This demonstrates that tourism competitiveness depends on the efficiency of local mobility systems rather than solely on external accessibility. The research also shows that sustainable mobility remains

underutilised. Moderate use of alternative transport modes and low awareness of sustainability policies suggest that environmental strategies are not fully integrated into the tourism experience. Therefore, sustainable destination development requires coordinated infrastructure, policy implementation and communication measures.

From a practical perspective, improving destination competitiveness requires integrated mobility planning focused on internal connectivity, reliable public transport services and accessible visitor information systems. Supporting low-impact mobility solutions may simultaneously enhance tourist experience and environmental sustainability.

Limitations of the study

This study has some limitations. First, it is based on a sample of 97 respondents, which limits the possibility of generalising the findings to all tourists visiting Kosovo. Second, the research relies on self-reported survey data, meaning that the results reflect tourists' perceptions rather than direct measurements of transport infrastructure or service quality. Third, the study focuses on selected destinations and does not establish direct causality between transport conditions and tourist satisfaction. Future research could include a larger sample, cover more destinations and combine survey data with interviews or official transport data. Despite these limitations, the study provides useful evidence that transport infrastructure, mobility management and policy communication are important for improving tourist satisfaction and supporting sustainable tourism development in Kosovo.

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Informed Consent Statement: Informed consent was obtained from all participants prior to completing the anonymous questionnaire.

Data Availability Statement: The data are not publicly available due to privacy considerations concerning the study participants

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ARCHITECTURAL HERITAGE OF AS-SALT, JORDAN: COMPREHENSIVE ANALYSIS, TOURISM DEVELOPMENT POTENTIAL AND STRUCTURAL ASSESSMENT FRAMEWORK

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Abstract: This study examines As-Salt, Jordan's architectural legacy, which is crucial to cultural heritage tourism since it was added to the UNESCO World Heritage List in 2021. This study explores the unique architectural features of As-Salt through thorough documentation and analysis of the city's historical building stock. These features include the city's famous yellow limestone construction, the fusion of Ottoman and European classical influences, and the patterns of spatial organization that developed during the Golden Age (1860–1920). In order to assess the built heritage of As-Salt's current relevance and preservation potential, this study combines architectural documentation, morphological analysis, and tourism development perspectives. The results show that the city's architecture, which combines Ottoman spatial traditions, European neoclassical elements, and native stone-building techniques that developed from nineteenth-century commercial vernacular through early twentieth-century modernization, is a singular example of architectural synthesis and cultural coexistence. The study problems key conservativeness by questioning the trade-off development between tourism and heritage. Discussions may be on the emergent management of heritage that would see the integration of sustainable tourism with respect to the cultural significance of a sacred site, which also provides for quality visitor experience. These conclusions are of much value for those professionals managing urban historic districts in the ME and point to the fact that architectural heritage is highly crucial in respect to sustainable urban development. In this research, a framework is proposed for structural assessment and restoration, which consists of non-destructive diagnostics integrated with a compatible intervention strategy. Literature evidence suggests that utilizing ultra-fine lime-based grouts (D_{90} under 100 μm) in conjunction with Textile-Reinforced Mortar (TRM) systems can offer a high-performance solution for enhancing ductility and seismic resistance. This framework aims to ensure safe adaptive reuse of heritage assets for the tourism sector while maintaining structural integrity in a seismically active region.

Keywords: As-Salt, Architectural Heritage, UNESCO World Heritage, Cultural Heritage Tourism, Heritage Conservation, Ottoman Architecture, Jordan, NDE, TRM, Lime grouts

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INTRODUCTION

Jordan's As-Salt City is a prime example of late 19th- and early 20th-century traditional Levantine architecture. The city saw substantial architectural development during its heyday (1881–1918), propelled by regional trade and the blending of Ottoman, European, and indigenous building traditions. A unique architectural vocabulary with distinctive façade compositions, material choices, and spatial arrangements resulted from this synthesis (Assi, 2020; Zalloom & Tarrad, 2020). In 2021, As-Salt's historic core was inducted into the World Heritage List by UNESCO, which acknowledged the city's Outstanding Universal Value as a demonstration of architectural excellence, urban hospitality, and cultural tolerance (UNESCO, 2021). Built primarily of native yellow limestone using traditional masonry techniques, the city's significant heritage building stock is both a cultural asset and a conservation challenge that calls for thorough documentation and strategic management (Cotella et al., 2025; Aburamadan et al., 2022).

As-Salt's UNESCO designation has put it in a favorable position for the growth of heritage tourism, but it has also made preservation more difficult. Sustainable heritage management necessitates striking a balance between community

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involvement, economic viability, accessibility for tourists, and conservation imperatives (Garrod & Fyall, 2000). Maintaining the site's Outstanding Universal Value while creating tourism infrastructure and programming that doesn't jeopardize architectural integrity or disturb residential communities is the main source of conflict (Jamhawi & Hajahjah, 2017). To support heritage management strategies that promote sustainable tourism development while maintaining the city's cultural authenticity and spatial character, this study looks at important architectural typologies found in As-Salt's historic center. The unique masonry typology of As-Salt's architectural legacy consists of load-bearing walls made of yellow limestone that can reach a thickness of one meter and support intricate cross-vaulted systems.

Because the city is close to the Dead Sea Transform, which is an active seismic zone, structural conservation requires a thorough understanding of the mechanisms underlying lime mortar carbonation and long-term durability performance (Balzani et al., 2024; Chen et al., 2024). In order to maintain the UNESCO-listed fabric and guarantee seismic safety, this study suggests combining sophisticated non-destructive testing fusion protocols (combining sonic velocity profiling with electromagnetic mapping) (Roumeliotis et al., 2024; Barrile et al., 2024).

Understanding this architectural legacy requires situating it within its historical context. The highest possible level of economic development came during the final days of Ottoman rule, therefore during this period, As-Salt became the economic axis of East Jordan. The city's geographical location was the main impetus behind its economic development as a passage along trade routes connecting Palestine and Syria with their Transjordanian backwoods. The kind of wealth managed by the mercantile elite trickled down in a manner creating changes in the landscape, redeploying storeys of privately-built mansions by wealthy families which purported to mark some discriminator of wealth and status in terms of Levantine architectural style (Rogan, 1999; Assi, 2020). During the golden season, some merchant families from the cities of the Levant brought architectural know-how, building techniques, and a very particular set of decorative traditions to As-Salt (UNESCO, 2021). This changing of cultural mores produced a peculiar architectural trend combining Ottoman interval structures, elements of European styles, and local building techniques (Assi, 2020).

It was this migration of skilled craftsmen to As-Salt that made this development possible, aided sharply by the master builder of Nablus, ʿAbd al-Rahman al-ʿAqruq, who shared his accomplishments, among others, in advanced Levantine architectural techniques transforming many a local bizarre design into yellow lime parts, fancy building fronts, and more than functional room designs (Jordan News, 2021; UNESCO World Heritage Site Guide, 2014).

These historical dynamics are best interpreted through established analytical frameworks. Ottoman architectural theory (Necipoğlu, 2005) and Islamic urban morphology studies (Bianca, 2000) establish analytical frameworks for understanding As-Salt's spatial organization. These theoretical foundations provide essential context for interpreting the synthesis of architectural traditions evident in As-Salt's built heritage. Regional architectural research examines economic-architectural relationships in Levantine cities (Assi, 2020), Ottoman administrative contexts (Rogan, 2020), and digital heritage documentation methodologies (Cotella et al., 2025).Building on these frameworks, heritage tourism scholarship (Timothy & Boyd, 2003; McKercher & du Cros, 2002) provides conceptual tools for evaluating sustainable tourism development potential. These frameworks emphasize the relationship between architectural authenticity and visitor experience quality, balanced with conservation imperatives and community engagement (Garrod & Fyall, 2000).

Alongside these cultural and touristic considerations, the structural dimension of heritage conservation demands equal attention. Contemporary approaches to heritage masonry conservation emphasize minimum intervention principles (ICOMOS) while addressing seismic vulnerability through compatible materials. Research demonstrates that ultra-fine lime-based grouts ($D_{90} < 100$ μm) combined with Textile-Reinforced Mortar (TRM) systems offer effective solutions for enhancing ductility and seismic resistance while maintaining material compatibility with historic fabric (Petrovčič & Kilar, 2022; Dinç-Şengönül et al., 2023). Non-destructive testing fusion protocols enable comprehensive structural assessment without compromising heritage values (Roumeliotis et al., 2024; Barrile et al., 2024).

PROBLEM STATEMENT, RESEARCH QUESTIONS, AND OBJECTIVES

Problem Statement

There is a significant lack of thorough architectural documentation of As-Salt's stock of historic buildings, even with the city's 2021 UNESCO World Heritage designation. Although recent literature has recognized the site's cultural and architectural significance (Assi, 2020; Zalloom & Tarrad, 2020; Cotella et al., 2025), there is still a dearth of systematic architectural analysis. The way Ottoman, European, and vernacular architectural traditions coexist in As-Salt's urban fabric has not been thoroughly examined in previous research. The Abu Jaber House is one of the few exceptions to the general lack of comprehensive architectural documentation and technical evaluation of heritage buildings. This lack of documentation makes it difficult to integrate architectural heritage into frameworks for sustainable tourism development and limits evidence-based conservation planning (Alnsour et al., 2023; Zalloom & Tarrad, 2020). In the heritage context of As-Salt, a thorough scholarly analysis is necessary to determine the relationship between architectural authenticity, spatial quality, and visitor experience.

For As-Salt and the surrounding area to benefit economically and socially from the city's cultural assets, a thorough research framework that connects formal architectural analysis, heritage documentation, and sustainable tourism principles is necessary. Beyond documentation, As-Salt's heritage faces two structural challenges: the inherent seismic vulnerability of multi-leaf limestone masonry walls, which often have internal voids and insufficient shear transfer capacity, and increased live loads from tourism adaptation (Dinç-Şengönül et al., 2023; Van Gemert et al., 2015). In similar contexts, historical interventions with incompatible materials, especially Portland cement, have accelerated the deterioration of limestone through As-Salt crystallization (Loke et al., 2025). In order to overcome these obstacles, knowledge-based structural evaluation that complies with ICOMOS minimum intervention guidelines must replace aesthetic restoration (Petrovčič & Kilar, 2022).

Research Questions

Main Research Question: How do the city's architectural heritage buildings aid in their promotion of tourism potential and sustainable heritage development, in As-Salt City and its surroundings? Sub-Questions:

First, what are the architectural elements and construction methods characteristic of traditional buildings in As-Salt City reflecting Ottoman, European, and local architectural characteristics? Second, how does the Abu Jaber House exemplify the evolution of architecture and craftsmanship during As-Salt City's golden age, and what are the architectural lessons to be learned from the analysis of the Abu Jaber House? Third, what recurring architectural patterns and typologies define the cityscape of historic downtown As-Salt, and how do these contribute to the urban fabric and visual integrity of the surroundings in the historic fabric? Fourth, in terms of tourism allure, how do the architectural qualities of As-Salt's heritage buildings, such as authenticity, aesthetics, and spatial experience, suitably cater to an urban situation? Fifth, what strategies could be suggested in order to work towards sustainability in tourism through use and maintenance of As-Salt City from the perspective of architectural heritage and its preservation through architectural authenticity and integrity? Sixth, what structural assessment framework and intervention strategies can be recommended, based on current research, to support the safe adaptive reuse of As-Salt's Ottoman-era heritage buildings for tourism?

Research Objectives

General Objective: The main aim of this research is to analyze the architectural characters in As-Salt city being combined in heritage buildings and their significance on sustainable heritage tourism development.

Specific Objectives: This study aims to document and analyze architectural variations of style and construction methods of traditional architecture of As-Salt city, which shows the blend of Ottoman, European, and indigenous architectural traditions; to undertake a comprehensive architectural analysis of the House of Abu Jaber as a grand case study of the city's past architectural magnificent achievement; to analyse architectural elements and urban design implications of Hammam Street and illustrate the examples of its spatial organization and business heritage; to examine how architectural authenticity, aesthetic value, and spatial qualities of historic buildings influence the experience of tourists as well as define the tourism appeal of As-Salt; to design sustainable tourism strategies balancing heritage conservation with community linkages; to contribute to the increased academic knowledge on heritage conservation by offering exhaustive documentation of a UNESCO World Heritage Site; and to establish a comprehensive structural assessment framework specifically for historic buildings in As-Salt based on literature evidence.

RESEARCH METHODOLOGY

Research Design and Approach

This research employs a qualitative methodological framework to examine As-Salt's architectural heritage through integrated architectural documentation, historical analysis, and heritage assessment protocols. The overall structure of the research methodology is illustrated in Figure 1. The study is structured around six representative case studies selected through purposive sampling to exemplify the dominant architectural typologies of As-Salt's Ottoman-European synthesis period (1881–1918). The methodology synthesizes three complementary analytical approaches, as outlined in Figure 1:

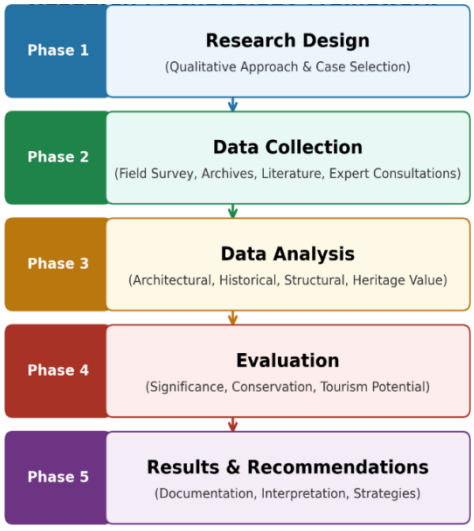


Figure 1. Conceptual framework of the research methodology, from research design to results and recommendations (Source: Authors)

A. Documentation and Architectural Analysis: Systematic documentation of heritage buildings within As-Salt's historic center employs multiple data collection methods, including direct field observation, detailed measured architectural surveys, comprehensive photographic documentation, and material characterization. These records capture architectural features, structural systems, construction materials, spatial organization, and decorative elements. Abu Jaber House serves as the principal case study, with comparative analysis extending to five additional significant heritage structures to identify recurring architectural patterns and typological characteristics.

B. Historical-Contextual Analysis: The late Ottoman period (1881–1918) witnessed significant architectural transformation in As-Salt, driven by urban expansion and evolving socio-economic conditions. This research utilizes archival sources, historical documentation, and published scholarship to contextualize architectural developments within broader patterns of regional trade, cultural exchange, and urban modernization.

C. Evaluating Heritage Tourism: This component evaluates the relationship between architectural authenticity, spatial quality, and visitor experience within sustainable tourism development frameworks. The analysis examines how As-Salt's architectural heritage can be effectively integrated into tourism programming while maintaining conservation standards and community engagement. Field investigations and analysis were conducted over 18 months (2024-2025).

Study Area and Scope

A. Geographic Scope: The research focuses on the historic center of As-Salt (32°02′N, 35°44′E), the administrative capital of Al-Balqa Governorate, situated approximately 28 km northwest of Amman, Jordan. Positioned along the

eastern edge of the Jordan Rift Valley escarpment, the city occupies a rugged mountainous terrain at elevations ranging from approximately 700 to 1,100 m above sea level (Figure 2).

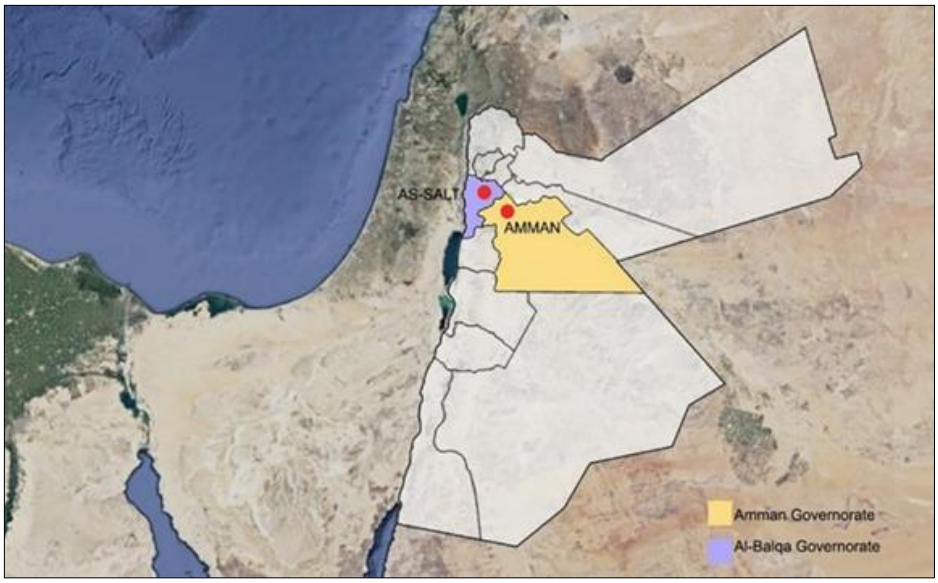


Figure 2. Location of the study area: As-Salt (32°02′N, 35°44′E) within Jordan, approximately 28 km northwest of Amman (Source: Aburamadan et al, 2022)

In 2021, As-Salt's historic core was inscribed on the UNESCO World Heritage List under the title "As-Salt – The Place of Tolerance and Urban Hospitality." The designated heritage area, covering approximately 70 hectares, is characterized by a distinctive urban morphology shaped by three prominent hills: Al-Qal'a, Al-Jad'a, and Al-Salalem. The organic street network and dense residential fabric of the old town have developed in direct response to this challenging topography, yielding a compact, vertically layered urban form (Figure 3).

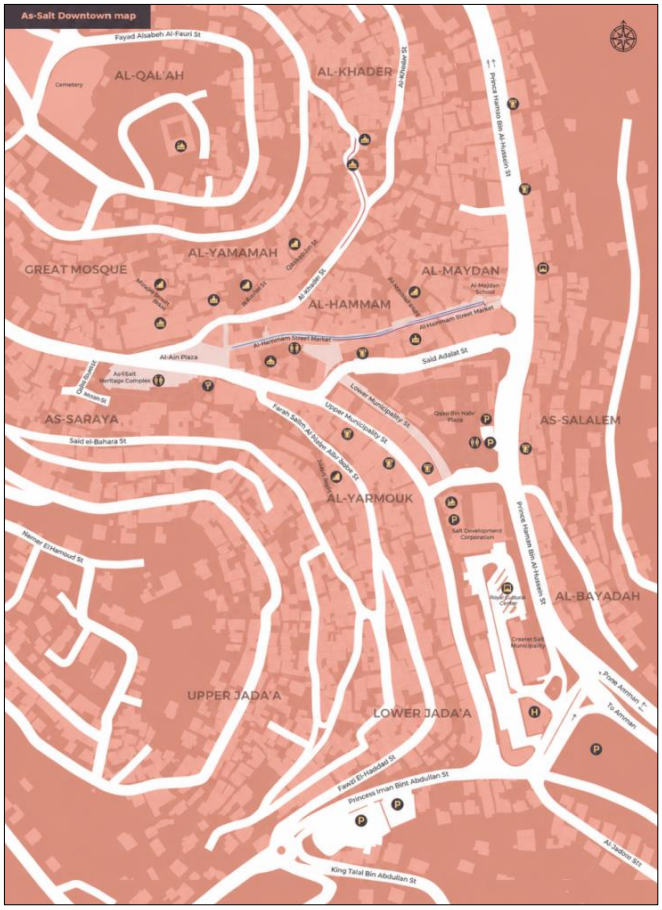


Figure 3. Location of the study area: the three principal hills — Al-Qal'a, Al-Jad'a, Al-Salalem — and Hammam Street (Source: Salt Development Corporation, n.d.)

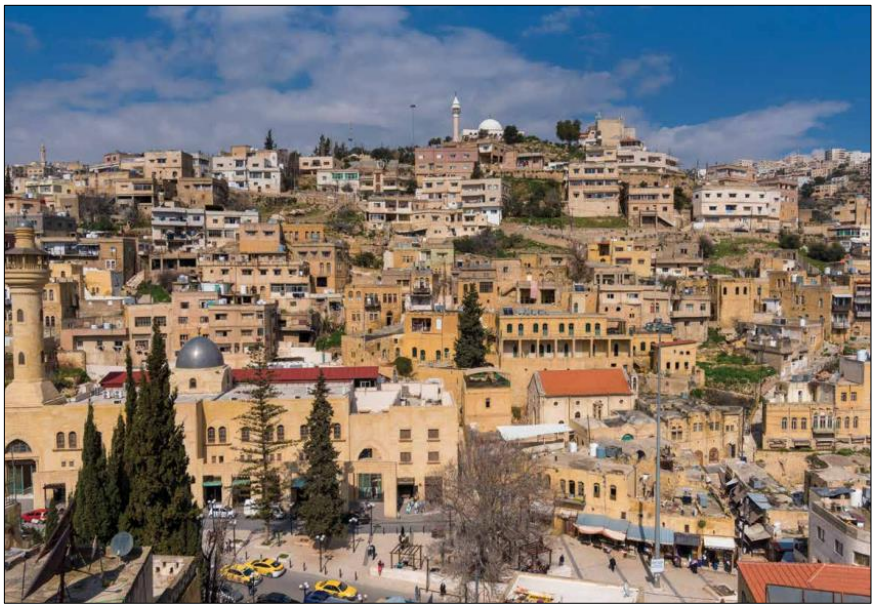


Figure 4. Panoramic view of Al-Qal'a Hill from Al-Jad'a Hill, showing the yellow limestone urban fabric and the Great Mosque dome (Source: Salt Development Corporation, n.d.)

Particular attention in this study is directed toward Hammam Street, the principal commercial artery that traverses the valley floor between the three hills, serving as the primary connector among the surrounding historic neighborhoods. The street and its immediate architectural context constitute the primary spatial unit of analysis.

The historic core of As-Salt is built across three closely-spaced hills — Al-Qal'a (Figure 4), Al-Jad'a (Figure 5), and Al-Salalem — creating a distinctive steep urban landscape where residential neighborhoods on the slopes are connected to the public spaces below through a network of stairs, alleyways, and nodes.

B. Temporal Scope: The study examines architectural developments during As-Salt's Golden Age (1881-1918), documenting their conservation status as of 2026. This temporal frame captures the city's most significant period of architectural production and subsequent conservation interventions.

C. Case Study Selection: While As-Salt's historic core contains an extensive inventory of heritage buildings, this study employs purposive sampling to select six representative case studies that exemplify the dominant architectural typologies of the Ottoman-European synthesis period. Selection Criteria:

- Architectural integrity: Buildings retaining original spatial organization and material fabric
- Typological diversity: Representation of distinct building categories (palatial residences, merchant houses, commercial structures)
- Structural condition: Varied states of preservation enabling comparative conservation analysis
- Documentation accessibility: Permission for detailed survey and non-destructive investigation
- Historical significance: Buildings documented in archival sources and heritage inventories

Selected Case Studies:

1. Primary case study: Abu Jaber House (comprehensive architectural and structural analysis)
2. Secondary case studies: Touqan House, Muhyar House, Al-Dawood House, Qaqish House, Falah Al-Hamad House.
3. Urban context: Hammam Street commercial corridor and surrounding heritage fabric.

This sampling strategy enables in-depth architectural analysis while maintaining research feasibility and ensuring representation of As-Salt's diverse architectural heritage.

D. Structural Assessment Framework: The methodology establishes a structural evaluation protocol for representative buildings characterized by thick load-bearing limestone masonry walls and cross-vaulted systems. This framework integrates:

- Non-destructive testing (NDT) fusion protocols: Combining sonic velocity profiling with electromagnetic mapping to assess masonry integrity without fabric damage.
- Material characterization: Laboratory analysis of historical lime mortars, limestone properties, and decay mechanisms.
- Seismic vulnerability assessment: Evaluation of lateral load capacity and shear transfer mechanisms in multi-leaf masonry construction.
- Compatible intervention strategies: Development of repair material specifications (ultra-fine lime-based grouts, Textile-Reinforced Mortar systems) informed by published studies on heritage masonry conservation.

This approach adheres to ICOMOS minimum intervention principles while addressing the dual challenges of seismic vulnerability and increased live loads from tourism adaptation.

Data Collection Methods

This research integrates multiple data collection methods to ensure comprehensive documentation and analysis of As-Salt's architectural heritage.

1. Field Surveys and Architectural Documentation: Systematic field investigations were conducted throughout As-Salt's historic center during 2024-2025, encompassing exterior surveys of heritage buildings, interior documentation of publicly accessible structures (museums, cultural centers, commercial establishments), and detailed observation of construction techniques, materials, and conservation conditions. Architectural measurements recorded essential dimensional data including building footprints, wall thicknesses, opening dimensions, vault spans, and urban spacing patterns. Comprehensive photographic documentation captured building exteriors, architectural details, construction materials, interior spaces, and urban fabric characteristics, providing visual records for comparative architectural analysis across the six case studies.

2. Archival and Documentary Research: Historical documentation was gathered from multiple institutional sources. Primary materials included UNESCO's 2021 World Heritage nomination file and ICOMOS advisory evaluation for As-Salt, JICA's 2010 cultural resources survey, and Jordan's Ministry of Tourism and Antiquities heritage management documentation. The research also consulted technical conservation reports, architectural surveys, restoration assessments, and interpretive materials from As-Salt Historical Museum (Abu Jaber House). These archival sources provided historical context for architectural development patterns and informed comparative analysis of building typologies.

3. Literature Review: The literature review synthesized scholarship across four thematic domains. Ottoman architectural theory (Necipoğlu, 2005) and Islamic urban morphology studies (Bianca, 2000) established analytical frameworks for understanding As-Salt's spatial organization. Regional architectural research examined economic-architectural relationships in Levantine cities (Assi, 2020), Ottoman administrative contexts (Rogan, 2020), and digital heritage documentation methodologies (Cotella et al., 2025). Heritage tourism scholarship (Timothy & Boyd, 2003; McKercher & du Cros, 2002) provided conceptual tools for evaluating sustainable tourism development potential. This synthesis revealed gaps in empirical architectural analysis and visitor experience research specific to As-Salt, justifying this study's integrated approach linking architectural heritage documentation with tourism development frameworks.

4. Expert Consultations: Informal consultations with local heritage specialists, conservation practitioners, museum staff, municipal heritage officers, and community historians provided contextual knowledge regarding As-Salt's architectural evolution, current conservation challenges, and community perspectives on heritage management priorities.

Analytical Framework

1. Architectural Analysis Methods: The architectural analysis employs a multi-layered methodological approach integrating typological, stylistic, material, and spatial investigation strategies. Typological analysis classifies buildings according to functional categories (residential, commercial, mixed-use) and identifies recurring spatial organization patterns, including courtyard houses and triple-arcade plans characteristic of As-Salt's Ottoman-European synthesis period. Structural systems are categorized by construction technique (cross-vaulted, flat-roofed, hybrid timber-masonry configurations). Stylistic analysis documents architectural influences—Ottoman, European neoclassical, and indigenous Levantine traditions—through examination of decorative programs, artistic elements, and façade composition strategies. Material and technical analysis investigates construction materials (local yellow limestone varieties, imported elements), structural techniques (load-bearing masonry walls, arches, vaults, early steel beam applications), and material supply chain patterns. Spatial analysis examines interior organization, circulation sequences, courtyard environmental strategies, and building-street relationships within the historic urban fabric.

2. Heritage Value Assessment: Heritage significance is evaluated through criteria adapted from UNESCO World Heritage and ICOMOS frameworks, assessing architectural significance (design uniqueness, craftsmanship quality, technical innovation), historical significance (association with As-Salt's Golden Age development), cultural significance (community identity, social values), authenticity (material integrity, design continuity), and integrity (structural completeness, contextual preservation). This multi-criteria assessment establishes the conservation priorities and informs intervention strategies for each case study building.

3. Tourism Development Potential: Tourism evaluation examines the relationship between architectural authenticity and visitor experience quality, considering spatial characteristics that enhance sensory engagement, interpretive programming opportunities, accessibility for diverse visitor demographics, adaptive reuse potential for sustainable economic functions, and integration capacity within As-Salt's broader heritage tourism infrastructure. This assessment framework links architectural qualities directly to tourism development strategies while maintaining conservation standards.

Ethical Considerations

This research adhered to established ethical protocols throughout all phases of heritage documentation and analysis. Field investigations maintained strict respect for private property rights and resident privacy, limiting architectural documentation to publicly accessible spaces, building exteriors, and cultural institutions open to visitors. All historical photographs and archival materials sourced from institutional repositories are appropriately attributed to their originating collections. The research approach demonstrates sensitivity to local cultural values and community perspectives on heritage preservation, acknowledging the invaluable contributions of indigenous architectural knowledge and local expertise in interpreting As-Salt's built heritage. These ethical considerations ensured that the documentation process respected both the physical heritage assets and the living communities that maintain cultural continuity within the historic center.

RESULTS

Architectural Synthesis: Ottoman, European, and Indigenous Influences

As-Salt's architectural heritage exemplifies a sophisticated synthesis of Ottoman, European, and indigenous building traditions that emerged during the Late Ottoman period. This architectural hybridity reflects the city's cosmopolitan

character and strategic position within regional trade networks, where foreign influences were selectively integrated while maintaining strong roots in local construction practices.

A. Ottoman Architectural Traditions: As-Salt's residential architecture demonstrates substantial Ottoman influence through characteristic structural and spatial configurations. Key Ottoman elements include vaulted construction systems (domes, barrel vaults, cross vaults), which define primary load-bearing techniques. These structural systems reflect the geometric harmony inherent in Ottoman architecture, where builders employed transitional elements such as squinches and pendentives to achieve spatial continuity between the cubic base and the vaulted ceiling (Al-Mughrabi et al., 2026; Necipoğlu, 2005). Centrally-located or strategically-positioned enclosed courtyards structure domestic spatial organization. These courtyard systems provided environmental comfort, privacy hierarchies, and social differentiation while expressing Islamic cultural values regarding family privacy, hospitality, and gender relations—features consistent with widespread Ottoman domestic architecture throughout the Levant (Bianca, 2000; Necipoğlu, 2005).

B. European Neoclassical Influences: Alongside Ottoman traditions, late 19th-century architectural production incorporated European neoclassical elements reflecting the city's economic and cultural openness. European influences manifest through sloping tiled roofs, imported steel beams, projecting balconies, and tall vertical windows inspired by contemporary European residential design. Material imports—Italian marble, German ceramics, Belgian stained glass—signify the cosmopolitan aspirations of As-Salt's merchant elite and their engagement with modernizing architectural aesthetics (Assi, 2020; Zalloom & Tarrad, 2020).

C. Indigenous Construction Practices: Despite global architectural currents, indigenous building practices remained fundamental to As-Salt's built environment. The predominant use of locally-quarried yellow limestone established the city's visual identity while ensuring material compatibility with regional climate and traditional construction methods (UNESCO, 2021). Architectural responses to As-Salt's mountainous topography—terraced construction, climate-responsive fenestration patterns, natural ventilation strategies—demonstrate site-specific design adaptations that integrate buildings with the natural environment and local climatic conditions (Daoudi et al., 2019; Salameh & Touqan, 2022). This synthesis of imported influences with indigenous practices reinforces local cultural identity within a cosmopolitan architectural vocabulary.

Comprehensive Analysis: Abu Jaber House

1. Historical Background and Basic Information

Located in As-Salt, the Historical Museum is housed in the Abu Jaber House, one of the finest examples of late Ottoman residential architecture in the city's historic center. The building was commissioned by the Abu Jaber family and constructed between 1896 and 1906. Situated at the base of Al-Jad'a Hill, the house reflects the characteristic yellow limestone construction and arched facades that define the surrounding historic neighborhood, as shown in Figure 5.



Figure 5. As-Salt historic urban fabric and architectural character of the study area, showing Al-Jad'a Hill with its dense layered arrangement of yellow limestone heritage buildings



Figure 6. Abu Jaber House / As-Salt Historic Museum, Hammam Street, combining white and local yellow limestone (Source: Authors)

The ground floor of the building which opened in 1896 used local yellow limestone for its construction and served as both storage areas and guest reception space (Trillo et al., 2020). The designer of the building ʿAbd al-Rahman al-ʿAqruq al-Nabulsi used advanced Eastern Mediterranean building methods which included cross-vaulted ceilings and intricately designed arched windows (Aburamadan et al., 2022). The second floor which finished construction in 1905 used decorative elements that combined local materials with international products to create spaces which included residential areas for the family (Cotella et al., 2025; UNESCO, 2021). The house demonstrates architectural styles which became common among As-Salt merchant families during the late Ottoman era as it combines traditional building methods with European decorative art (Assi, 2020). This master of Nabulsi craftsmen, Abd al-Rahman al-Aqruq, actually supervised the building, further transferring Nabulsi architectural traditions to As-Salt through superior craftsmanship and superior building technologies (Assi, 2020; Trillo et al., 2020). He was one of the notable builders who moved from Nablus in the last decades of the Ottoman period and brought with him specialized knowledge about stone building, decor, and spatial organization (Aburamadan et al., 2022). A comprehensive restoration was done on the building which had been inaugurated as the As-Salt history museum, ensuring the preservation of its architectural integrity and adapting the interior spaces to house museum

functions (Figure 6) (UNESCO, 2021; Cotella et al., 2025). It has now become a focal point in As-Salt heritage conservation operations, interpreting the city's social, architectural, and cultural history for visitors (Alnsour et al., 2023).

2. Structural Analysis and Architectural Elements

Ground Floor: The bottom floor is supported by a traditional structural system consisting of thick-bearing walls of stone and semi-circular arches used by late-ottoman domestic architecture in As-Salt. As far as the roofing of main interior spaces is concerned, a cross-vault system has been used to cover its wide area without the aid of internal walls. Not only does this system contribute to increased structural stability, but it also offers some flexibility in the use of space within the defined structural parameters, thereby integrating technical construction knowledge with locally rooted social and spatial practices (Municipal Heritage Platform Balqa Governorate, 2025; Bianca, 2000; Necipoğlu, 2005). The building demonstrates the characteristic use of local yellow limestone, the primary construction material sourced from nearby quarries during As-Salt's Golden Age (UNESCO, 2021). The distinctive yellow limestone which became a historical construction material for As-Salt architectural development originated from local quarries that included the Al-Salalem area (UNESCO, 2021). The high-quality construction of Abu Jaber House demonstrates the building standards from its time period because builders used local yellow limestone to create the structure which expert craftsmen from Nablus built under the guidance of master builder Abdel Rahman al-Aqrouq (Assi, 2020 UNESCO, 2021). Rounded cobblestones were used for floors. The coloring made them in black and light white. In the guest hall, decorative colored tiles with geometric and floral patterns measuring 30×30 cm were used, in colors including black, yellow, pink, and the natural stone color, indicating a high level of craftsmanship.

Second Floor: The second floor denotes a distinct shift higher up in the construction technology of As-Salt in the late Ottoman period. Imported European steel beams were used to support the ceilings of the upper floor, thus allowing the walls to be kept at a thickness of almost 30 cm, as opposed to the significantly thicker walls of the ground floor. That technological advancement has allowed for big, roomy, and not dogmatically organized interior spaces with an increased natural light and breathing ability, testifying to the success of Western structural innovation within a traditional Levantine architectural context (Assi, 2020; Necipoğlu, 2005). Italian Carrara marble was used to tile the second floor of Abu Jaber House. The marble was specially imported from Italy to Haifa port by sea, then transported by train from Haifa to Daraa, followed by the Hejaz Railway from Daraa to Amman, and finally carried on camels' backs from Amman to As-Salt.



Figure 7. Interior of the Madafa (guest reception hall), Abu Jaber House, showing Italian marble flooring and yellow limestone walls (Source: Authors)



Figure 8. Interior hall, Abu Jaber House / As-Salt Historic Museum, now a cultural event space, with arched windows and marble floor tiling (Source: Authors)

This complex logistics chain demonstrates the exceptional wealth and determination of the Abu Jaber family to create one of the finest houses in As-Salt (Jordan News, 2021). German tiling on pitched roofs ridge balconies evokes durability and the essence of European architecture. Belgian glass functions for the window openings, whether clear or tinted color glass, ensuring the daylighting and place embellishments (Zalloom & Tarrad, 2020). On the second floor, three separate apartments were designed, each incorporating a small interior courtyard that served as a secluded open-air retreat and a decorated guest reception hall (madafa) (Figure 7). Adapted from the Ottoman residential tradition to the specific urban context of As-Salt, the spatial arrangements reflect the social rituals of wealthy merchant households, including the formal reception of visitors, private family living, and leisure (Bianca, 2000; Assi, 2020). The structural components of the second floor demonstrate a high degree of material finish and construction precision. Pitched ceilings clad with red clay tiles were supported on sloped timber rafters, while cantilevered stairs (volée) projected from the façade to maximize interior space. These elements exemplify the late Ottoman architectural practice of integrating European construction techniques to enhance functional adaptability, while the applied ornamentation complements the architectural character of the historic fabric (Necipoğlu, 2005; Assi, 2020; Municipal Heritage Platform, Balqa Governorate, 2025).

3. Decorative and Artistic Elements

The house of Abu Jaber presents beautiful scenes from tiles of Eastern and Western design culture are woven together to form an interesting fusion of decorative elements (Figure 8). Geometric patterns embody Islamic design practices in never-ending and tightening repetitive actions that impart continuity and rhythm in the visual; floral decoration shows the influence of European design, with naturalistic patterns deriving from the sources of organic forms, truly exemplifying the

patterns of the botanical world, inspired also being with water-based ornamentation, and counterbalancing the whole sky with compositions of geometric forms.The wall paintings in Abu Jaber House are a unique artistic phenomenon in As-Salt City, not found in any other building. These include European rural house paintings discovered during restoration work, kitchen paintings mimicking oak bark (a decorative technique common in Europe), and ceiling paintings depicting the four seasons executed using oil paints. The German artist 'Menlik' from Haifa is believed to have executed these works.

Recurring Architectural Patterns in As-Salt

1. Yellow Limestone as Unifying Element: Local yellow limestone constitutes the unifying architectural element that connects As-Salt's heritage buildings and gives them their distinctive architectural identity (Figure 9). This distinctive yellow limestone was traditionally extracted from local quarries, particularly from the Al-Salalem area, though these historical quarries are now closed (ICOMOS, 2021). Current conservation work sources similar stone from quarries in Dair Allah and the Mafraq region (UNESCO World Heritage Centre, 2021). The limestone exhibits warm yellow coloring ranging from light yellow to golden, relatively smooth texture easy to carve and shape, durability resistant to weather conditions, and creates visual unity when used in adjacent buildings.

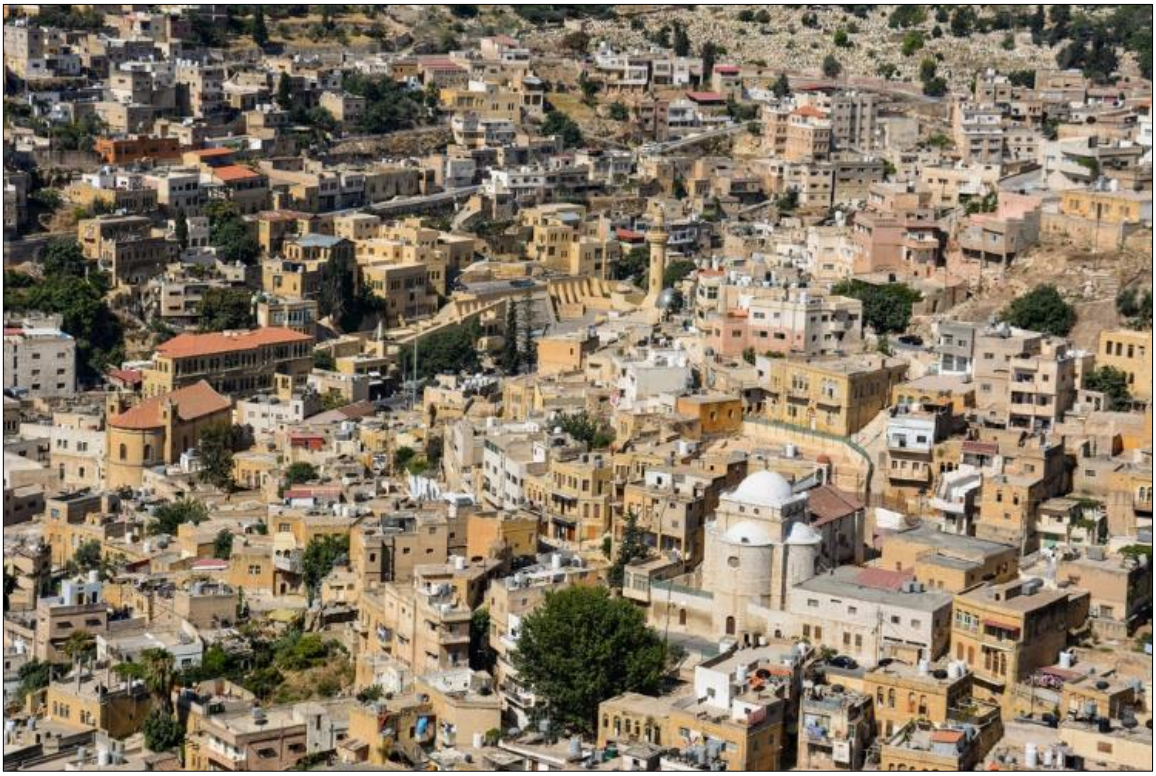


Figure 9. Panoramic view of As-Salt's historic center, showing the yellow limestone urban fabric cascading along Al-Qal'a and Al-Jad'a hills (Source: Authors)

2. Arches and Arcades: Arches and arcades are among the most eye-catching architectural features in As-Salt buildings, serving both structural and aesthetic purposes. Structurally, they support ceilings and distribute loads on side walls, reduce pressure from load-bearing walls, and allow coverage of wide spaces without internal columns. Aesthetically, they create harmonious visual rhythm in facades and express craftsmanship skill and artistic mastery. Types include pointed arches, semi-circular arches, cross vaults, and segmental arches.

3. Windows and Openings: As-Salt buildings are characterized by abundant arched windows, predominantly in the upper stories, reflecting European architectural influences adapted to local climatic needs (Assi, 2020; Trillo et al., 2020). These carefully proportioned openings ensure ample natural lighting and ventilation, demonstrating the synthesis of imported design aesthetics with climate-responsive building practices (Aburamadan et al., 2022; UNESCO, 2021). A representative example is found on the upper floor of the Abu Jaber House, where triple-arched windows combine pointed arches with polychrome stained glass in green, red, and yellow, set within ornamental wrought-iron grilles that exemplify the European influences integrated into the traditional Levantine residential design of As-Salt's Golden Age (1881–1918) (Figure 6, 8, 10).

4. Roofing Systems: Roofing systems (Figure 2, 5, 6, 9) in As-Salt buildings varied according to time period and economic level. Traditional roofs included stone vaults and small domes in some rooms. Advanced roofs featured sloped wooden roofs covered with red tiles and modern flat roofs using steel beams.

5. Urban Fabric and Topographic Integration: As-Salt extends over three main hills — Al-Qal'a, Al-Jad'a, and Al-Salalem — giving the city a unique architectural character (UNESCO, 2021). Yellow limestone buildings are arranged on the slopes of these hills, forming a cohesive architectural mass consistent with the natural contours of the terrain (Figure 9). Urban fabric characteristics include vertical gradation with buildings terraced on the hillsides, compact density with narrow

spaces between buildings, and winding streets following the natural topography. The city's distinctive monumental stairways connect the hillside neighborhoods and serve as primary pedestrian routes (Figure 11 a), while the coexistence of mosques and churches within the historic skyline reflects the cultural tolerance that defines As-Salt's urban identity (Figure 11 b).



Figure 10. Triple-arched stained-glass windows, upper floor, Abu Jaber House (Source: Authors)

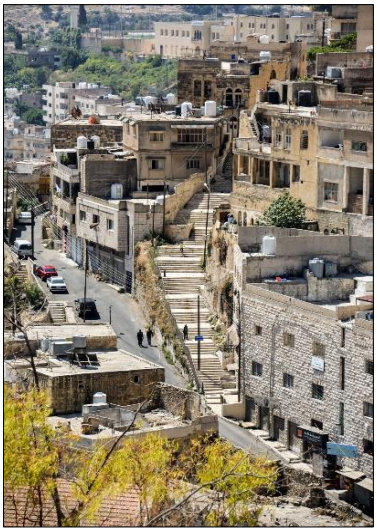
(a)   (b)

Figure 11. Urban landscape: (a) stone stairways (*salalem*) linking hillside neighborhoods (Source: Daher, n.d.); (b) mosque minaret and church bell tower coexisting, reflecting the tolerance behind the city's inscription on the UNESCO World Heritage List in 2021; Abu Saleem, 2016)

Comparative Case Studies

1. Touqan House: Located on Prince Hamza Street near Hammam Street in As-Salt, Touqan House is a prominent heritage building constructed between 1900 and 1905 by master builder ʿAbd al-Rahman al-ʿAqruq for the Touqan family, who migrated from Nablus (Trillo et al., 2020; UNESCO, 2021). The house currently serves as the As-Salt Archaeological Museum, showcasing artifacts from the Roman, Byzantine, and Islamic periods. The building's entrance exhibits cross-vaulted and barrel-vaulted ceilings which serve as structural roofing systems for the building while the upper floor uses iron girders which match the construction materials that builders used for the Hijaz Railway infrastructure (UNESCO, 2021). Architecturally, the frontage portrays unique decorative elements. The façade integrates Art Nouveau and Neoclassical elements, including decorated columns, floral-petal pilasters, and a symmetrically composed stone staircase with ornate balustrades (Cotella et al., 2025). These architectural features exemplify the blending of European aesthetic traditions with the local Levantine building vocabulary that characterized late Ottoman-era merchant residences in As-Salt (Assi, 2020; Aburamadan et al., 2022) (Figure 12).

2. Muhyar House: The Muhyar complex on Hammam Street exemplifies the integrated commercial-residential typology that defines As-Salt's historic commercial district. The complex consists of two buildings: the Muhyar Building, with its main entrance and two-storey design, and the Muhyar House, which lies to the east of the main building; both structures were constructed using local yellow limestone (UNESCO, 2021). The main exterior of the Muhyar House features two distinct window styles combined with three arched windows extending across the principal entrance area. The design employs Ottoman architectural elements to create street frontages that support commercial activities (Cotella et al., 2025). The main entrance provides access to a curved stairway linking the ground-level commercial spaces to the upper residential quarters. Documentary sources confirm that street-level vaulted rooms functioned as commercial premises, while the upper floors served as family living quarters (Trillo et al., 2020; Alnsour et al., 2023). This architectural arrangement was widely adopted

in Ottoman-Levantine trading towns, as it enabled merchant families to operate their businesses from home while maintaining the privacy of their domestic life (Assi, 2020) (Figure 13 a, b). The yellow limestone construction and seamless integration into Hammam Street's commercial fabric contributed to As-Salt's inscription on the UNESCO World Heritage List in 2021, which recognized the city's integrated urban development and diverse architectural styles (UNESCO, 2021).

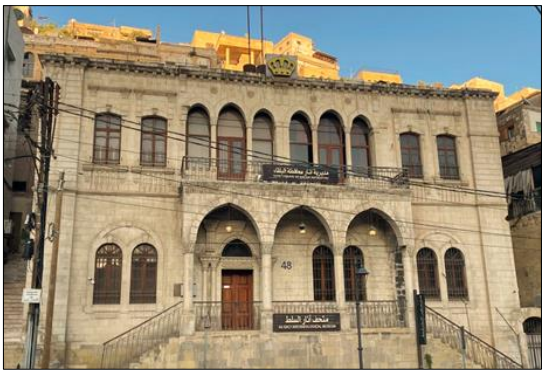


Figure 12. Touqan House, now the As-Salt Archaeological Museum: façade showing ground-floor arcade, decorative columns, and yellow limestone masonry (1900–1905) (Source: Authors)

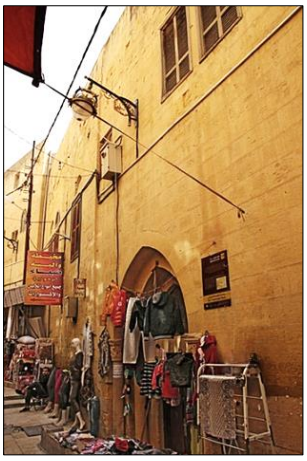
(a)   (b)

Figure 13. (a) Muhyar House, Entrance (b) Hammam Street by day, showing ground-floor commercial spaces (*souq*) with mixed-use commercial-residential buildings typical of Ottoman-Levantine trading towns (Source: Authors)

3. Al-Dawood House (Dawood Triangle): Al-Dawood House, commonly known as the Dawood Triangle, stands at the junction of Al-Khader Street and Hammam Street, opposite Al-Ain Plaza. The building demonstrates a distinctive architectural response to non-standard urban land configurations. Constructed by the Daoud family in the late 19th century, this two-storey mixed-use building features a triangular plan that was purposefully designed to conform to the acute corner site at one of the key intersections of As-Salt's historic commercial district (Jamhawi & Hajahjah, 2017; Trillo et al., 2020) (Figure 14 a, b).

4. Qaqish House: The Qaqish House, constructed between 1895 and 1900, is located in the Al-Qal'a district on Al-Khader Street (Figure 15). The building exhibits a traditional courtyard plan that ensures visual privacy while facilitating natural ventilation throughout the interior spaces (Trillo et al., 2020; UNESCO, 2021).

(a)   (b)

Figure 14. Al-Dawood House (Dawood Triangle) at Al-Khader/Hammam junction: (a) triangular-plan mixed-use building in yellow limestone; (b) view from Al-Ain Plaza within its urban setting (Source: Authors)

The design of both interior and exterior spaces establishes a harmonious relationship with the surrounding mountainous landscape and the local temperate climate (Aburamadan et al., 2022). Architecturally, the Qaqish House represents the evolution from simple peasant dwellings to the more refined stone residences built by prosperous merchants during the late Ottoman period, incorporating characteristic elements such as cross-vaulted ceilings, yellow limestone walls, and arched window openings (Trillo et al., 2020). The building is recognized as one of As-Salt's earliest significant heritage residences and currently serves as the headquarters of As-Salt's City Development Project (Aburamadan et al., 2022).

5. Falah Al-Hamad House: Falah Al-Hamad House is located on Prince Hassan bin Talal Street, approximately 400 metres uphill from the Historic Old As-Salt Museum (Figure 16). Constructed between 1890 and 1918 for Falah al-Hamad, a municipal council member and tribal court specialist, the building represents the quintessential architectural character of As-Salt's merchant residences (UNESCO, 2021). The façade features an elaborately decorated entrance portal with twisted columns exhibiting Art Nouveau and Neoclassical stylistic elements, reflecting the multicultural influences that shaped As-Salt's architecture during the late Ottoman period (Cotella et al., 2025). The building served multiple functions across four generations: the first floor operated as "Al-Khreisat Madafa," a traditional guest reception hall in accordance with Levantine hospitality customs, while the ground floor housed a flour mill that remained operational until the 1970s (Trillo et al., 2020; UNESCO, 2021). During the 1948 Arab-Israeli War, the house served as a refuge for Palestinian refugees, demonstrating its significant social and humanitarian role within the local community (UNESCO, 2021). The building is currently planned for restoration and adaptive reuse as a public library, incorporating spaces that will preserve its historical function of hospitality and community service (Alnsour et al., 2023).

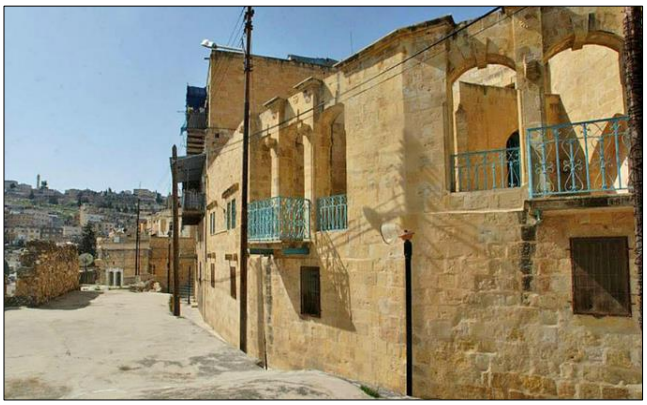


Figure 15. Qaqish House, Al-Khader Street (1895–1900): pointed arches, yellow limestone masonry, and wrought-iron balconies (Source: Authors)



Figure 16. Falah Al-Hamad House (1890–1918): ornate Art Nouveau entrance portal and yellow limestone masonry, now deteriorated and awaiting restoration (Source: Authors)

Urban Commercial Corridor: Al-Hammam Street

1. Historical Development: Al-Hammam Street (Figure 17) was established during the 1880s by merchants coming from Nablus, and named after an old Turkish bath whose remains are still visible. The street creates a unique commercial pathway which stretches 300 meters from Al-Ain Plaza to its pedestrian-only area (Khirfan, 2013). The urban plan demonstrates how a street connects with the historical city area while commercial buildings create a street front that harmonizes with the area's natural landscape (Khirfan, 2017).

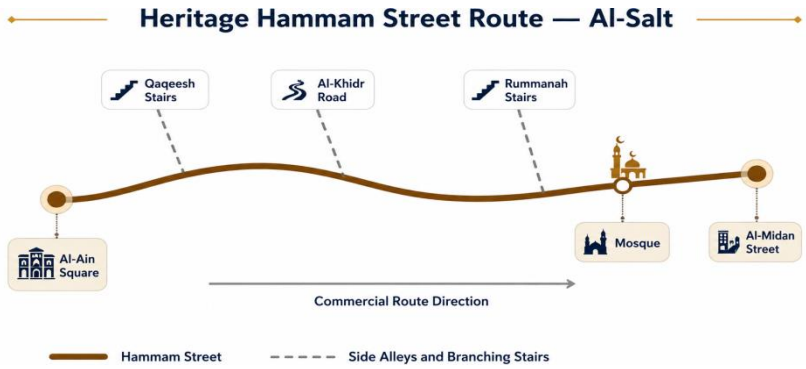


Figure 17. Urban plan of Al-Hammam Street, connecting Al-Ain Square to Al-Maidan Street (Source: Authors)

2. Architectural Characteristics: Al-Hammam Street demonstrates the mixed-use development pattern that defines As-Salt's commercial building design. The Abu Alouf Building (constructed 1881–1884) by master builder Abdel Rahman al-Aqrouq for Daoud Abdul Rahman Touqan from Nablus exemplifies this pattern, with five commercial shops and a main gateway at street level opening onto Al-Hammam Street, and two residential apartments of varying sizes on the upper floor accessed through a stairway from the main entrance. The architectural design establishes a continuous commercial frontage that merges with residential spaces, showcasing urban planning practices from the late Ottoman era. The building's construction used local yellow

quarried limestone, while the ground floor contains wide openings directly facing the street and the upper floor features arched windows typical of the period (Khirfan, 2013; Universes in Universe, n.d.), as shown in Figure 18.



Figure 18. The Abu Alouf Building, Al-Hammam Street: mixed-use building in local yellow limestone construction (Source: Authors)

3. Religious and Commercial Integration: The Small Mosque (Figure 18 a, b) was constructed in 1906-1907 by Sulaiman Abu Al-Hussein, a local builder from As-Salt, using traditional yellow limestone quarried from the surrounding area (UNESCO, 2021). The mosque demonstrates Islamic architectural design principles which have been modified to fit the architectural practices of the As-Salt area. The building design creates a wide prayer space that connects to a wooden narrow mezzanine which contains a minbar and a mihrab that displays elaborate Islamic geometric and floral patterns of late Ottoman religious design (Trillo et al., 2020; UNESCO, 2021). The decorative features showcase the expert skills of local craftsmen who operated according to traditional Islamic design standards. The mosque's most distinctive architectural feature is its minaret, which designers built to replicate the minaret of the Hanbali Mosque in Nablus, Palestine (Cotella et al., 2025). The architects created this design to show the deep cultural and trade ties between As-Salt and Nablus which existed during the late Ottoman period when Nabulsi merchants and craftsmen, including builders like ʿAbd al-Rahman al-ʿAqruq, contributed significantly to As-Salt's architectural development (Assi, 2020). The minaret thus serves as a physical manifestation of the architectural lineage and cultural exchange between these two important Levantine trading centers.

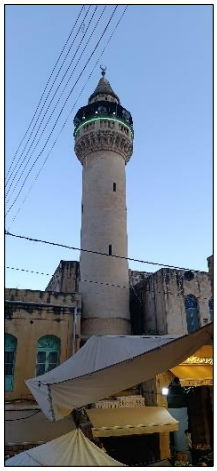
(a)   (b)

Figure 19. (a) The minaret (b) As-Salt Small Mosque on Al-Hammam Street: arched entrance integrated with commercial market stalls, demonstrating religious-commercial coexistence (Source: Authors)



Figure 20. A nighttime view of Al-Hammam Street, showing limestone-paved sidewalks, wooden shopfronts, and the commercial corridor's overhead canopies (Source: Authors)

4. Street Infrastructure and Pedestrian Networks: Since the Ottoman period, As-Salt's historic center has retained its original street plan with stone-paved roads and sidewalks typical of late-Ottoman urban design principles. Hammam Street shows the older form of street design with proper stone-paved sidewalks and progressive walking and vehicular pathways (UNESCO, 2021). Street surfaces use limestone blocks from local quarries arranged in geometric patterns. The street network system enables the city to overcome topographic challenges spanning three hills through advanced design using stone staircases and stepped pathways (Zalloom & Tarrad, 2020). The Harmony Trail, serving as a heritage walking path, starts at Abu Jaber House and takes visitors through historical streets showing As-Salt's traditional urban fabric (UNESCO, 2021). Figure 20 illustrates the northern section of Al-Hammam Street, highlighting the preserved stone-paved pathways and traditional wooden shopfronts that characterize this historic commercial corridor.

DISCUSSION

Architectural Heritage as Tourism Asset

1. Tourism Value of Architectural Elements: As-Salt architectural heritage represents a unique tourism resource due to its authenticity and uniqueness, creating a visual and cultural experience not repeated elsewhere. The density and concentration of heritage buildings within a compact area (approximately 2,000 meters diameter) enriches the visiting experience. The uniform yellow stone creates visual integration across the urban fabric, while functional diversity of heritage buildings as museums, cafes, commercial shops, and residences provides immediate material experience of living heritage rather than static display.

2. Visitor Spatial Experience: Visitors to downtown As-Salt city experience a multidimensional spatial journey. The visual experience features As-Salt's hillside setting creating continuous streetscapes of yellow limestone facades achieving unity through repeated arched openings, decorative stonework, and human-scale proportions. The movement experience includes staircases and narrow lanes connecting hillside neighborhoods, with courtyards and small plazas punctuating the urban fabric. The sensory experience engages multiple senses: yellow limestone unifies building facades and paving creating tactile warmth; street sounds from markets and cafés animate the district; aromas of traditional coffee and sweets from historic shops evoke cultural memories tied to place.

3. Future Tourism Development Potential: As-Salt's architectural heritage possesses significant tourism potential through heritage hotels via adaptive reuse of heritage buildings into boutique hotels, heritage restaurants and cafes occupying heritage buildings allowing visitors to experience traditional architecture while dining, specialized museums dedicated to traditional crafts and local architecture, workshops teaching traditional crafts such as stone carving and traditional carpentry providing interactive visitor experience, and specialized architectural tours led by architecture and history specialists targeting tourists interested in architectural heritage.

Structural Assessment and Conservation Framework

1. Non-Destructive Evaluation Methods: Accurate diagnostic protocols are essential for structural intervention. Non-destructive testing (NDE) is recommended for mapping internal deficiencies without compromising the building's integrity. Sonic and ultrasonic testing techniques (measuring wave velocities between 1000 and 4000 m/s) should be used to identify density variations and delamination within cross-sections. Furthermore, ground-penetrating radar (GPR) should be used to plan internal geometry and determine moisture distribution, achieving a void detection resolution of 1–5 cm (Hussain & Akhtar, 2017). Further, integrate these datasets through NDE fusion enhance diagnostic accuracy. Specifically, combining sonic velocity profiles with GPR radargrams provides a comprehensive assessment of injection efficiency and void continuity (Roumeliotis et al., 2024). In addition, infrared thermography (IRT) should be used to detect thermal anomalies indicative of subsurface discontinuities or moisture pockets (Tejedor et al., 2022). The flat-jack test remains the reference for determining the modulus of elasticity and stress states in situ (Hussain & Akhtar, 2017). In the context of As-Salt, these techniques are recommended for confirming wall configuration and identifying moisture-induced limestone erosion and thus guiding intervention point locations (Hussain & Akhtar, 2017; Tejedor et al., 2022).

2. Intervention Strategies for As-Salt's Ottoman Masonry: The structural rehabilitation of heritage buildings in As-Salt requires a comprehensive integration of materials science, diagnostics, and structural analysis. The evaluation phase should initiate with visual inspection and moisture mapping, acknowledging carbonation inhibition outside the 50–70% RH range (Chen et al., 2024). This is followed by NDT fusion to locate internal voids within cross-sections (Hussain & Akhtar, 2017; Roumeliotis et al., 2024). Repair materials should be carefully selected to ensure compatibility with existing limestone properties (mechanical and chemical properties). Priority should be given to lime mortars modified with pozzolans achieving compressive strengths of 2.5–7.8 MPa (Tombulca & Çavuş, 2023). The structural rehabilitation should encompass three integrated components. First, mass consolidation through mineral grouts with $D_{90} < 100$ μm should be used to restore monolithic behavior (Padovnik et al., 2024), targeting 61% shear strength recovery (Dinç-Şengönül et al., 2023). Second, seismic strengthening by TRM (Textile-Reinforced Mortar) systems with lime-based matrices should be used to address out-of-plane vulnerability and provide breathable reinforcement without vapor impermeability (Petrovčič & Kilar, 2022; Azimi et al., 2025). Third, post-rehabilitation monitoring should compare pre- and post-injection UPV measurements (Roumeliotis et al., 2024), supplemented by permanent wireless sensor networks to track dynamic responses for early detection of settlement or seismic damage (Pallarés et al., 2021; Barrile et al., 2024). This integrated approach respects the minimum intervention principles for heritage rehabilitation while guaranteeing structural safety in a seismically active zone.

3. Assessment Framework: Vulnerability Modeling and Monitoring: For seismic vulnerability assessment of heritage buildings, pushover analysis should be employed to derive capacity curves and identify collapse mechanisms. Equivalent frame modeling is recommended to approximate nonlinear behavior (Petrovčič & Kilar, 2022). Assessment should focus on

susceptibility to soft-story mechanisms and out-of-plane failures, particularly at floor–wall connections (Yildizlar et al., 2019; Htet et al., 2025). As-Salt is situated near the Dead Sea, one of the most active seismic zones. Therefore, hazard analyses shall account for inertial forces from massive limestone walls. Accordingly, interventions should be designed to maximize ductility and stability (Balzani et al., 2024; Petrovčič & Kilar, 2022). Furthermore, structural digital twins within Heritage Building Information Modeling (HBIM) increasingly support risk management and maintenance protocols (González et al., 2025). Permanent Structural Health Monitoring (SHM) networks should be integrated into significant heritage structures for long-term performance verification. The monitoring framework should incorporate: (1) Operational Modal Analysis (OMA) to track shifts in modal frequencies and damping ratios as early indicators of stiffness degradation, (2) accelerometers and tiltmeters to detect minute deformation trends enabling service life prediction (Pallarés et al., 2021), and (3) laser scanning with drone photogrammetry to provide high-precision point clouds for tracking millimetric shifts (Barrile et al., 2024).

Heritage-Tourism Integration and Sustainability

The primary challenge lies in balancing tourism development with heritage conservation while maintaining As-Salt's Outstanding Universal Value. Increased visitor numbers generate economic benefits but create risks including structural stress from increased live loads, wear on historic fabric from intensive use, and potential disruption to residential communities. Sustainable tourism development requires strategic planning that integrates conservation imperatives with accessibility, economic viability, and community engagement. Key strategies include implementing visitor capacity management to prevent overuse, establishing conservation protocols for adaptive reuse ensuring structural safety while maintaining authenticity, developing community-based tourism initiatives ensuring local economic benefits, creating interpretive programming that educates visitors about heritage values and conservation needs, and establishing monitoring systems tracking both tourism impacts and conservation outcomes. Success requires collaboration among local and central government, academic institutions, private sector developers, local communities, and international heritage organizations.

CONCLUSION AND RECOMMENDATIONS

As-Salt City's architectural heritage portrays an exclusive architectural trend from the late Ottoman era to the early 20th century. The city successfully integrated Ottoman architectural symbols, European influences, and local traditions to manufacture a distinctive architectural style embodying local authenticity. Detailed analysis of Abu Jaber House and other heritage buildings demonstrates that As-Salt's traditional architecture stands out through: yellow limestone as the main element for construction giving tangible identity; evolution from traditional construction methods to contemporary materials and technology; rich decorative style integrating Eastern and Western motifs; and effective integration with mountainous terrain creating harmonious urban form. The research concludes that the preservation of As-Salt as a global tourism destination requires a shift toward "knowledge-based restoration". The proposed framework demonstrates through literature evidence that minimum interventions can meet the safety requirements of building codes. In addition, the proposed framework begins with NDT fusion and concludes with compatible repair materials. Published evidence confirms that lime mortars modified with pozzolans represent the most effective choice for balancing compressive strength (up to 7.8 MPa) with the required flexibility (Tombulca & Çavuş, 2023). Furthermore, permanent SHM networks should be integrated into the most significant structures to detect millimetric deformations early, thereby ensuring the sustainability of cultural tourism and the protection of life in historic city (Pallarés et al., 2021; Roumeliotis et al., 2024; Barrile et al., 2024). Building on these conclusions, several practical recommendations follow. For heritage conservation: implement systematic documentation of remaining undocumented heritage buildings; establish conservation protocols based on ICOMOS minimum intervention principles; prioritize compatible repair materials (ultra-fine lime grouts, TRM systems) over Portland cement-based solutions; and integrate permanent SHM systems in key heritage structures. For tourism development: develop heritage hotels through adaptive reuse maintaining architectural integrity; establish specialized architectural tours with trained guides; create interpretive centers explaining architectural heritage and conservation; implement visitor capacity management preventing overuse; and develop community-based tourism ensuring local economic benefits. For structural safety: conduct seismic vulnerability assessments using pushover analysis; implement NDT fusion protocols before intervention; establish monitoring frameworks tracking long-term performance; and develop emergency response protocols for heritage structures.

Future research should further address: quantitative assessment of tourism economic impacts and visitor satisfaction; long-term monitoring of conservation interventions measuring effectiveness; comparative studies of As-Salt with other Levantine heritage cities; development of digital heritage platforms using HBIM for management; investigation of climate change impacts on limestone deterioration; and community perception studies regarding heritage tourism development.

In closing, As-Salt's architectural heritage represents an exceptionally fine cultural and tourism asset. Should this heritage continue to be preserved and developed, it can become synonymous with cultural authenticity and economic wealth. The Abu Jaber House and similar heritage buildings are not mere yellow stones joined piece after piece, but dramatic representations of the golden age in architecture and culture; they become a link connecting past and present and a sustainable asset for the city's future. Success requires relentless energy by principal stakeholders—local and central government, academia, industry, community, and international organizations—working together to ensure As-Salt's heritage maintains its deeper meanings and implications for generations to come.

Limitations

This research acknowledges several methodological constraints. Access to privately-owned heritage buildings limited interior documentation to publicly accessible structures, while deteriorated conditions prevented safe entry to some buildings.

Original architectural drawings and detailed construction specifications are absent for most heritage structures, and historical records regarding construction dates and ownership chains remain incomplete. The scope of field surveys was constrained by single-researcher capacity, and long-term conservation monitoring extends beyond the research timeframe. Limited availability of tourism economic data and visitor statistics restricted quantitative tourism impact assessment.

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List of Abbreviations: ICOMOS = International Council on Monuments and Sites; UNESCO = United Nations Educational, Scientific and Cultural Organization; NDT = Non-Destructive Testing; NDE = Non-Destructive Evaluation; TRM = Textile-Reinforced Mortar; SHM = Structural Health Monitoring; HBIM = Heritage Building Information Modeling; GPR = Ground-Penetrating Radar; IRT = Infrared Thermography; OMA = Operational Modal Analysis; UPV = Ultrasonic Pulse Velocity; RH = Relative Humidity.

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A STUDY ON FACTORS AFFECTING SMART TOURIST DESTINATION VISITING BEHAVIOR: A CASE STUDY IN CAN THO CITY, VIETNAM

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Abstract: Smart tourism destinations have become increasingly important in the era of digital transformation and sustainable tourism development. Despite growing scholarly interest, previous studies have mainly examined technological factors or behavioral theories separately, leading to limited understanding of how digital perceptions and sustainability-oriented norms jointly influence tourist behavior. This study aims to extend the Theory of Planned Behavior by integrating e-attitude and resource efficiency norms to explain tourists' visit intention and actual behavior toward Smart tourism destinations. A quantitative research design was employed using survey data collected from tourists visiting smart tourism destinations. To conduct the study, the authors conducted direct interviews with 441 tourists visiting several smart tourist destinations in Can Tho City, Vietnam (Ninh Kieu Wharf, Cai Rang Floating Market, Son Island, Truc Lam Phuong Nam Zen Monastery, and Binh Thuy Ancient House) using a convenient sampling method. Convenience sampling was adopted due to accessibility and the exploratory nature of the study. The collected data were analyzed using Partial Least Squares Structural Equation Modeling. Reliability and validity of the measurement model were assessed through indicator loadings, composite reliability, average variance extracted, and discriminant validity. The structural model was evaluated using path coefficients, effect size (f^2), predictive relevance (Q^2), variance inflation factor (VIF), and standardized root mean square residual (SRMR). The results reveal that e-attitude significantly and positively influences visit intention and represents the strongest predictor in the model. Resource efficiency norms also positively affect visit intention, although with a relatively weaker effect. Furthermore, visit intention significantly influences actual visiting behavior and mediates the relationships between antecedent constructs and behavior. These findings indicate that tourists' decisions in smart tourism contexts are shaped by both digital perceptions and sustainability-oriented norms. The study contributes to the literature by extending TPB with digital and sustainability dimensions, thereby providing a more comprehensive explanation of tourist behavior in smart tourism environments. The findings also provide practical implications for destination managers and policymakers seeking to improve digital experiences and promote sustainable tourism practices.

Keywords: e-Attitude, e-Consumption behavior, resource efficiency norms, smart tourism destinations, visitor behavior

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INTRODUCTION

The rapid advancement of digital technologies, including artificial intelligence (AI), big data analytics, the Internet of Things (IoT), and mobile platforms, is fundamentally transforming the tourism industry. In this evolving landscape, smart tourism destinations (STD) have emerged as an integrated development model that leverages digital infrastructure to enhance tourist experiences, optimize resource utilization, and support sustainable destination management (Gretzel et al., 2015; Mandić & Kennell, 2021). Unlike traditional destinations, STD operate as interconnected ecosystems where tourists, service providers, and governing bodies interact through real-time data and intelligent systems (Buhalis & Amaranggana, 2015).Existing research on smart tourism has primarily focused on technological infrastructure, destination attributes, and sustainability outcomes. Prior studies have emphasized the role of smart technologies in improving service quality, enhancing tourist satisfaction, and fostering sustainable development (Cavalheiro et al., 2020; Dabeedooal et al., 2019). Furthermore, studies grounded in behavioral theories-particularly the Theory of Planned Behavior (TPB)-have demonstrated that attitudes, subjective norms, and perceived behavioral control significantly influence tourists' behavioral intentions toward smart tourism destinations (Ajzen, 1991; Sun et al., 2020; Torabi et al., 2022).

However, despite these contributions, important gaps remain in the literature. First, from a theoretical perspective, existing studies largely rely on traditional behavioral frameworks such as TPB, which were developed in pre-digital contexts. These models primarily capture rational and cognitive evaluations but may not fully explain tourists' behaviors in technology-mediated environments, where digital interactions, online perceptions, and electronic experiences play a central role in decision-making (Hasan, 2022b; Jeong & Shin, 2019). Second, from a construct perspective, there is limited integration of digital-era psychological factors-such as e-attitude-into tourism behavior models. E-attitude reflects

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individuals' evaluations of digital technologies and platforms, which are increasingly critical in shaping tourist decision processes (Hasan, 2022a; Berhe et al., 2020). In addition, sustainability-related norms, particularly resource efficiency norms, have been underexplored in the context of smart tourism behavior, despite their growing relevance in environmentally conscious travel (Farrow et al., 2017; Wang et al., 2018).

Third, from a contextual perspective, empirical evidence from emerging smart tourism destinations remains scarce. Most prior studies have been conducted in developed tourism markets, limiting the generalizability of findings to developing regions where digital transformation is still evolving (Novianti et al., 2022). In particular, cities such as Can Tho - an emerging tourism hub in the Mekong Delta of Vietnam-represent an important yet underexplored context for examining the interaction between digital transformation, sustainability, and tourist behavior.

To address these gaps, this study adopts an extended behavioral framework by incorporating e-attitude and resource efficiency norms into the analysis of tourists' visiting behavior toward smart tourism destinations. Specifically, this study aims to: (1) examine the effects of e-attitude and resource efficiency norms on tourists' intentions to visit STD, and (2) investigate the influence of visit intentions on actual visiting behavior.

By doing so, this study makes several contributions. Theoretically, it extends behavioral research by integrating digital and sustainability-related constructs into a unified framework, thereby providing a more comprehensive explanation of tourist behavior in smart tourism contexts. Empirically, it offers evidence from an emerging destination, contributing to the diversification of research settings in the smart tourism literature. Practically, the findings provide implications for policymakers and destination managers in designing strategies that enhance digital engagement and promote sustainable tourism development. Overall, this study responds to the growing need for a more nuanced understanding of tourist behavior in the digital era and contributes to advancing research on smart tourism destinations.

LITERATURE REVIEW

Research on STD has evolved significantly in recent years, particularly with the rapid advancement of digital technologies and the increasing emphasis on sustainability. The existing literature can be critically synthesized into three major research streams: (1) technology-enabled smart tourism systems, (2) behavioral models of tourist decision-making, and (3) digital consumption and sustainability-oriented behavior.

The first stream focuses on the role of smart tourism technologies (STTs) in shaping tourism ecosystems. Early studies conceptualize STD as technology-driven systems that integrate ICT, big data, and IoT to enhance tourist experiences and destination management. More recent studies have extended this perspective by emphasizing the complexity and multi-level nature of smart tourism systems. For instance, a recent systematic review (Yap et al., 2025) highlights that STTs function as interconnected systems in which technological attributes, mediating mechanisms, and contextual conditions jointly shape tourism outcomes under conditions of uncertainty and complexity. Similarly, emerging research has examined how smart tourism service ecosystems and digital platforms influence user experience and engagement, particularly in emerging markets (Qiao et al., 2026). Despite these advancements, this stream remains largely supply-oriented, focusing on technological capabilities while underexploring the psychological and behavioral mechanisms of tourists.

The second stream builds on established behavioral theories, particularly the TPB, to explain tourist intentions and actions. Prior studies consistently confirm that attitude, subjective norms, and perceived behavioral control significantly influence behavioral intention, which in turn predicts actual behavior. However, recent studies have begun to question the adequacy of traditional models in digitally mediated environments. For example, Inmor et al. (2025) propose a context-sensitive model demonstrating that tourist engagement with smart tourism services is shaped by multiple interacting conditions, including technological, social, and experiential factors. Likewise, Singh et al. (2025) highlight the role of technology engagement in strengthening place attachment through smart travel applications, suggesting that emotional and experiential dimensions extend beyond traditional cognitive evaluations. These findings indicate that while TPB remains a useful foundation, it may not fully capture the complexity of behavior in digital tourism contexts.

The third stream focuses on digital consumption behavior and sustainability-related constructs. With the increasing integration of digital platforms, artificial intelligence, and data-driven services, tourists' decision-making processes are increasingly shaped by digital interactions. Recent research shows that features of digital tourism platforms significantly influence tourist experience and revisit intention (Qiao et al., 2026). At the same time, sustainability considerations-particularly resource efficiency and environmental norms-have gained increasing attention as key drivers of responsible tourist behavior. However, these two perspectives (digital behavior and sustainability) are often examined separately, leading to a fragmented understanding of tourist decision-making. A critical synthesis of these research streams reveals several important gaps. First, there is a lack of theoretical integration between technology-driven perspectives and behavioral theories, resulting in limited explanatory power for digitally mediated tourist behavior. Second, digital-era constructs such as e-attitude and technology engagement have not been systematically incorporated into mainstream behavioral models. Third, sustainability-related norms, particularly resource efficiency norms, remain underexplored in the context of smart tourism behavior. Finally, although recent studies (e.g., Yap et al., 2025) have begun to explore emerging markets, empirical evidence from developing smart tourism destinations remains limited.

To address these gaps, this study integrates insights from the three research streams by incorporating e-attitude and resource efficiency norms into an extended behavioral framework. E-attitude captures tourists' evaluations of digital technologies and platforms, while resource efficiency norms reflect socially embedded expectations regarding sustainable behavior. By combining these constructs with behavioral intention, this study aims to provide a more comprehensive explanation of tourists' visiting behavior toward smart tourism destinations, particularly in emerging contexts. Through this

integrative approach, the study contributes to bridging the gap between technology-driven, behavioral, and sustainability-oriented perspectives, thereby advancing the theoretical and empirical understanding of tourist behavior in the digital era.

Smart tourism destination visiting behaviors

Behavior is understood as specific actions of an individual that can be observed and measured based on widely accepted standards (Godey et al., 2016). Within the framework of behavioral theories, many studies affirm that behavior is a direct result of intention, and this intention is influenced by underlying psychological factors. Specifically, Sun et al. (2020) and Hasan & Aziz (2024) show that behavior is a function of intention, where intention is formed based on attitudes, subjective norms, and the individual's perceived behavioral control – consistent with Ajzen (1991) argument in the TPB. This implies that when individuals have a positive assessment of their behavior, receive support from their social environment, and believe in their ability to perform the behavior, they tend to translate their intention into actual action.

In the context of tourism, Ghosh & Mukherjee (2023) argue that tourist behavior reflects the entire decision-making process, including destination selection, trip execution, and evaluation of the experience at that destination. At the same time, Torabi et al. (2022) suggest that the behavior of visiting STD is significantly influenced by the subjective attitudes and norms of tourists. Based on these arguments, it can be argued that the behavior of visiting STD is a result of the visit intention, where the intention is formed not only from traditional elements of TPB but also from elements specific to the digital environment. Specifically, STD visit intention can be determined by online attitudes (e-attitude) and norms of resource utilization efficiency. These factors reflect how tourists value digital experiences, the degree of resource optimization when using technology, and their concern for sustainable tourism development.

This study adopts an extended behavioral framework grounded in the TPB (Ajzen, 1991), integrating digital-era and sustainability-oriented constructs to better explain tourist behavior in smart tourism destinations (STD). TPB has been widely applied in tourism research to predict behavioral intention and actual behavior (Han et al., 2010; Lam & Hsu, 2006). It posits that behavioral intention is the most immediate predictor of behavior, shaped by individuals' attitudes, subjective norms, and perceived behavioral control (Ajzen, 1991). However, TPB was developed in a pre-digital context and primarily emphasizes rational cognitive evaluations. Recent studies suggest that such traditional models may not fully capture decision-making processes in digitally mediated environments, where interactions are increasingly shaped by online platforms, real-time information, and user-generated content (Jeong & Shin, 2019; Hasan, 2022b; Ghosh & Mukherjee, 2023). In addition, sustainability considerations have become increasingly important in shaping tourist behavior, particularly in smart tourism contexts (Mandić & Kennell, 2021; Wang et al., 2018). To address these limitations, this study extends TPB by incorporating two key constructs: e-attitude and resource efficiency norms.

E-attitude and Visit Intention

E-attitude refers to an individual's evaluative disposition toward digital technologies and online platforms used in tourism contexts (Hasan, 2022a; Berhe et al., 2020). In smart tourism environments, tourists rely heavily on digital interfaces such as mobile applications, online reviews, and real-time information systems, which shape perceptions and influence decision-making (Buhalis & Amaranggana, 2015; Gretzel et al., 2015).

Prior research indicates that positive attitudes toward digital technologies significantly enhance users' intention to adopt smart services and engage with digital platforms (Venkatesh et al., 2012). From a theoretical perspective, e-attitude can be considered an extension of the traditional "attitude" construct in TPB, capturing technology-mediated evaluations in digital environments. Accordingly, the following hypothesis is proposed:

H1: E-attitude positively influences tourists' visit intention to smart tourism destinations.

Resource Efficiency Norms and Visit Intention

Resource efficiency norms refer to socially shared expectations regarding responsible and sustainable use of resources (Farrow et al., 2017; Wang et al., 2018). In smart tourism contexts, sustainability is increasingly embedded in destination strategies, often facilitated by digital technologies that promote efficient resource use and environmentally responsible behavior (Mandić & Kennell, 2021). Norm-based theories suggest that individuals' behavioral intentions are influenced by perceived social expectations and moral obligations (Ajzen, 1991; Schwartz, 1977). In tourism, studies have shown that pro-environmental norms significantly affect tourists' decision-making and behavioral intentions (Han et al., 2010; Juvan & Dolnicar, 2014). Thus, resource efficiency norms can be conceptualized as an extension of subjective norms in TPB, emphasizing sustainability-oriented social expectations. Therefore, the following hypothesis is proposed:

H2: Resource efficiency norms positively influence tourists' visit intention to smart tourism destinations.

Visit Intention and Actual Behavior

Consistent with TPB, behavioral intention is the most direct predictor of actual behavior (Ajzen, 1991). In tourism research, visit intention has been widely validated as a strong predictor of actual travel behavior (Lam & Hsu, 2006; Sun et al., 2020). In the context of smart tourism, tourists who develop strong intentions based on digital perceptions and sustainability norms are more likely to translate these intentions into actual visiting behavior.

Thus, the following hypothesis is proposed:

H3: Visit intention positively influences actual visiting behavior toward smart tourism destinations.

Mediating Role of Visit Intention

TPB also suggests that intention serves as a central mediating mechanism linking psychological factors and actual

behavior (Ajzen, 1991). Empirical studies have confirmed that intention mediates the relationship between attitudes, norms, and behavior in tourism contexts (Han et al., 2010; Sun et al., 2020). In this study, visit intention is expected to mediate the effects of both e-attitude and resource efficiency norms on actual behavior.

Therefore, the following hypotheses are proposed:

H4: Visit intention mediates the relationship between e-attitude and actual visiting behavior.

H5: Visit intention mediates the relationship between resource efficiency norms and actual visiting behavior.

Based on a literature review and the formulation of hypotheses regarding the relationships between latent variables, the author proposes a research model -"Factors Affecting Smart Tourist Destination Visiting Behavior: A Case Study in Can Tho City, Vietnam"- as illustrated in Figure 1 below.

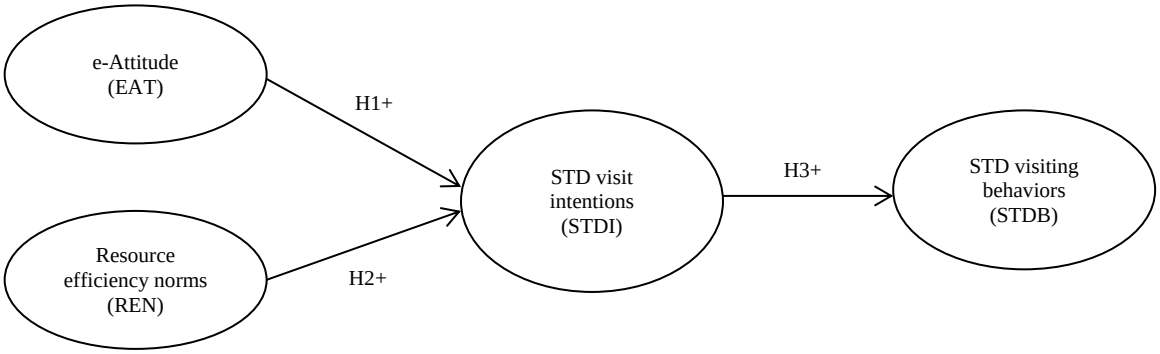


Figure 1. Proposed research model

RESEARCH METHODOLOGY

Measurement scale

All measurement items were adapted from previous studies to ensure the validity of the scale. The content of the scale was slightly modified to align with the research context. Each measurement item was evaluated using a 5-point Likert scale. Refer to Table 1 for a detailed overview of all scales used in this study.

Table 1. Interpretation of observed variables in the research model

Construct	Code	Observed variables	Source
e-Attitude	EAT1	I have a positive view on the application of information and communication technology (ICT) in smart tourism destinations	Hasan et al. (2026)
	EAT2	In my opinion, deploying ICT in smart tourism destinations is a reasonable and effective choice	
	EAT3	I believe that using ICT in smart tourism destinations brings many practical values and benefits to tourists	
	EAT4	The application of IT helps improve the quality of services at smart tourism destinations	Additional information from expert interviews (2025)
	EAT5	I support continued investment and development of IT at smart tourism destinations.	
Resource Efficiency Norms	REN1	I believe that smart tourism destinations adopt water-saving technologies, such as low-flow showerheads, to minimize water usage	Hasan et al. (2026)
	REN2	I believe that smart tourism destinations implement energy-efficient lighting solutions, including LED or CFL bulbs	
	REN3	I believe that smart tourism destinations apply effective insulation materials to buildings to reduce energy consumption for cooling	
STD Visit Intentions	STDI1	I intend to visit smart travel destinations in the near future	Hasan et al. (2026)
	STDI2	I am ready to choose smart travel destinations for my trip	
	STDI3	I will make an effort to arrange my plans so that I can visit smart travel destinations	
STD Visiting Behaviors	STDB1	I frequently visit smart tourism destinations	Hasan et al. (2026)
	STDB2	When traveling, I tend to choose and visit smart tourism destinations	
	STDB3	I often prioritize visiting tourist destinations that incorporate the features of smart tourism	

Data collection

The survey was conducted between August and October 2025 in Can Tho using a convenience sampling approach due to the difficulty of accessing the entire tourist population. According to Hair et al. (2022), convenience sampling is considered acceptable in exploratory and prediction-oriented studies employing Partial Least Squares Structural Equation Modeling (PLS-SEM), particularly when the target population cannot be comprehensively identified. Data were collected through face-to-face interviews to ensure respondents clearly understood the questionnaire items and to improve response validity. The survey participants consisted of tourists visiting representative smart tourism destinations in Can Tho, including Ninh Kieu Wharf, Cai Rang Floating Market, Son Islet, Truc Lam Phuong Nam Zen Monastery, and Binh Thuy Ancient House, which were selected because they represent prominent tourism attractions increasingly integrating digital technologies and smart tourism

practices. A total of 500 questionnaires were distributed, yielding 472 returned responses, corresponding to a response rate of 94.4%. After removing incomplete and unreliable questionnaires, 441 valid observations were retained for analysis, satisfying the recommended sample size requirements for PLS-SEM analysis (Hair et al., 2022). The demographic characteristics of respondents were measured using categorical variables and reported as percentages (%) representing the proportion of respondents within each category relative to the total valid sample (n=441). Regarding gender, male respondents accounted for 46.94% and female respondents accounted for 53.06%. Age was measured in years and classified into ordinal age groups, including under 20 years old (20.86%), from 20 to under 30 years old (40.82%), from 30 to under 40 years old (19.27%), and from 40 to under 50 years old (2.72%). Monthly income was measured in million Vietnamese Dong per month (million VND/month), with 16.33% earning less than 3 million VND, 28.34% earning from 3 to under 6 million VND, 42.86% earning from 6 to under 9 million VND, and 12.47% earning more than 9 million VND per month.

Information on the characteristics of the eligible study sample is presented briefly in Table 2. Overall, the sample structure indicates that young and middle-income tourists constitute the majority of respondents. This demographic profile is consistent with previous tourism technology studies suggesting that younger tourists are generally more familiar with digital technologies and more likely to engage with smart tourism services and technology-enabled travel experiences.

Table 2. The demographic survey data

Demographic profile		**Frequency (n = 441)**	**Percent (%)**
Gender	Male	207	46.94
	Female	234	53.06
Age	Under 20	92	20.86
	From 20 to under 30	180	40.82
	From 30 to under 40	85	19.27
	From 40 to under 50	72	16.33
	Above 50	12	2.72
Income	Under 3 mil VND/month	72	16.33
	From 3 to under 6 mil VND/month	125	28.34
	From 6 to under 9 mil VND/month	189	42.86
	Above 9 mil VND/month	55	12.47

RESULTS

In the initial stage, the measurement model was assessed and analyzed to confirm its quality before advancing to the second stage, which involved evaluating the structural model.

Measuring model

Table 3 demonstrates that all measurement items achieved convergent validity. The table includes Cronbach's Alpha values, average variance extracted (AVE) statistics for each dimension, and factor loadings for each item. With only rare exceptions, the results indicate that the outer loadings of the items were approximately 0.708 or higher, supporting the proposed factor structure (Hair et al., 2022). The AVE values range from 0.639 to 0.748, surpassing the recommended threshold of 0.50 (Hair et al., 2022). Additionally, the composite reliability (CR) and Cronbach's Alpha values, which ranged from 0.719 to 0.907, confirm construct reliability, exceeding the significance threshold of 0.7.

In this study, the heterotrait–monotrait (HTMT) criterion was applied to assess discriminant validity (Henseler et al., 2015). Discriminant validity is established when the square root of the AVE for each construct exceeds its correlations with other constructs. The results presented in Table 4 indicate that the square root of the AVE is higher than the correlations between all pairs of dimensions, confirming discriminant validity.

Table 3. Construct reliability and validity (Notes: CA: Cronbach's Alpha; CR: Composite Reliability, AVE: Average Variance Extracted; OL: Outer Loadings; EAT: e-Attitude; REN: Resource Efficiency Norms; STDI: STD Visit Intentions; STDB: STD Visiting Behaviors)

Construct	**Code**	**CA**	**CR**	**AVE**	**OL**
e-Attitude	EAT1	0.871	0.907	0.663	0.713
	EAT2				0.853
	EAT3				0.838
	EAT4				0.853
	EAT5				0.806
Resource Efficiency Norms	REN1	0.719	0.841	0.639	0.832
	REN2				0.753
	REN3				0.811
STD Visit Intentions	STDI1	0.802	0.883	0.715	0.849
	STDI2				0.825
	STDI3				0.863
STD Visiting Behaviors	STDB1	0.831	0.899	0.748	0.833
	STDB2				0.892
	STDB3				0.868

Table 4. Discriminant validity

Construct	Resource Efficiency Noms	STD Visit Intentions	STD Visiting Behaviors	e-Attitude
Resource Efficiency Noms	**0.800**			
STD Visit Intentions	0.342	**0.846**		
STD Visiting Behaviors	0.223	0.587	**0.865**	
e-Attitude	0.257	0.635	0.630	**0.814**

Structural model

The structural relationships among the constructs were examined using standardized path coefficients (β) and their associated p-values. As reported in Table 5 and Figure 2, both e-Attitude and Resource Efficiency Norms exhibited positive and statistically significant direct effects on STD Visit Intentions ($\beta = 0.586$, $p < 0.05$; $\beta = 0.191$, $p < 0.05$). The significance of these relationships is supported by t-values greater than 1.96 at the 5% significance level, in line with the criteria suggested by Henseler et al. (2009). Notably, e-Attitude emerged as the most influential predictor of STD Visit Intentions, indicating that favorable perceptions of smart technologies strongly enhance tourists' visit intention such destinations. Together, e-Attitude and Resource Efficiency Norms explained 43.8% of the variance in STD Visit Intentions ($R^2 = 0.438$), reflecting a moderate level of explanatory power for the proposed model.

Table 5. Hypothesis analysis results

Relationship	Path coefficients	P- values	Hypotheses	Decision
Direct effects				
EAT → STDI	0.586	0.000	H_1	**Accepted**
REN → STDI	0.191	0.000	H_2	**Accepted**
STDI → STDB	0.587	0.000	H_3	**Accepted**
Indirect effects				
EAT → STDI → STDB	0.344	0.000	H_4	**Accepted**
REN → STDI → STDB	0.112	0.000	H_5	**Accepted**

Notes: EAT: e-Attitude; REN: Resource Efficiency Norms; STDI: STD Visit Intentions; STDB: STD Visiting Behaviors

Hypothesis H_2 posited that resource efficiency norms have a significant effect on tourists' visit intention smart tourism destinations. The results support this hypothesis ($\beta = 0.191$, $p = 0.000$), indicating that stronger resource efficiency norms are positively associated with higher visit intentions. In other words, tourists who are more conscious of efficient resource use are more inclined to visit smart tourism destinations. This finding is in line with previous research by Wang et al. (2018), which also identified a significant relationship between personal norms and visit intention in the smart tourism context.

Similarly, Hypothesis H_3 suggested that the visit intention smart tourism destinations significantly influences actual visiting behavior. The empirical evidence confirms this relationship ($\beta = 0.587$, $p = 0.000$), thereby supporting H_3. This result implies that stronger and more positive intentions increase the likelihood that tourists will engage in actual visiting behavior. The finding is consistent with the study conducted by Hasan and Aziz (2024), which likewise demonstrated that visit intention is a significant predictor of visiting behavior in smart tourism settings.

Collinearity Assessment (VIF): To assess potential multicollinearity issues among the predictor constructs, variance inflation factor (VIF) values were examined. The results indicate that all VIF values ranged from 1.357 to 2.462, which are well below the recommended threshold of 5.0 (Hair et al., 2022). This finding confirms that multicollinearity is not a concern in the structural model and that the predictor constructs are sufficiently distinct from one another. Furthermore, the full collinearity assessment revealed that all VIF values were below the more conservative threshold of 3.3, suggesting that common method bias (CMB) is unlikely to threaten the validity of the results (Kock, 2015). These findings support the robustness and reliability of the proposed model.

Effect Size (f^2): Effect size (f^2) was calculated to evaluate the relative impact of each exogenous construct on endogenous variables. Following Cohen (1988), f^2 values of 0.02, 0.15, and 0.35 indicate small, medium, and large effects, respectively. The results indicate that e-attitude has a large effect on visit intention ($f^2 = 0.571$), suggesting that digital perceptions represent the most influential determinant of tourists' intention to visit smart tourism destinations. In contrast, resource efficiency norms demonstrate a small effect on visit intention ($f^2 = 0.061$), indicating a relatively weaker but still meaningful contribution. Furthermore, visit intention exerts a large effect on actual visiting behavior ($f^2 = 0.526$), confirming the strong predictive role of intention in shaping tourists' actual behavior toward smart tourism destinations. These findings indicate that e-attitude is the dominant predictor of visit intention.

Predictive Relevance (Q^2): Predictive Relevance (Q^2): The predictive relevance of the model was assessed using the blindfolding procedure. According to Hair et al. (2022), Q^2 values greater than zero indicate that the model has predictive relevance for endogenous constructs. The results show that the Q^2 values for visit intention $Q^2 = 0.305$ and actual behavior $Q^2 = 0.254$ are above zero, confirming that the proposed model possesses satisfactory predictive capability.

Model Fit (SRMR): The overall model fit was assessed using the standardized root mean square residual (SRMR). The results show that the SRMR value is 0.070, which is below the recommended threshold of 0.08 suggested by Henseler et al. (2015). This indicates that the proposed model demonstrates an acceptable level of fit and that the discrepancy between the

observed and predicted correlations is relatively small. Therefore, the structural model can be considered well-fitted to the empirical data, supporting the adequacy and robustness of the proposed framework.

Mediating effects

Beyond their direct effects on STD Visit Intentions, the results reported in Table 5 and Figure 2 also indicate the presence of significant indirect relationships. Specifically, e-Attitude has a positive and statistically significant indirect effect on STD Visiting Behaviors through STD Visit Intentions ($\beta = 0.344$, $p < 0.001$). Similarly, Resource Efficiency Norms indirectly influence STD Visiting Behaviors via STD Visit Intentions ($\beta = 0.112$, $p < 0.001$).

These findings suggest that STD Visit Intentions serve as a mediating variable, transmitting the effects of both e-Attitude and Resource Efficiency Norms onto actual visiting behavior. Thus, tourists' favorable attitudes toward smart tourism technologies and their resource efficiency norms contribute to visiting behavior primarily by strengthening their visit intention smart tourism destinations.

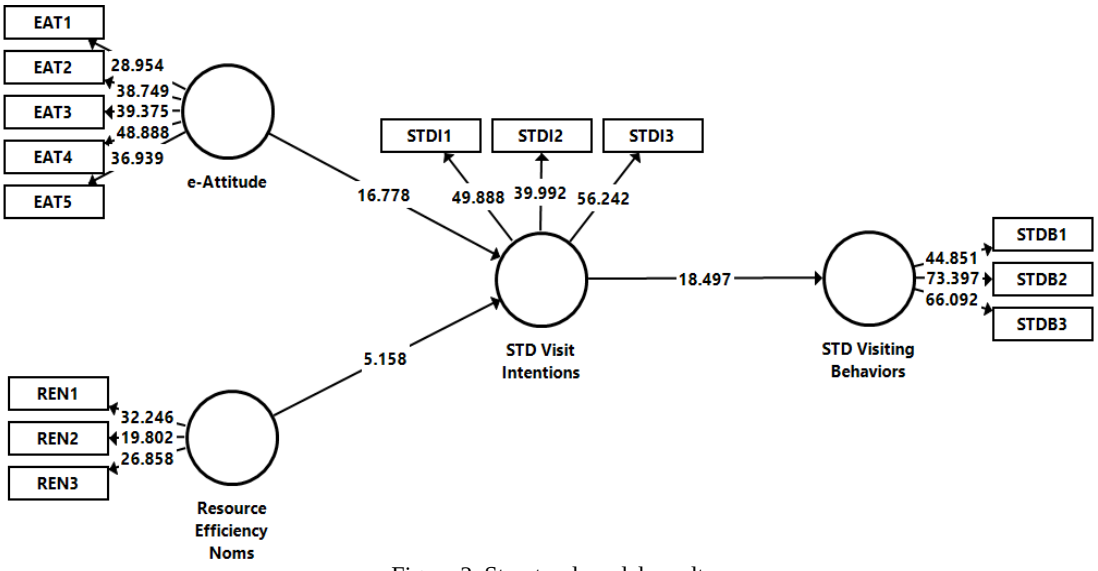


Figure 2. Structural model result

DISCUSSION

This study aims to explain tourists' visiting behavior toward smart tourism destinations (STD) by extending the Theory of Planned Behavior (TPB) with digital and sustainability-related constructs. The findings provide several important theoretical and practical insights.

First, the results demonstrate that e-attitude has a significant and positive effect on visit intention, with the strongest explanatory power among the antecedents. This finding suggests that tourists' evaluations of digital technologies play a central role in shaping behavioral intentions in smart tourism contexts. Unlike traditional tourism settings, where attitudes are formed primarily through offline experiences, smart tourism environments rely heavily on digital interfaces such as mobile applications, online platforms, and real-time information systems. As a result, e-attitude becomes a critical determinant of decision-making. This finding extends TPB by showing that attitude formation in the digital era is increasingly mediated by technology-based interactions rather than purely cognitive evaluations. It is consistent with prior studies highlighting the importance of digital engagement in influencing tourism behavior, but it further emphasizes that such influence operates as a core psychological mechanism rather than a peripheral factor.

Second, the results indicate that resource efficiency norms significantly influence visit intention, highlighting the role of sustainability-oriented social expectations in shaping tourist behavior. This finding supports the extension of subjective norms in TPB by incorporating environmental and resource-related considerations. In the context of smart tourism, where digital systems often promote efficient resource use and sustainable practices, tourists appear to internalize these norms and incorporate them into their decision-making processes. Compared to earlier studies that focus primarily on pro-environmental attitudes, this result suggests that socially embedded expectations regarding sustainability may exert a more structured influence on intention formation. This contributes to the literature by integrating sustainability norms into behavioral models of smart tourism.

Third, the study confirms that visit intention significantly predicts actual visiting behavior, consistent with the core assumption of TPB. This finding reinforces the robustness of intention as a key determinant of behavior, even in digitally mediated environments. Importantly, it suggests that despite the increasing complexity of tourism decision-making, the intention–behavior link remains valid when extended with context-specific constructs. This supports the continued relevance of TPB as a foundational framework while highlighting the need for contextual adaptation.

Fourth, the mediating analysis reveals that visit intention plays a crucial mediating role in linking both e-attitude and resource efficiency norms to actual behavior. This finding provides empirical support for the mechanism proposed in the extended framework, demonstrating that psychological factors influence behavior indirectly through intention.

More importantly, it highlights that both digital perceptions and sustainability norms are not directly translated into behavior but are filtered through a deliberate decision-making process. This insight contributes to a more nuanced understanding of how different types of antecedents operate within the behavioral process in smart tourism contexts.

From a theoretical perspective, this study makes several contributions. First, it extends TPB by integrating digital-era constructs (e-attitude) and sustainability-oriented norms (resource efficiency norms), thereby enhancing its explanatory power in the context of smart tourism. Second, it bridges previously fragmented research streams by combining technology-driven perspectives with behavioral and sustainability-oriented approaches. Third, it provides empirical evidence from an emerging tourism destination, contributing to the diversification of research contexts in the smart tourism literature.

From a practical perspective, the findings suggest that destination managers should prioritize digital experience design to enhance tourists' e-attitude. Investments in user-friendly mobile applications, real-time information systems, and interactive platforms can significantly influence tourists' visit intention.

In addition, policymakers should promote sustainability-oriented communication strategies that reinforce resource efficiency norms, thereby encouraging responsible tourism behavior. Integrating digital innovation with sustainability messaging may create synergistic effects in attracting tourists to smart destinations.

Overall, the study highlights that tourist behavior in smart tourism contexts is jointly shaped by digital perceptions and sustainability considerations, mediated through behavioral intention. This underscores the importance of adopting an integrated approach that combines technological advancement with environmental responsibility in both research and practice.

The findings of this study are broadly consistent with, yet extend, existing research on smart tourism behavior. First, the significant effect of e-attitude on visit intention aligns with prior studies that emphasize the role of digital engagement and technology acceptance in shaping tourist decisions (Jeong & Shin, 2019; Ghosh & Mukherjee, 2023). While earlier research often treats technology-related factors as external drivers of behavior, this study advances the literature by conceptualizing e-attitude as a core psychological construct within an extended behavioral framework. This suggests that digital perceptions are not merely contextual influences but are internalized as part of tourists' evaluative processes.

Second, the positive impact of resource efficiency norms on visit intention is consistent with studies on pro-environmental behavior in tourism (Han et al., 2010; Juvan & Dolnicar, 2014), which highlight the importance of social and moral norms in influencing decision-making. However, this study extends prior work by focusing specifically on resource efficiency within smart tourism contexts, where sustainability is often embedded in digital systems and destination management strategies. This indicates that sustainability-related norms may operate more explicitly and systematically in smart tourism environments compared to traditional tourism settings.

Third, the strong relationship between visit intention and actual behavior confirms the foundational assumptions of the Theory of Planned Behavior (Ajzen, 1991) and is consistent with empirical findings in tourism research (Lam & Hsu, 2006; Sun et al., 2020). Importantly, the present study demonstrates that this relationship remains robust even when the model is extended to include digital and sustainability constructs, thereby supporting the adaptability of TPB in contemporary tourism contexts.Finally, the mediating role of visit intention is in line with prior studies that identify intention as a key mechanism linking psychological factors and behavior (Han et al., 2010; Sun et al., 2020). However, this study contributes further by showing that both digital perceptions (e-attitude) and sustainability norms (resource efficiency norms) operate through this mediating pathway. This provides a more integrated understanding of how diverse antecedents jointly influence tourist behavior in smart tourism destinations.

Overall, while the findings are generally consistent with existing literature, they extend prior research by integrating digital and sustainability perspectives into a unified behavioral framework, thereby offering new insights into tourist decision-making in the era of smart tourism.

CONCLUSION AND LIMITATIONS

This study investigates tourists' visiting behavior toward STD by extending the TPB with digital and sustainability-related constructs. Specifically, the study examines the roles of e-attitude and resource efficiency norms in shaping visit intention and subsequent actual behavior within an emerging smart tourism context.

The findings reveal that both e-attitude and resource efficiency norms significantly influence tourists' visit intention STD, with e-attitude emerging as the strongest predictor. In turn, visit intention plays a central role in translating these psychological factors into actual visiting behavior. The mediating analysis further confirms that intention serves as a key mechanism linking digital perceptions and sustainability norms to behavior. These results highlight the importance of integrating both technological and environmental considerations in understanding tourist decision-making.

From a theoretical perspective, this study contributes to the literature in several ways. First, it extends TPB by incorporating e-attitude and resource efficiency norms, thereby enhancing its explanatory power in digitally mediated and sustainability-oriented contexts. Second, it bridges previously fragmented research streams by integrating technology - driven and sustainability perspectives into a unified behavioral framework. Third, by providing empirical evidence from an emerging smart tourism destination, the study broadens the geographical and contextual scope of existing research.

From a practical perspective, the findings suggest that destination managers should focus on enhancing tourists' digital experiences to foster positive e-attitudes. Investments in user-friendly digital platforms, real-time information systems, and interactive services can significantly increase tourists' visit intention.

In addition, policymakers should promote sustainability-oriented initiatives and communication strategies that reinforce resource efficiency norms, thereby encouraging responsible tourism behavior. The integration of digital innovation and sustainability practices can create a competitive advantage for smart tourism destinations.

Despite these contributions, the study has several limitations. The use of convenience sampling may limit the generalizability of the findings, and the focus on a single destination context may restrict external validity. Furthermore, the study considers a limited set of constructs, and future research is encouraged to incorporate additional variables, such as perceived behavioral control, trust in technology, and perceived risk. Longitudinal and comparative studies across different destinations would also provide deeper insights into the dynamics of tourist behavior in smart tourism environments.

In conclusion, this study demonstrates that tourist behavior in smart tourism destinations is shaped by the combined influence of digital perceptions and sustainability-oriented norms, mediated through behavioral intention. By adopting an integrated theoretical approach, the study provides a more comprehensive understanding of tourist decision-making in the digital era and offers valuable implications for both research and practice.

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THE FACTORS INFLUENCING THE SATISFACTION OF THAI PASSENGERS ON THE INTERNATIONAL RAILWAY ROUTE BETWEEN BANGKOK (THAILAND) AND VIENTIANE (LAOS)

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Abstract: Laos is a destination with beautiful culture, traditions and nature that attracts many tourists, especially Thai tourists, so there is a strong tourism link between the two countries. The Thailand-Laos railway, the Krung Thep Aphiwat Central Terminal - Vientiane (Khamsavath) route, which is an important new railway tourism route to connect the capitals of the two countries. This research aims to study the experiential international economic factors, the market mix and satisfaction factors for Thai service users on the Thai-Laos railway service. The samples are Thai passengers who used the train service on the route between Krung Thep Aphiwat Central Terminal (Bangkok) of Thailand and Vientiane Railway Station (Khamsavath) in Laos in both directions with 394 respondents. Questionnaires collected from Google Forms were employed to collect data from a randomly selected convenience sample. Data were analysed using confirmatory factor analysis (CFA) and structural equation model analysis (SEM) to verify the accuracy of the latent variable structure and the consistency of the model with empirical data by using the JASP 0.19.3 software. Analysis results from CB-SEM revealed that the marketing mix factor had the greatest positive influence on satisfaction and the dimension of service delivery was found to be the main factor. In addition, experiential and international economic factors were found to have a significant indirect influence. This emphasizes the importance of security management and clear information communication. Relevant agencies should adopt guidelines, seamless service and joint testing to reduce the travel time and anxiety of passengers. In addition, there are suggestions to integrate cross-border travel insurance into the ticketing system to reduce risk perception and to meet international safety standards for tourism on the Thailand-Laos railway route.

Keywords: Thai - Lao Railway, satisfaction, marketing mix, international economics, experience

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INTRODUCTION

Rail transport is crucial in connecting various aspects, including society, culture, economy, tourism, and investment, both domestically and internationally. This leads to development in connected areas, generating income and employment, attracting investment, and facilitating cultural exchange. An example is the Laos-China railway line, which connects the economy, investment, and tourism in the Greater Mekong-subregion. In regard to the intermediary country in the Mekong sub-region, the Lao People's Democratic Republic (Laos), there are unique tourist attractions and beautiful nature that attract both domestic and international tourists to popular destinations in Lao, such as Luang Prabang and Vang Vieng.

According to a report by The Laotian Times (2025), Laos was expected to welcome more than four million tourists, an increase of nearly one million compared to 2023. This was a result of the "2024 Visit Laos Year" policy where Laos granted special visa waivers to visitors from more than 30 countries. In addition, Luang Prabang was descibed as "a hidden paradise" by Time magazine in 2023 and one of the 50 best places to visit (Vientiane Times, 2025). This implies that Laos is a popular tourist attraction in the GMS. In 2024, The Laotian Times (2025) reported that the number of Thai tourists traveling to Laos ranked first at 1,215,553. This was followed by Vietnam and China. Hence, Thai tourists are significant in the regional market of Laos. There is, therefore, a strong connection between the tourism businesses of Thailand and Laos.

The Lao government has invested in infrastructure development, such as roads, transportation such as trains and facilities to support tourism (Lao News Agency, 2024). In addition, a new railway route has been created while the train route from Krung Thep Aphiwat Central Terminal (Bangkok) to Vientiane Railway Station (Khamsavath) also began to provide services. The first train operation between Krung Thep Aphiwat Central Terminal and Vientiane Railway Station (Khamsavath) was inaugurated on 19 July 2024 (Figure 1.). There was a lot of interest from tourists and the public and, as a result, all of the seats were booked in a short time (State Railway of Thailand (SRT), 2024).

This railway is part of the international economic and development cooperation in Southeast Asia between Thailand and Laos (Nonthapot et al., 2025). The railway supports cost reduction and increases the potential for cargo transportation.

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Figure 1. International rail link Thailand and Laos: Krung Thep Aphiwat Central Terminal – Vientiane Station (Khamsavath) route (Google Maps, 2025; datasource for the photos: authors, 2025)

It is continuous investment and creates opportunities for the Thai private sector to do business in Laos (Neighboring Countries Economic Development Cooperation Agency (NEDA), 2023).

Laos is a destination with beautiful culture, traditions and nature that attracts many tourists, especially Thai tourists, so there is a strong tourism link between the two countries. The Thailand-Laos railway, the Krung Thep Aphiwat Central Terminal - Vientiane (Khamsavath) route, which is an important new railway tourism route to connect the capitals of the two countries. As a result, tourism, investment, opportunity creation, and international development have been enhanced. Studying tourist behavior in regard to marketing strategies is considered important to plan and develop services to be effective and responsive to needs. and to determine the level of satisfaction with the use of the service (Qin, 2012)

However, there are still limited academic studies on satisfaction in regard to the use of the Thailand-Laos railway (Krung Thep Aphiwat Central Terminal (Bangkok) - Vientiane Railway Station (Khamsavath). The study based on marketing education in this area in regard to rail transportation lacks academic attention. In order to better understand the factors affecting the satisfaction of using the railway service between Thailand and Laos need to be studied to fill the gaps. The results can be used as guidelines to support the government and the private sector, who will be able to use the information obtained from the research to develop and improve services to meet the demand for the Thailand-Laos railway.

MATERIALS AND METHODS

Related concepts and theories

Ideas and research related to the marketing mix and satisfaction. Tourism industry marketing research is the analysis of tourism resources and services that can be sold to tourists. This research is a study of Thai passengers using the Thailand-Laos railway service, and in the rail transportation business, there are three important elements: 1) trains, 2) routes, and 3) railway stations. Once the resources and services are known, attention is given to the tourism marketing mix, which is a strategic marketing tool that entrepreneurs can employ to generate results and drive demand to meet their goals by encouraging tourists to travel and buy tourism services. This allows tourism business operators to make profits and to develop services to satisfy tourists (Jittangwattana, 2012; Kotler et al., 2014). Furthermore, the future research directions proposed by Wahpiyudin et al. (2025) emphasize the importance of developing marketing models tailored to local context, which aligns with the present study's focus on analyzing marketing factors along the Thai-Laos railway route.

This marketing model consists of several components. Kotler et al. (2014) described the marketing framework in terms of the basic marketing mix, or 4Ps, which consist of Product, Price, Place, and Promotion. These are the main elements used in general marketing strategy. However, in the context of service marketing, Booms & Bitner (1981) expanded this concept, suggesting that in addition to the basic 4Ps, three more elements should be emphasized to reflect the specific characteristics of the service: People (including employees and stakeholders), Process (related to the procedures and methods of service delivery), and Physical Evidence (which helps build awareness and trust among service recipients).

Thus, these seven Ps are used as a key conceptual framework in service marketing. In addition, Jittangwattana (2012) proposed a tourism marketing concept with basic elements like Booms & Bitner's (1981) but adapted it to the specific

context of the tourism industry. The key difference is that the role of the people component in the tourism industry (people in tourism) was expanded to encompass a wider range of dimensions.

Furthermore, elements such as the integration of tourism services (packaging in tourism) to create value and convenience for tourists, the organization of activities or events to attract tourists (tourism programming), and the creation of business partnerships (partnership in Tourism) have been added to strengthen the networks and to enhance the overall competitiveness of the tourism industry (Jittangwattana, 2012). Kotler et al. (2014) described the 4Ps as follows:

1) Product means the goods and services offered by the entrepreneur to the target market.

2) Price refers to the amount of money that customers have to pay to acquire the product or service.

3) Distribution channel (Place) refers to the activities of the entrepreneur that enables the product or service to reach customers.

4) Promotion refers to activities used to communicate the value of products and services to attract customer interest.

The desired outcome of tourism operators is satisfaction. Satisfaction helps researchers to understand the needs of consumers and confirms the consumer's ability to make decisions about goods and services (Oliver, 1997). Consumer satisfaction is an emotional response, and the focus of the response is based on a comparison of performance with certain standards, which vary from context to context. It may be a comparison of general or specific standards, and the period in which consumers evaluate satisfaction can occur at a variety of moments (Giese & Cote, 2000). It is divided into three levels. Dissatisfaction occurs when a customer receives a product or service that is worse than expected; satisfaction occurs when a customer receives a product or service that meets their expectations, and a high level of satisfaction occurs when a customer receives a product or service that exceeds their expectations.

A review of relevant research in the tourism and hospitality industries revealed that the marketing mix affects satisfaction regarding the decision to buy products or services in the tourism industry. Rattanasomchok (2015), Pannarong (2017), Sirimongkol (2023), Thet (2023), Baidun et al. (2022), Tielung & Untu (2021), Do & Vu (2020), Magatef (2015) all pointed out that the 7Ps marketing mix affects consumer satisfaction in different contexts.

In addition, studies conducted in the context of bus travel in Thailand and Asia by Kieanwatana et al. (2022), Chanchai & Suwan (2021), and Phornthepkasemsant et al. (2021) also discussed the factors influencing decision-making and satisfaction in regard to train travel in normal and COVID-19 situations. It was found that passengers paid attention to safety, time, and the care of the staff, the convenience of service and connecting to the train station, access to information and a fast process for buying tickets and making payments. In addition, Sangpikul (2018); Vuong et al. (2024); Setiawan et al. (2024) discussed service quality factors related to customer experience, such as service providers, reliability, customer experience, Internet of Things (IoT), services and facilities, safety and cleanliness, which all affect satisfaction and loyalty to the service or destination.

The components of satisfaction measured by the passenger's experience after using the service on a train journey are consistent with the concept of Yuda Bakti & Sumaedi's (2015) P-TRANSQUAL which was developed from Parasuraman's SERVQUAL concept, Zeithaml & Berry (1988) and Cronin & Taylor (1992) as described by Yuda Bakti & Sumaedi (2015). They described the elements, which included 1) Comfort, 2) Tangible components, 3) Personnel, and 4) Reliability in measuring the quality of land transportation services in Indonesia. Nonthapot & Nasoontorn (2020), also studied the impact of service quality on the satisfaction of passengers traveling on routes between Thailand and Laos.

Concepts and research related to the field of travel experience

Social factors influence consumer behavior, including some informal groups, such as friends, family members, colleagues and neighbors. Family members can have a great influence on purchasing decisions, including abstract travel product purchases. Before deciding to purchase goods or services, tourists cannot usually experience the good or services to see if they will be satisfied or not. Therefore, it is important to rely on the recommendations of others (Kotler, 2000; Jittangwattana, 2012). This is in line with Pan et al. (2021) who studied tourist destination choice as affected by the destination images of social network members. This study revealed that the decision of tourists to visit destinations is influenced by family members, friends, colleagues, and social media members, who contribute by increasing their knowledge about the destination. It is also consistent in terms of reviews on social networks (Kim & Park, 2017), and it can also predict the performance of the services.

In other words, the review score on social media affects the user's decision to use the service. In addition, Nonthapot (2019b) also found that the people who influence travel decisions, the length of stay and the method of booking also affect the decision to travel. In the context of the China-Laos railway corridor, Liu et al. (2026) demonstrate that the railway infrastructure plays a significant role in reducing time-related frictions, which is a critical factor shaping the travel experience of time-sensitive passengers who prioritized speed and reliability. Nonthapot & Thomya (2020) also found that knowledge of Thai and foreign tourists traveling in Nong Khai and Bueng Kan provinces, which are linked to Laos, consists of life experience, learning lifestyle and travel experiences. From the above review, according to Nonthapot (2019b), the travel experience factor is influenced by the people around you, including family and friends, as well as social media, the length of stay, and how a reservation is made. Therefore, this research employs seven variables 1) the people around them, 2) social media, 3) booking method, 4) length of stay, 5) duration of travel, 6) life experience, and 7) lifestyle.

Concepts and research related to the field of international economics

Marketing analysis of the tourism industry involves analyzing the needs and behaviors of tourists, which change over time and depend on economic and social environments. These factors affect consumption and spending in various ways. It was found that tourists desire destinations with a low cost of living but standard services, as well as convenience and safety

(Jittangwattana, 2012; Kotler et al., 2014). These are consistent with Yai-in et al. (2023), a study of the economic corridors of the Greater Mekong Subregion countries along the Ayutthaya-Nong Khai-Vientiane-Luang Prabang-Bangkok route revealed that relatively low costs influence tourists' decisions to travel along the Mekong Subregion Silk Road. Foreign tourists perceive the cost of living in these countries as not excessively high when comparing the exchange rates of Western currencies against the currencies of China, Thailand, and Laos. It is also in line with the findings of Nonthapot & Lean (2015), cited in Nonthapot (2019b), which revealed that exchange rates are an important variable that affects travel. The lodging business, which is part of the tourism industry, may be also be related. Train travel is also one of the elements of the tourism industry. In addition, Ruengmaneekit & Chaiboonsri (2014), studied the international tourism demand model by studying Malaysia, Thailand and Singapore by analyzing the relationships between the following economic variables: tourist income, exchange rate, and travel expenses that affect the travel of foreign tourists. The change is in the same direction as the number of tourists visiting Thailand. In other words, if these economic factors change, it may result in an increase in the number of tourists visiting Thailand. However, the cost of travel has changed in the opposite direction to the number of tourists entering Thailand. If the cost of travel increases, the number of tourists visiting Thailand will decrease.

In addition, the studies by Rifai & Kurniawan (2023) and Nonthapot (2019b) both revealed that the number of foreign tourists visiting Indonesia is significantly influenced by economic growth and exchange rate fluctuations, reflecting the role of macroeconomic factors in foreign tourists' travel decisions. Beyond exchange rates affecting travel, Nonthapot (2019b) further noted that the opening of the country and participation in the ASEAN Economic Community (AEC) significantly facilitate international tourist movement and clearly stimulate regional tourism. These findings are consistent with the work of Pimsakul & Nimsai (2015), who predicted the impact of AEC policies on trade and tourism in border towns of Chiang Rai province. They found that border trade and transportation and economic connectivity with neighboring countries in the Mekong sub-region acted as important attractions, positively impacting the expansion of trade and tourism in the area. This aligned with the regional cooperation context highlighted by Yang et al. (2026), who found that regional collaboration and infrastructure development particularly the Thai-Laos railway serves as key factors in reducing cross-border trave barriers, thereby facilitating passenger's decisions to travel by rail.

In conclusion, the international economic factors in the decision to use the Thailand-Laos railway service of Thai passengers are observed in regard to five variables: 1) exchange rate, 2) immigration formalities, 3) travel expenses, 4) participation in the ASEAN Economic Community (AEC), 5) connection with neighboring countries.

Moreover, in regard to the 7Ps marketing concept, the correlation coefficients between the variables showed the relationship between the 'People' and 'Process' variables. In order to prevent problems of multicollinearity, the researcher considered the concept of Hair et al. (2019) to combine the two variables, which is based on the theoretical concept of Grönroos & Ravald (2011), which described the service as business logic that involves the connection between the service provider and the functional system of these two variables. This is also consistent with the Service Delivery System in the work of Lodorfos et al. (2015) in terms of employee performance elements and process control with the goal of bridging the gap between customer expectations and the experience gained.

In addition, Brady & Cronin (2001) stated that interaction quality is a dimension that measures the functional quality of a service, which reflects the elements of 'People' (measured by the attitudes, behaviors, and expertise of employees) and 'Process' (delivery methods). Therefore, the researcher defined the Service Delivery (SERV) variable and renamed the observable variable in the next step of the confirmatory component analysis. The proposed conceptual framework and the hypotesized relations among the study variables are graphically illustrated in Figure 2.

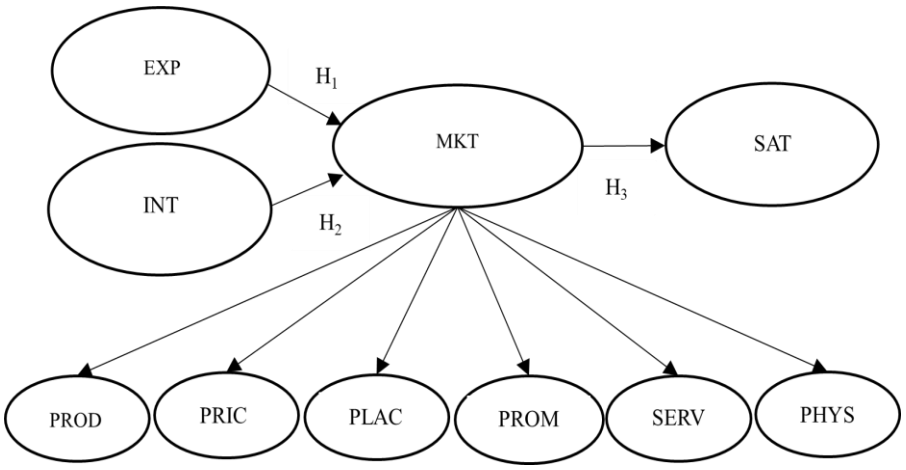


Figure 2. The proposed conceptual framework of the study

Hypotheses in the study

H1: Experience factors influence the decision to use the Thailand-Laos railway, depending on marketing mix factors.

H2: International economic factors affect the decision to use the Thailand-Laos railway, depending on marketing mix factors.

H3: Marketing mix factors affect satisfaction with the Thailand – Laos Railway Service.

Population and sample selection

The target population of this study consisted of Thai passengers who used the train service on the route from Krung Thep Aphiwat Central Terminal and Vientiane Railway Station (Khamsavath) in both directions. Due to the unknown total population size, a sample size of 400 was determined, following the methodological precedents of Sihabutr & Nonthapot (2021), cited in Nonthapot et al. (2024) and Nonthapot et al. (2025). This sample size ensures accuracy in data analysis. A convenience sampling technique was employed for data collection. Following the collection phase, data screening was conducted to identify multivariate outliers using Mahalanobis Distance Square. Observations with a p-value of less than 0.001 were excluded from the dataset, resulting in a final valid sample of 394 respondents for the structural equation modeling analysis.

Research Instrument and Measurement

The research instrument was a structured questionnaire comprising 54 items, organized into four main sections. The first section gathered respondents' demographics and general information. The second section assessed factors related to passenger experience and international economics, which influenced the decision to use the service. The third section examined the Marketing Mix (7Ps) and its impact on satisfaction. The fourth section measured the overall satisfaction level of passengers using the Thailand – Laos railway service. All items in the second to fourth sections were measured using a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (Strongly agree) (Best, 1981).

Statistical Data Analysis

1) Basic statistical analyses of the studied variables, including mean, median, popularity, skewness, and skewness were conducted. In normal distribution checks, the absolute value of the skew does not exceed 1.0 and the absolute value of the skewness does not exceed 1.5 (Schumacker & Lomax, 2004; Sirimat & Nonthapot, 2025).

2) Correlation coefficient analysis between variables/indicators (Correlation Coefficient) consider the direction and relationship of the variables.

3) Verification of the consistency of the model with empirical data (Overall Testing). It is a confirmatory component analysis to prove the acquired model, which is determined by statistical values. The acceptable value of the Relative Chi-Square: χ^2/Degree of Freedom value must be less than 5.00 (Wheaton et al., 1977); for RMSEA (Root Mean Square Error of Approximation), the acceptable value must be less than 0.07 (Steiger, 2007); the CFI (Comparative Fit Index)/TLI (Tucker-Lewis Index) value must not be less than 0.90 (Hu & Bentler, 1999; Schumacker & Lomax, 2004), and for the statistical value SRMR (Standardised Root Mean Square Residual), the acceptable value must be less than 0.08 (Hu & Bentler, 1999).

4) Structural Straightness Evaluation of Latent Variable Measurement Models (Measurement Model) is based on the weight of the elements (λi), which should be greater than 0.50 or the statistically significant Cronbach's Alpha should be greater than 0.70 and the average of the extractable variability of the latent variable (AVE) should be greater than 0.50 (Henseler et al., 2015)

5) Evaluation of the classified accuracy between the latent variables (Discriminant Analysis Validity) checks that the relationship of the latent variables in the structural equation model are sufficiently correlated to analyze the structural equation model.The correlation coefficients between the latent variables in the research model are not more than the square root value of AVE (Fornell & Lacker, 1981).

6) The conformity of the model (Overall Testing) is developed with empirical data based on model consistency index values, as well as structural straightness tests. The value of each parameter and the reasonableness of the size and direction of each parameter value is according to the assumption mentioned above.

RESULTS

General information of the respondents

Based on the analysis of the sample data, the number of train users 394 was found to be as follows: 225 females, accounting for 57 percent. 167 people aged between 21-30 years old, accounting for 42 percent.The highest level of education was at the undergraduate level, with 254 students, accounting for 64.5 percent, of which 239 students or 60 percent were students, followed by employees/employees of private businesses. 54 people, 13.7 percent, with an average monthly income of not more than 10,000 baht, 182 people, or 46.2 percent, followed by 115 people with an income of 10,001 – 20,000 baht, at 29.2 percent.

Empirical Analysis

Regular Distribution Verification for Suitability of Element Analysis Assertionist and Structural Equation Model Analysis. The results of the analysis of the skewness and popularity of the variables showed that the skewed value was in the range of -1.00 to -0.51. The absolute value of skewness was not more than 1.00 and the absolute value of the skewness was in the range of -0.64 to 0.89 (Schumacker & Lomax, 2004) and represents data from that variable with a normal distribution. This set of data is suitable for estimation by the Maximum Likelihood (ML) in affirmative element analysis and structural equation model analysis.

Results of confirmatory component analysis to verify the structural straightness of latent variables

When the data has been normalized and the structural model has been adjusted, the next step is to test the confirmatory component to see whether the model is consistent with the empirical data. It is measured by the consistency value of the model (Model Fit) and evaluates the structural accuracy of the measurement model (Construct Validity) including the classification

of the latent variables. Moreover, Discriminant Validity is employed to examine the relationship of the latent variables in the structural equation model as to whether there is a sufficient correlation to analyze the structural equation model.

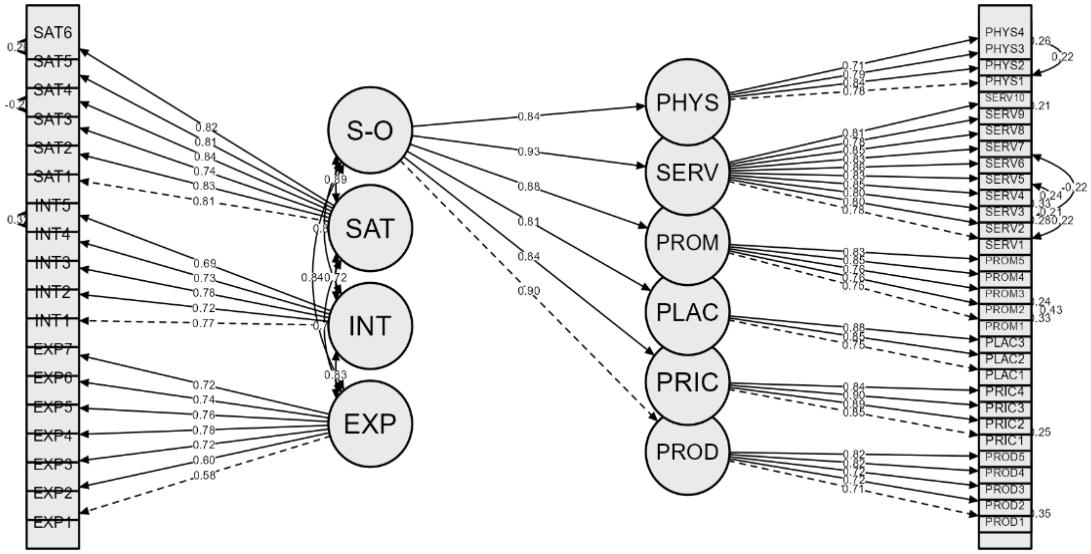


Figure 3. CFA Diagram of the measurement model Source: Output from JASP 0.19.3 (2025)

Figure 3 shows that the model is consistent with the empirical data. From the conformity measurement index of the model through a specified criterion, the statistical value of the relative kai-square (Relative Chi-Square: χ^2/Degree of Freedom) is 2.447, where the acceptable value must be less than 5.00 (Wheaton et al., 1977). The acceptable value of RMSEA must be less than 0.070 (Steiger, 2007). The CFI/TLI (Tucker-Lewis Index) values are 0.902 and 0.900 respectively. The acceptable value must not be less than 0.90 (Hu & Bentler, 1999; Schumacker & Lomax, 2004) and the statistical value SRMR value is 0.046, while the acceptable value must be less than 0.08 (Hu & Bentler, 1999).

$$\chi^2 = 2687.082, df = 1098, \chi^2/df = 2.447, CFI = 0.902, TLI = 0.900, RMSEA = 0.061, SRMR = 0.046$$

Table 1. Results of the CFA for the measurement model (Source: Compiled from the authors' calculations)

Second-Order Variable	First-order variables	Question Item	Factor Loading (λ)	R^2	CR	AVE	95% Confidence Interval	
							Lower	Upper
	EXP				**0.873**	**0.497***		
		EXP1	0.578***	0.334			0.507	0.649
		EXP2	0.601***	0.361			0.533	0.669
		EXP3	0.722***	0.522			0.669	0.775
		EXP4	0.783***	0.613			0.738	0.827
		EXP5	0.762***	0.580			0.714	0.809
		EXP6	0.744***	0.554			0.694	0.794
		EXP7	0.719***	0.516			0.665	0.772
	INT				**0.855**	**0.543**		
		INT1	0.772***	0.596			0.724	0.819
		INT2	0.717***	0.514			0.662	0.772
		INT3	0.777***	0.604			0.730	0.824
		INT4	0.726***	0.527			0.671	0.780
		INT5	0.687***	0.472			0.628	0.747
	SAT				**0.918**	**0.651**		
		SAT1	0.808***	0.653			0.770	0.846
		SAT2	0.828***	0.685			0.793	0.863
		SAT3	0.739***	0.547			0.690	0.789
		SAT4	0.838***	0.702			0.804	0.873
		SAT5	0.806***	0.65			0.768	0.845
		SAT6	0.817***	0.668			0.780	0.855
MKT					**0.949**	**0.756**		
	PROD		**0.903*** **	**0.816**	**0.871**	**0.576**	**0.873**	**0.934**
		PROD1	0.711***	0.505			0.656	0.765
		PROD2	0.721***	0.519			0.667	0.774
		PROD3	0.719***	0.517			0.666	0.772
		PROD4	0.817***	0.667			0.777	0.856
		PROD5	0.820***	0.673			0.781	0.859

	PRIC		**0.843*** **	**0.710**	**0.926**	**0.758**	**0.806**	**0.879**
		PRIC1	0.846***	0.716			0.812	0.880
		PRIC2	0.888***	0.788			0.861	0.915
		PRIC3	0.904***	0.817			0.880	0.928
		PRIC4	0.843***	0.710			0.810	0.876
	PLAC		**0.806*** **	**0.650**	**0.867**	**0.686**	**0.761**	**0.851**
		PLOT1	0.746***	0.556			0.695	0.796
		PLOT2	0.852***	0.726			0.816	0.889
		PLOT3	0.881***	0.776			0.848	0.914
	PROM		**0.882*** **	**0.778**	**0.893**	**0.627**	**0.849**	**0.915**
		PROM1	0.747***	0.558			0.697	0.798
		PROM2	0.763***	0.582			0.715	0.811
		PROM3	0.763***	0.582			0.715	0.811
		PROM4	0.848***	0.719			0.813	0.883
		PROM5	0.832***	0.692			0.794	0.869
	SERV		**0.932*** **	**0.868**	**0.953**	**0.672**	**0.912**	**0.952**
		SERV1	0.777***	0.604			0.736	0.819
		SERV2	0.798***	0.637			0.759	0.837
		SERV3	0.797***	0.635			0.759	0.836
		SERV4	0.848***	0.719			0.817	0.878
		SERV5	0.830***	0.689			0.797	0.863
		SERV6	0.857***	0.735			0.829	0.886
		SERV7	0.832***	0.693			0.799	0.865
		SERV8	0.855***	0.731			0.826	0.884
		SERV9	0.781***	0.61			0.740	0.822
		SERV10	0.814***	0.663			0.779	0.850
	PHYS		**0.844*** **	**0.713**	**0.862**	**0.611**	**0.803**	**0.886**
		PHYS1	0.782***	0.612			0.735	0.829
		PHYS2	0.837***	0.700			0.797	0.877
		PHYS3	0.793***	0.628			0.747	0.838
		PHYS4	0.708***	0.502			0.649	0.768

Variable: EXP = Experience Factor; EXP1 = Personal recommendations (Word-of-Mouth from family and friends); EXP2 = Social media influence and online travel reviews; EXP3 = Online booking accessibility via website and mobile applications; EXP4 = Length of stay at the destination; EXP5 = Travel duration; EXP6 = Experiential learning and life experience through rail travel; EXP7 = Lifestyle-based transportation mode preference; INT = International economics; INT1 = Currency exchange rate volatility; INT2 = Simplicity and convenience of immigration procedures; INT3 = Overall travel and tourism expenditures; INT4 = Regional integration (AEC membership and visa-free policies); INT5 = Cross-border linguistic proximity and communication ease; MKT = Marketing Mix; PROD = Product; PROD1 = Expediency and swiftness of travel; PROD2 = Frequency/Headway of train departures; PROD3 = Cleanliness of seating and interior cabin; PROD4 = Safety and security of the passenger coaches; PROD5 = Adequacy of on-board facilities and amenities; PRIC = Price; PRIC1 = Perceived value for money regarding service quality; PRIC2 = Fare proportionality relative to travel distance; PRIC3 = Fare affordability and economic reasonableness; PRIC4 = Diversity of fare classes and pricing options; PLAC = Place; PLAC1 = Convenience of ticket purchasing and refund processes; PLAC2 = Adequacy of ticket counters at railway stations; PLAC3 = Diversity and accessibility of ticket booking channel; PROM = Promotion; PROM1 = Diverse multi-channel advertising and public relations; PROM2 = Corporate Social Responsibility (CSR) activities during festivals; PROM3 = Communication via telephone hotline (Call Centre 1690); PROM4 = Tourism promotion and destination marketing; PROM5 = Modernized corporate image of the State Railway of Thailand; SERV = Service delivery; SERV1 = Appropriateness of staff appearance and grooming; SERV2 = Staff courtesy and professional conduct; SERV3 = Staff attentiveness and helpfulness; SERV4 = Effectiveness and accuracy of staff communication; SERV5 = Promptness in staff problem-solving; SERV6 = Efficiency in travel safety management; SERV7 = Travel convenience and comfort; SERV8 = Service delivery speed and responsiveness; SERV9 = Train punctuality and on-time performance; SERV10 = Adequacy of staffing levels for passenger service; PHYS = Physical; PHYS1 = Adequacy of station amenities and structure; PHYS2 = Visibility and accessibility of station information counters; PHYS3 = Adequacy, cleanliness, and safety of station waiting areas; PHYS4 = Cleanliness of restroom at station, terminal, and platforms; SAT = Satisfaction; SAT1 = Overall perceived safety and security of service; SAT2 = Physical environment of trains and stations (modernity and functional utility); SAT3 = Cleanliness of passenger coaches and station facilities; SAT4 = Service performance of on-board and station staff; SAT5 = Adequacy of train capacity and coach dimensions; SAT6 = Reasonableness of waiting and travel time duration

Table 1 shows that all variable measurement models are consistent with the empirical data, and all observable variables are observed. It can explain the variance of the measurement model statistically significant at the level of 0.001 and has a component confidence value where CR is 0.855 – 0.953 as well as having a straightness that is measured by the average of the extractable variability of all variables according to the specified criteria.

The AVE value is 0.497 – 0.758 and from the AVE value of the EXP variable (AVE = 0.497), the value is less than 0.50, but with the criteria of Fornell & Larcker (1981) is acceptable since the CR value is greater than 0.700 (CR = 0.873), so it can be concluded that all variables are structurally straight.

Discriminant Validity Assessment Results

Based on the estimation of the variable classified straightness measurement model (Discriminant Validity) from the

evaluation method of Fornell & Larcker (1981), the evaluation criterion is that the correlation coefficient between the latent variables must not exceed the square root value of the value. The AVE of the latent variables defined criterion has one pair where the correlation coefficient is greater than the square root of the value (Table 2).

Table 2. Discriminant validity assessment using the Fornell & Larcker (1981) criterion (Source: Compiled from the authors' calculations)

Construct	EXP	INT	PROD	PRIC	PLAC	PROM	SERV	PHYS
EXP	0.686							
INT	0.840	0.737						
PROD	0.780	0.780	0.760					
PRIC	0.703	0.789	0.778	0.876				
PLAC	0.703	0.631	0.777	0.690	0.825			
PROM	0.811	0.710	0.787	0.738	0.755	0.790		
SERV	0.754	0.788	0.825	0.807	0.716	0.800	0.821	
PHYS	0.694	0.628	0.721	0.608	0.712	0.769	0.753	0.800

For the result of the Heterotrait-Monotrait Ratio (HTMT) of correlations in Table 3, it was found that for the threshold of the HTM that can be used to evaluate the categorical accuracy, all variables meet the specified criteria, which are not more than 0.85 (Voorhees et al., 2016; Roemer, 2021). Therefore, there is a value that fits the criteria (Anderson & Gerbing, 1998; Bagazzi & Phillips,1982).

Table 3. Result of the Heterotrait-Monotrait Ratio (HTMT) of correlations (Source: Compiled from the authors' calculations)

Construct	EXP	INT	PROD	PRIC	PLAC	PROM	SERV	PHYS
EXP	1.000							
INT	0.821	1.000						
PROD	0.787	0.799	1.000					
PRIC	0.686	0.783	0.792	1.000				
PLAC	0.691	0.611	0.786	0.696	1.000			
PROM	0.792	0.665	0.768	0.697	0.741	1.000		
SERV	0.736	0.776	0.824	0.802	0.708	0.766	1.000	
PHYS	0.694	0.605	0.723	0.611	0.720	0.770	0.751	1.000

Results of Hypothesis Testing, Experience Factors, International Economic Factors, and Market Factors Affecting Satisfaction with the Thai-Laos Railway Service

Figure 4 demonstrates that the structural equation model is consistent with the empirical data at an acceptable level. The conformity measurement index of the model met the specified criteria. $X^2 = 2543.809$, df = 1049, $X^2/df = 2.424$, RMSEA = 0.060, CFI = 0.905, TLI = 0.900 and SRMR = 0.047. From all the ststistic values, it can be estimated as shown in Table 6.

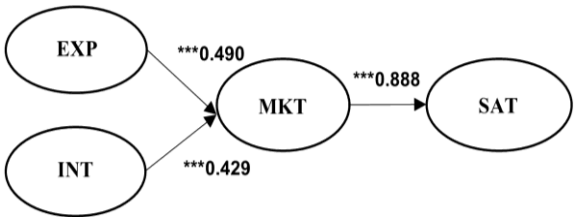


Figure 4. Results of the structural equation model (SEM) for factors influencing the satisfaction of Thai passengers in using the Thai - Lao railway (Source: Compiled by the authors based on JASP 0.19.3 output (2025)

$X^2 = 2543.809$, df = 1049, X2/ df = 2.424, CFI = 0.905, TLI = 0.900, RMSEA = 0.060, SRMR = 0.047

Table 4. Path coefficients and hypothesis testing results (Source: Compiled by the authors based on JASP 0.19.3 output (2025)
Note: ***p-value < 0.001, R^2 of MKT = 0.777 and R^2 of SAT = 0.788

Hypotheses	β	Hypothesis Results
H1: EXP → MKT	0.490***	Supported
H2: INT → MKT	0.429***	Supported
H3: MKT → SAT	0.888***	Supported

Table 4 presents the results of the analysis which showed that the satisfaction factor in using the Thai-Laos railway service was influenced as a whole with the highest being the marketing mix factor (TE = 0.888). The marketing mix factor is a factor that has a direct and positive influence on the satisfaction factor of using the Thai-Laos railway service.

In addition, it was found that the factors of experience and international economic factors are factors that indirectly influence the satisfaction factor in using the Thai-Laos railway service.

Both the experience factor and the international economic factor have an indirect influence of 0.439 and 0.377, respectively. For the marketing mix factor, it was found that it was the result of the factors of experience and international economic factors (TE) were equal to 0.490 and 0.429 respectively as shown in Table 5.

Table 5. Direct, indirect, and total effect analysis of factors influencing passenger satisfaction
(Source: Compiled by the authors based on JASP 0.19.3 output (2025) (Note: ***p-value < 0.001)

Endogenous	Exogenous				
	Effect	R^2	EXP	INT	MKT
MKT	DE	0.777	0.490***	0.429***	-
	IE		-	-	-
	TE		0.490***	0.429***	-
SAT	DE	0.788	-	-	0.888***
	IE		0.439***	0.377***	-
	TE		0.439***	0.377***	0.888***

DISCUSSION

The purpose of this research was to analyze the factors affecting the satisfaction of users of the Thailand-Laos railway service by using a structural equation model with Covariance Based (CB-SEM) to test the causal relationship between various variables from the results of statistical estimation. The important findings of studies that can be discussed in the dimensions of economics and tourism are as follows:

The results of the study show that the marketing mix factor, which consists of six main components, namely service delivery, product, marketing promotion, physical characteristics, price, and distribution channel, can explain the latent variables of the marketing mix factor. This is a factor in the consideration of using the Thai-Laos railway service and can act as a structural representation of the latent variables (MKT).

The satisfaction with the Thai-Laos Railway service factor consists of six main components. All components can explain the latent variables of satisfaction, with the component weight values being high in all respects. This indicates that these six indicators are important factors in creating the satisfaction factor for the use of the Thai-Laos railway service and can act as a structural representation of latent variables (SAT).

The experience factor (EXP) consists of a total of seven main components. As this result, this point is consistent with Nonthapot & Thomya (2020), who found that the service user wants to acquire life experience. In addition, the duration of the trip and the length of stay were also found to be important factors in the decision to travel on the Thailand-Laos route (Nonthapot, 2019b). In addition, the international economic factors (INT), which consist of five main components. It confirms that these structural factors serve as important agents in explaining the desire to use the Thai-Laos railway service.

The indicators indicate that in the context of the Thai-Laos railway, which is an international railway connecting the region, users pay attention to travel expenses, in line with the concept of Chittangwattana (2012) and Kotler et al. (2014), as well as a study by Anek Aiin et al. (2023), which stated that the cost of travel is a factor in deciding to travel to an accessible destination and obtain standard service. In addition, the exchange rate factor affects the decision to travel (Nonthapot & Lean (2015) cited in Nonthapot (2019b) and Rifai & Kurniawan (2023), and Nonthapot (2019b), who also noted that membership of AEC also affects travel.

In regard to the influence of the marketing mix factor on the user satisfaction factor of the Thai-Laos railway service, the results of the analysis of the structural equation model showed that the marketing mix factor has a positive influence on the satisfaction factor with a total influence value. The factors of experience and international economic factors also indirectly influenced the satisfaction factor. The decision to use the railway is based on the consideration of the marketing mix factors. The user also considered the experience of the user and the economic factors of the two countries.

Moreover, the results determined the relationship between Marketing Mix Factors (MCT). It was found that the dimension that plays an influential role was satisfaction (SAT), the highest being the dimension of service delivery (SERVE). This indicates that users of the Thailand-Laos railway service attach the most importance to the dimension of service delivery. In other words, the user considers receiving services from the staff and the service system as a priority. In terms of the indicators of satisfaction in using the Thai-Laos railway service, the service of employees on trains and stations was considered to be important. It is evident that service users value receiving services from both service providers and systems that mediate services as well as speed of service and clear and accurate communication to bridge the gap between customer expectations and the experience received (Lodorfos et al., 2015)

CONCLUSIONS

As mentioned above, the factors of service delivery (SERV) are the most important and indicate that the marketing mix factors affect the satisfaction of using the Thai-Laos railway service. Consequently, the State Railway of Thailand should develop a seamless service system (Seamless Service). Emphasis should be placed on the speed of information communication and the clarity of the public information points, including the development of staff competencies in providing clear and precise information, especially in the border crossing procedures at Nong Khai and Vientiane stations (Khamsavath) to reduce the anxiety of service users and to increase the efficiency of travel time management.

Moreover, both governments should consider extending cooperation to offer "Juxtaposed Border Facilities" or joint testing at one point (a one-stop border post). This will reduce redundancy in checking baggage and border crossing

documents, which will reduce the total travel time (McLinden et al., 2010; Kieck, 2010). Cross-border travel insurance integrated into the ticket price is an option for users that reduces the perception of risk when making travel decisions. In addition, to enhance standards of safety, confidence and protection of service users (Quintal et al., 2010; OECD, 2020) accident insurance is available for all parties including passengers and operators of the MRT who are on duty on the passenger train. This includes getting on or off a train and accidents caused by the operation of the train from the departure station to the destination station (SRT, 2023) and may consider providing additional insurance options by extending coverage to accidents that occur during a trip.

In term of the experience dimension, the State Railway of Thailand, in collaboration with the tourism authorities of both Thailand and Laos, should consider developing integrated travel packages that emphasize 'life learning experience.' These packages must take into account travel duration and length of stay to effectively attract the younger traveler segment who prioritizes these factors. Furthermore, service delivery should be enhanced by ensuring accurate and clear communication from frontline personnel, particularly regarding cross-border and immigration procedures, to mitigate passenger anxiety and to bolster confidence. Additionally, providing a diverse fare structure and seating classes is essential to offer value for money and to cater to varying people with different purchasing powers, allowing passengers to manage their budgets effectively and encouraging repeat usage in the future.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and was granted exemption by the Khon Kaen University Ethics Committee for Human Research (KKUEC) (Protocol ID: HE683243, date of approval: 5 June 2025), as it met the criteria for exemption determination regulations.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. Participants were informed about the study's purpose and their right to withdraw at any time, and anonymity was strongly maintained.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

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STRATEGIC PUBLIC RELATIONS COMMUNICATION AND TOURISTS' BEHAVIORAL INTENTIONS: A MEDIATION MODEL OF DESTINATION IMAGE IN A TOURISM CONTEXT

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Abstract: This study investigates the role of strategic public relations communication in shaping tourists' behavioral intentions by examining the mediating role of destination image in a tourism context. The study employs a quantitative, cross-sectional research design to examine the relationships among strategic public relations communication, destination image, and tourists' behavioral intentions. Data were collected from 526 respondents who had either previously visited Jordan or were actively considering visiting the destination and had experience with official or institutional communication related to Jordan. The data were analyzed using partial least squares structural equation modeling (PLS-SEM). The findings indicate that strategic public relations communication positively influences destination image, while destination image positively influences tourists' behavioral intentions. However, strategic public relations communication does not have a statistically significant direct effect on tourists' behavioral intentions. The analysis further demonstrates a significant indirect relationship between strategic public relations communication and tourists' behavioral intentions through destination image, supporting its mediating role. These findings suggest that strategic public relations communication contributes to tourists' behavioral intentions primarily by shaping their perceptions of the destination rather than by directly influencing behavioral intentions. The study highlights destination image as an important explanatory mechanism linking institutional communication with tourists' behavioral responses and provides empirical evidence from the tourism context of Jordan.

Keywords: strategic public relations, destination image, tourists' behavioral intentions, tourism decision-making processes, Jordan

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INTRODUCTION

Strategic planning of tourism has progressively moved from direct acquaintance to destination characteristics toward mediated communication practices that frame tourists' assessments prior to travelling. Tourists, in existing tourism markets, trust largely on digital and institutional communication so that they may evaluate destination credibility, understand representative meanings, and minimize apparent ambiguity before making minds to travel. This conversion has been made quicker due to effective advertisement of information abundance, digitalized platforms and intensified risk-related sensitivity, especially in the destinations where institutional trust and reputational narratives robustly effect tourist awareness (Ahmad et al., 2025; Gretzel et al., 2020; Buhalis & Sinarta, 2020). In recent times, the evidence-based research endorse that institutionally and officially created communication plays a pivotal role in making tourists' observations and behavioral intents under information overload and uncertainty conditions (Marine-Roig & Huertas, 2020).

In tourism research work, tourists' behavioral intents, generally measured as purposes to visit, revisit and suggest destinations, are broadly documented as critical predictors of destination competitiveness and long-term sustainability.

Afshardoost & Eshaghi (2020); Sabiote-Ortiz et al. (2024) argue that a quantitative evidence's substantial body establishes that these intentions are determined mainly by tourists' reasoning and perceptual assessments instead of objective features of destination. Destination image, among these perceptual determining factors, has reliably appeared as a significant descriptive concept. According to Stylidis et al. (2020); Marine-Roig & Huertas (2020), destination image is usually considered as a cognitive–touching demonstration that depicts tourists' emotions, beliefs and inclusive destination impressions: additionally, observation-based research frequently endorses its powerful impact on behavioral intentions of tourists across different tourism backgrounds.

Although there exists the significance of destination image in research related to tourism behavior, current critical reviews highlight that the literature remains inordinately result-focused. Whereas many studies articulate the destination image effects

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on behavioral intentions, relatively inadequate consideration has been given to conceptualizing the way destination images are tactically created through the processes of institutional communication (Alrahman, 2025; Alsharairi et al., 2026; Tasci et al., 2022). In this sense, communication is often observed as a functional effort, such as message frequency, information provision or promotional manifestation. It is not treated as a relational and strategic process entrenched within institution-based practices. Such theoretical decline constrains the descriptive tourism behavior models' depth by complicating the mechanisms with which communication frames interpretive frameworks of tourism before the formation of intention.

Within tourism studies, this mentioned restraint is specifically obviously observable in the strategic communication treatment. Huerta-Álvarez et al. (2020); Gorji et al. (2023); Alsharairi & Jamal (2021) argued, though the current research progressively recognizes the significance of engagement, credibility and transparency in communication of destination, these components are frequently investigated in isolated ways or included under wider branding and marketing frameworks. Subsequently, communication is mostly abridged to content quality or message efficacy, restraining tourism models the ability to constitute relational constructs such as institutional credibility, trust and perceived validity or legitimacy. Such exclusions are theoretically substantial, specifically in the destinations categorized by high-alleged menaces. In this risk, institutional signs instead of promotional claims powerfully form decisions made by tourists. Contrastingly, in view of Valentini (2021); Ki et al. (2021), scholarship of public relations theorizes strategy-based communication as an institutional procedure aiming to build long-standing relationships, trust and credibility through dialogic, planned and clear interaction held between organizations and their people. Fundamentally, strategic public relations communication is different from marketing-centered communication by giving priority to legitimacy, relationship management, and reputational solidity over persuasion of short-time nature. Strategic public relations communication, especially when applied to tourism contexts, can thus be theorized as the synchronized institutional usage of communication to frame how destinations are brought into interpretation, trust, and legalized by forthcoming tourists, specifically under uncertainty conditions.

While discussing from a theoretical point of view, the exclusion of strategic public relations communication from prevailing tourism behavior models becomes challenging (Alyaqoub & Alsharairi, 2020). Modern-day environments of tourism are categorized by information asymmetry, digital mediation, and elevated observations of risk; these are the situations in which tourists are improbable to interpret institution-based communications directly into behavioral dispositions. Actually, there should be affectively and communication processing, building image of destination as an explanatory mechanism where in tourists may assess destinations and then prepare their intentions (Alsharairi et al., 2025; Li et al., 2025; Sabiote-Ortiz et al., 2024). While handling communication as a direct forbearer of intention, takes tourist decision-making to oversimplification and confines the existing models' theoretical accuracy. However, the current study aims to address the theoretical limitation mentioned above by creating a theoretically based mediation model through which is conceptualized as an institution-based antecedent building destination image formation prior to the development of behavioral intention. Along with it, strategic public relations communication works in such a way that its effect functions fundamentally with the help of destination image as a cognitive and influential mechanism interpreting institutional communication into behavioral results. While acting so, this study moves off from prevailing marketing-centered enlightenments repositioning communication as a strategy-focused institutional forebear within theory of tourism behavior. It is an important point that the current study, instead of expanding the Planned Behavior Theory, functions outside its attitudinal structure by conceptualizing strategic public relations communication as a pre-attitudinal, exogenous construct shaping image formation prior to intention development (Laskin & Freberg, 2024).

The utilized theoretical gap is specifically prominent in destinations where credibility of institutions, arbitrated reputation and safety discernments play a pivotal role in evaluations of tourism. According to the observation of Hassan & Soliman (2021), research related to tourism continues to be controlled by East Asian and Western backgrounds, highlighting apprehensions about the context-specific generalizability and robustness of dominating communication-focused models. Existing destinations in the Middle East, like Jordan, exemplify systematically expressive backgrounds in which institution-centered communication and external risk descriptions strongly form the destination images of tourists. Strategic public relations communication in such kind of settings ranges beyond the promotion, working as a critical mechanism to legitimize destinations and handle reputational improbability.

In order to ground the suggested relationships theoretically, the current study derives understandings from destination image research and public relations scholarship. This study theoretically has been grounded in the relational angle of public relations. These relations theorize strategic communication as an institutional process aiming at constructing trust, credibility and long-standing associations between the organizations and their masses instead of attaining short-duration persuasive results (Laskin & Freberg, 2024). Valentini (2021); Ki et al. (2021) are of the view that communication, especially from this point of view, does not prompt behavioral responses directly; rather, it directs the way stakeholders affectively and cognitively interpret organizational legitimacy and institutional messages. When it is applied to the backgrounds of tourism, the relational approach comes ahead proposing that official destination communication shows influence on tourists' assessments by constituting understandings of safety, credibility and institutional reliability instead of directly persuading travel plans. In order to elaborate how these communication-centered evaluations are interpreted into behavioral results, the destination image theory further assists the present study, and is theorized as a cognitive–affect based explanatory mechanism; through this mechanism, tourists incorporate institutional communication clues into general destination assessments that direct formation of intention (Alsharairi et al., 2025; Stylidis et al., 2020; Tasci et al., 2022). The current study, by incorporating the relational aspect of public relations with the destination image theory, adopts a process-based theoretical framework that elaborates behavioral intentions of the tourists as the result of arbitrated insight formation instead of direct communication impacts.

In this regard, the present study provides three theoretically based contributions to tourism related communication, and destination-based image research work. The current study, against this contextual background, makes tourism communication research advanced by clearly incorporating strategic public relations communication as an outsider descriptive variable within a destination image analytical framework. The study produces three theoretical contributions by establishing and experimentally verifiable testing a mediation-centered organizational model while utilizing quantitative data taken from the tourism context of Jordan. Firstly, in tourism research, conceptually it differentiates public relations communication from marketing-centered communication. Secondly, it strengthens destination image theory by placing image as a dominant explanatory mechanism instead of a simple behavior antecedent. Third, it makes the context-based reliability of tourism communication models strengthen by investigating a reputationally and geographically sensitive-centered destination background. The subsequent section advances the theoretical framework and hypotheses supporting the given model.

LITERATURE REVIEW

The present study theoretically grounds in the relational perception of public relations conceptualizing strategy-focused communication as a long-standing institutional process having an aim to build credibility, trust and shared discernment between the organizations and their masses (Ledingham & Bruning, 2000). This aspect, especially within tourism background, indicates that institutional communication does not predominantly functions as a direct convincing mechanism; rather it develops stakeholders' affective and cognitive evaluations, which facilitate behavioral results.

The placement of this theoretical perspective is incorporated with the destination image theory, which theorizes destination image as a cognitive–influencing explanatory structure with which the tourists develop mediated information and institutional indicators while framing behavioral intents and evaluative results (Stylidis et al., 2020). With the incorporation of these two perceptions, the current study assumes a process-centered framework, which elaborates behavioral intentions of the tourists as the result of interceded viewpoint development instead of direct communication impacts.

Strategic Public Relations Communication in Tourism

In recent times, the tourism scholarship progressively recognizes the dominant role of communication in building tourists' perceptions and judgement processes, specifically in digital-oriented mediated situations. According to Huerta-Álvarez et al., (2020), much of this literature, however, goes on approaching communication with the help of a mainly marketing-centric lens, showing emphasis on content quality, message exposure, or promotional usefulness. Although, such perspectives have provided contribution in perceiving outcomes of destination promotion, they provide inadequate theoretical understanding into how institutional or organizational communication develops relational sense, trust, and legitimacy known as dimensions, which are critical in circumstances featured by perceived risk and improbability. Additionally, strategic public relations communication offers a distinctive theoretical perception which ranges beyond persuasive and marketing objectives. Strategic communication, when discussed in perspective of contemporary public relations theory, is brought to conceptualization as an institutional and relationship-intended process aiming at developing trust, credibility and long-standing legitimacy with the help of strategic, transparent and dialogic communication with shareholders (Alsharairi et al., 2026; Valentini, 2021). Contrary to the marketing communication that mainly pursues short-lived attitudinal responses, public relations communication stresses over management of relationship as well as repute-based durability as strategic results. These distinctions, when discussed in tourism contexts, are especially prominent since tourists mostly assess destinations not merely grounded on attractiveness but on institutional trustworthiness and considered safety as well. Ki et al. (2021) argued that though studies on tourism progressively recognize concepts related to public relations like credibility, transparency and institutional repute, such constructs are often investigated in segmented ways or included under wider marketing and branding frameworks. Consequently, communication grounded on strategic public relations is hardly put forward or tried as a distinctive illustrative construct in quantitative-based models of tourism. Such kind of conceptual uncertainty compels the tourism research ability to capture the institutional communication's unique role in building tourists' insights prior to intent development.

Destination Image as a Cognitive–Affective Interpretive Framework

In tourism research, destination image vestiges one of the most comprehensively investigated constructs; it is also broadly acknowledged as one of the main factors of behavioral or attitudinal intentions of tourists. Its definitions in recent times, as argued by Valentini et al. (2020), theorize destination image as a multifaceted construct incorporating both affective responses that consist of feelings and emotional touches toward the destination, and cognitive evaluations including knowledge and beliefs regarding characteristics of destination. A wide-ranging frame of experiential proof endorses that destination image expressively effects tourists' intentions of visiting, revisiting, and suggest destinations all over different tourism backgrounds (Afshardoost & Eshaghi, 2020). Although it has empirical strength, critical reviews in recent times indicate continuous theoretical restrictions in the destination image research. Moreover, lot of the literature exists as outcome-centric concentrating initially on the behavioral destination image outcomes, however giving relatively inadequate focus to its formation processes and antecedents (Tasci et al., 2022). As the antecedents become under examination, they are mostly applied as experiential factors or fragmented information sources instead of as incorporated institution-based processes of communication. This isolated conduct restricts theoretical perception of the way destination images are built strategically prior to travelling. Similarly, studies conducted in recent times recommend that destination image should be considered not as a fixed insight; it should be understood as an energetic cognitive–affective explanatory structure in which tourists proceed interceded information and institutional indicators (Marine-Roig & Huertas, 2020).

Destination image, from this viewpoint, works as an underlying process that interprets communication inputs into evaluative decisions, framing how destinations are evaluated and understood before the formation of behavioral intentions.

This kind of reconceptualization highlights the significance of investigating communication-guided image building process instead of concentrating completely on post-image behavioral or attitudinal results.

Tourists' Behavioral Intentions in Mediated Decision-Making Contexts

In tourism research, behavioral intentions of tourists are fundamental outcome variables, as they possess robust projecting validity for destination performance and real travel behavior. According to the findings of Sabiote-Ortiz et al., (2024), behavioral intentions are generally brought under operation as visit or revisit intentions, and suggest destinations; hence they are extensively utilized as signs of destination durability and competitiveness. In this regard, empirical research persistently reveals that objective destination characteristics do not influence but the perceptual and affective evaluations vigorously effect these intentions (Alsharairi et al., 2023; Afshardoost & Eshaghi, 2020).

Whereas dominant behavioral models, like the Planned Behavioral Theory, accentuate on subjective norms, attitudes and interpreted behavioral control as direct intention determinants, the contemporary tourism-based research raises questions on the adequacy of these frameworks in high-uncertainty and digitally mediated circumstances. Tourists, in such environments, mostly develop intentions before having direct experiences, trusting deeply on organizational communication as well as mediated prompts. Subsequently, attitude-forming constructs like destination image has to play an important role in building formation of intention by constructing how one interprets information affectively and cognitively.

However, the current empirical research progressively back mediation-grounded elucidations of a tourist's behavior. Gorji et al. (2023); Li et al. (2025) claimed that these studies also represent the destination image that show impacts of constructs namely trust, reputation and observed menace on behavioral intentions. The findings recommend claiming that models having direct-effect tend to fabricate decision-making processes of the tourists by ignoring the explanatory systems in which communication effects behavior. Nonetheless, mounting empirical assistance for mediation-grounded methods, the research with limitations has investigated destination image considering it as a mediator involving strategic public relations-based communication behavioral tendencies of tourists.

Integrating Strategic Public Relations Communication and Destination Image

Public relations communication has its importance especially when it is linked with the institutions. In this regard, incorporation of strategic public relations-based communication with destination image research comes ahead to address a vital theoretical breach in the studies of tourism. In a unique way, position is given to public relations communication as it involves relationship management, credibility and transparency (Alyaqoub et al., 2023; Valentini, 2021).

Contrary to promotion-linked messaging, which may mainly influence impressive responses or awareness, strategic public relations communication frames how prospective tourists interpret, legitimize and trust the destinations. Destination image is considered a key element in tourism industry. Research on tourism conducted in recent times indicates the significance of institutional repute and reliability in determining destination image, especially in the circumstances categorized by intensified observed risk or negative storylines of the media (Hassan & Soliman, 2021; Tahat, 2025).

The derived outcomes correspond with public relations theory, which suggests that legitimacy and trust building are key processes; through these mechanisms, institutional communication affects the perceptions of the stakeholders. Nonetheless, the research on tourism has still to systematically incorporate these kinds of mechanisms into models quantitative in nature that explicate behavioral intentions of tourists. The current study, while theorizing strategy-based public relations communication as an external institutional forbearer/antecedent and destination image as a mediating cognitive–emotional explanatory mechanism, reacts to calls for more interpretative and theory-guided tourist decision-making models. The current study, grounded on this incorporation, advances a mediation-rooted model connecting strategic public relations communication, behavioral intents of tourists and destination image. In view of that, the hypotheses given below are suggested.

Hypotheses Development

Development of hypothesis may lead to a direction connected to expected outcomes. Whereas strategic public relations communication concerns are well defined as the strategic institutional usage of communication performs aiming at constructing transparency, credibility, and long-standing relational trust with the shareholders (Valentini, 2021). Similarly, destination image is considered as a multi-faceted cognitive–touching demonstration depicting tourists' emotions, beliefs, and general views regarding a destination (Stylidis et al., 2020). Behavioral intentions of tourists speak of individuals' detailed possibility of captivating in upcoming travel-linked behaviors, together with visiting and suggesting destinations for tourism (Afshardoost & Eshaghi, 2020).

Strategic Public Relations Communication and Destination Image

Strategic public relations communication in the present study leads to practices of institutional communication featured by transparency, integrity along with relationship-centered involvement aiming to frame destinations interpretations of the tourists. However, within present-day tourism contexts, tourists more and more depend on this institutional communication in order to assess destinations before going to travel, specifically under information asymmetry conditions as well as repute-based perception. In view of this aspect, public relations scholarship put emphasis that communication, having base on institutional legitimacy and trust developing, plays an influential role in building understandings of the stakeholders (Valentini, 2021). Such kind of communication practices, especially in tourism situations, are as a result estimated to leave an impact on destination image by constituting how tourists affectively and cognitively perceive destination-specific information (Marine-Roig & Huertas, 2020). Additionally, destination image works as a cognitive emotion-based depiction illustrating tourists' destination-directed beliefs and emotions. In perspective of the interpretive role by destination image in

interceded decision-taking, planned public relations communication is anticipated to exercise a determinative impact on how tourists consider destinations before formation of their intention to travel. Therefore, the subsequent hypothesis is suggested:

H1: Strategic public relations communication has a prominent and positive influence on the destination image.

Destination Image and Tourists' Behavioral Intentions

Regarding different tourism situations, destination image has been regularly recognized as a key determining factor of behavioral intentions of tourists. Any supporting destination image enriches evaluation-based decision-making sense, decreases perceived vagueness, and boosts tourists' readiness of visiting, revisiting, and suggesting destinations. Empirical studies and meta-analytic facilitate strong proof that destination image leaves a prominent impact on behavioral intents by interpreting conceptual assessments into behavioral promptness (Afshardoost & Eshaghi, 2020; Stylidis et al., 2020). The current proof also exhibits that a supportable destination image prominently encourages tourists' behavioral intentions, comprises visit, revisit, as well as suggestions referring intentions, especially in experientially and culturally enriched tourism backgrounds (Chuamuangphan et al., 2025). Destination image as a cognitive–affective concept plays a significant role in connecting pre-travel assessments to intention development. Within digital-mediated contexts, where the tourists depend greatly on non-direct information means, destination image functions as a main underlying process through which insights are transformed into behavioral results. For that reason, the succeeding hypothesis is suggested

H2: In this hypothesis it is claimed that destination image reflects a prominent positive impact on behavioral intentions of tourists.

Strategic Public Relations Communication and Tourists' Behavioral Intentions

Strategic public relations communication, however, is conceptualized to initially leave an impact on tourist's behavior with the help of perception-based mechanisms, before the tourism research recommends that institutional communication may also put a direct impact on behavioral intentions of the tourists. While official communication addresses destination credibility, institutional reliability and safety, it may build tourists' preparedness to think of or be engaged with a destination even before full consolidation of destination image (Gorji et al., 2023; Hassan & Soliman, 2021).

When this direct relationship is investigated, it permits for a more accurate evaluation to know whether strategic public relations communication reflects influence on intention framing beyond its non-direct effect with the help of destination image. Within the recommended theoretical placement, the direct impact of strategic public relations communication on the behavioral intentions of tourists is dealt as investigative instead of supposed to be in dominating position.

Resultantly, the hypothesis given below is suggested:

H3: The hypothesis reflects that strategic public relations communication depict a direct impact on tourists' behavioral intentions.

The Mediating Role of Destination Image

The current advancements in tourism research progressively assist mediated descriptions of tourist judgement finalizing, stressing that perception-centered concepts perform as explanatory mechanisms connecting communication contributions to behavioral results. To intercede the institutional reputation impacts such as trust, and perceived risk on behavioral intentions of tourists, destination image has been presented making its central role prominent in interpreting communication-centered assessments into behavioral reactions (Gorji et al., 2023; Li et al., 2025). Strategic public relations communication, from this point of view, is improbably to effect tourists' behavioral intentions not with first framing their affective and cognitive destination evaluations. According to the findings of Purwanto & Suryanto (2022), the studies conducted in the past progressively favor mediation-oriented interpretations of tourist's decision-making, manifesting that destination image works as an explanatory process with which underlying (antecedent) aspects leave impacts on visit-linked intentions.

The present study, by placing destination image as a mediating process, goes beyond direct-impact elucidations, and provides a more theoretically accurate explanation of the way institutional communication shows impact on the tourist's behavior. In view of that, the current study examines whether destination image completely or to some extent mediates the association existing between strategic public relations communication and behavioral intentions of the tourists. In this sense, the following hypothesis is suggested:

H4: Destination image mediates the relationship between strategic public relations communication and tourists' behavioral intentions.

Conceptual Framework of the Study

The present study, while focusing on public relations theory and destination image research, recommends a mediation-centered conceptual framework clarifying how strategic public relations communication leaves impact on the behavioral intention of tourists. The framework places strategic public relations communication as an institution-based antecedent that builds tourists' insights through transparent, credibility-oriented and practices of relationship-related communication. Instead of presuming a genuinely persuasive task, communication is developed as a strategy-grounded mechanism; this process constitutes how affectively and cognitively destinations are understood before moving to travel. Similarly, destination image, within this theoretical framework, is dealt as a fundamental cognitive–moving structure interpreting institutional communication into evaluation-based findings regarding destination. Moreover, destination image, going on consistently with prior tourism-grounded research, depicts tourists' emotions, beliefs and general impressions, and performs as a main factor of behavioral intents. Therefore, this model supposes that strategic public relations communication has impacts on tourists' behavioral intents chiefly through its influence on destination image, instead of through direct persuasive aspect only.

Simultaneously, the framework permits for the investigation of a prospective direct relationship existing between behavioral intentions of tourists and strategy-centric public relations communication. This way is involved to judge whether institutional communication that addresses safety, credibility and legitimacy may independently affect intention development of destination image or not. When both direct and indirect processes are integrated, the suggested framework makes the empirical assessment able to judge the aspect whether destination image entirely or to some extent mediates the relationship that appears between strategic public relations communication and behavioral intentions of the tourists.

In general, the suggested conceptual framework provides a theoretically based and empirically verifiable description of tourist judgement making in digital-based mediated as well as repute concerning sensitive tourism environments. Similarly, with the integration of strategic public relations communication into a destination image-grounded model, the framework empowers tourism communication research moving beyond marketing-centered descriptions and offers a clearer elucidation of the way institutional communication builds tourist behavior. Underlying the suggested framework, these conceptual relationships have been demonstrated in Figure 1.

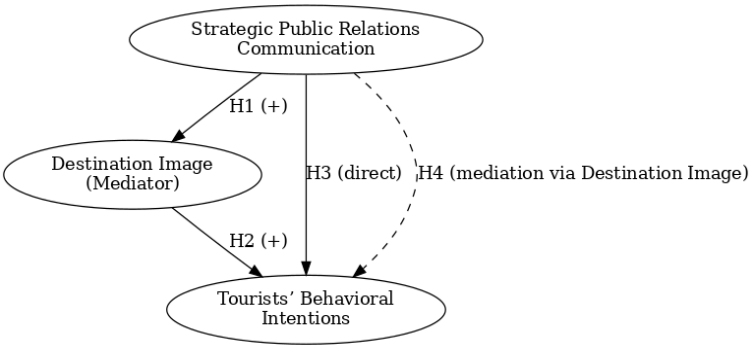


Figure 1. Conceptual framework of the study

MATERIALS AND METHODS

Research Design

The present study employs an explanatory, quantitative, cross-sectional research pattern/design to evaluate empirically the suggested conceptual framework and set hypotheses. A design explanatory in nature is considered suitable when the main objective is to investigate theoretical-based derived fundamental relationships among the underlying concepts (Hair et al., 2022). Considering that the aim of this study is to elaborate how strategic public relations communication shows influence on tourists' behavioral intentions by means of a mediating perceptual process, a quantitative approach makes systematic hypothesis able in assessing and theory authentication. The study employed cross-sectional design because the study concentrates on tourists' pre-travelling or contemporaneous assessments, instead of changes with the passage of time.

It reasons that in tourism research, cross-sectional designs are extensively utilized to investigate destination images and behavioral intents, specifically when constructs are made before being prepared to real visitation (Stylidis et al., 2020).

To collect data efficiently, this design facilitates and is considered methodologically appropriate to estimate direct and indirect associations within mediation-centered models. In this perspective, the present study bases on a positivist research pattern, which supposes that the links existing among constructs can be measured with objectively and tested statistically. Similarly, according to Kline (2023), positivist approaches govern tourism research implementing mechanized equation processing to elucidate tourist behavioral action and judging practices.

Study Context and Population

The tourism destination in Jordan is the empirical background of the present study. Jordan embodies a theoretically relevant environment because of its dependence on institutional communication regarding the management of destination image, alleged risk, as well as worldwide tourism repute. The tourism research conducted in the past establishes that destinations positioned in regionally or politically sensitivity-based situations rely greatly on institutional and official communication regarding the formation of tourists' insights and ambiguity mitigation (Hassan & Soliman, 2021; Marine-Roig & Huertas, 2020). In view of that, Jordan facilitates a suitable environment to investigate strategic public relations communication role in destination image building and behavioral intent shaping.

In this study, the selected target population involves international tourists who either have performed their visit to Jordan or have keenly considered the destination visit. The reason of the population selection was that the study concentrates on communication-guided evaluations which may be occurring both prior to and following the visitation. As argued by Afshardoost & Eshaghi (2020), tourism research, overall, persistently manifests that destination image along with behavioral intentions are widely structured with the help of mediated information source prior to travelling, molding potential visitors a theoretically suitable target population regarding the current investigation

Sampling Strategy and Sample Size

Since there has been no comprehensive sampling frame to facilitate international tourists especially exposed to destination-connected communication about Jordan, a non-probability purposive sampling technique was employed. As far as purposive sampling concerns, it is generally employed in tourism-based research specifically when the aim is to target

respondents possessing particular characteristics or informational experience pertinent to the objectives of the study (Dolnicar et al., 2018). Accordingly, in this study, the main standard was the exposure of respondents to official or institutional communication linked with the destination.

All the respondents were included in the sample based on the criteria given below:

(1) they were 18 years of age or more;

(2) had visited Jordan previously or having been actively searching to get information about Jordan to visit it;

(3) having experience in institutional or official-level communication about the destination, like official websites of tourism, promotional campaigns or social media pages

Such selected criteria make it sure that respondents have enough cognitive as well as informational base to purposefully evaluate and assess destination image, strategic public relations communication and behavioral intents (Alyaqoub et al., 2024; Peng et al., 2018). Regarding adequacy of sample size, methodological literature highlights that mediation-centered structural equation models need adequately big samples to make sure that there should be model stability, enough statistical strength and trustworthy valuation of both direct and indirect impacts (Hair et al., 2022; Kline, 2023). A minimum sample size of 200 respondents is generally commended for the models that consist of multiple experiential indicators and three underlying constructs. In the current study, data of 526 respondents were collected, considerably higher than the suggested limit. It was done purposefully aiming that such kind of sample size facilitates strong statistical power to test the suggested mediation model. Moreover, on one side it reduces the issues of estimation bias, and enhances the trustworthiness and strength of the findings on the other hand. To prove this logic, Sabiote-Ortiz et al. (2024) argue that larger sample sizes are specifically helpful in tourism research depending on communication and perceptual-based conceptualizations.

Along with handling the minimum sample size commendations, there was availed further support for the appropriateness of the sample by the "10-times rule". According to the findings of Hair et al. (2022), this rule is generally employed in PLS-SEM, in which it is recommended that the size of sample should be no less than ten times the maximum number of structural avenues focused on any underlying construct in the given model. Within the structural form of the suggested model, the gotten sample size of 526 respondents considerably goes above this requirement, making it sure that there should be model stability and enough statistical power.

Data Collection Procedure

Regarding the collection of data, there was used an online self-managed questionnaire, which was furtherly distributed through digitally oriented platforms frequently visited by international level visitors, together with social media groups related to travelling and tourism debating platforms. In modern tourism research, online surveys are accepted on a large level due to their ability and efficacy to reach the respondents, geographically disseminated (Dolnicar et al., 2018).

However, the questionnaire of this study was arranged in English, the leading language of global tourism communication. At the commencement of the survey, screening questions were included to make sure of the eligibility of the respondent was based on the pre-established sampling criteria. In order to minimize the potential influence of common method biasness, respondents were made sure of privacy; questionnaire items were made accessible in a non-evaluative and neutral way, reliable with suggested technical solutions (Podsakoff et al., 2016).

Ethical Considerations

The present study was managed according to the established ethics-based principles for social science research. Voluntary participation was administered; similarly knowledgeable consent was obtained from all the respondents before data collection process. It was ensured that not any kind of personal-based detectable information was generated and collected, and likewise confidentiality was maintained in all responses guaranteeing that data would be used entirely for academic research drives. In this way, the present study followed established ethical procedures while conducting survey-based research as suggested by Bryman (2021).

Common Method Bias Assessment

Harman's single-factor test was utilized in order to evaluate the prospective effect of common method biasness. The outcomes pointed out that there was no single factor responsible for the variance majority, signifying that common method biasness was not a serious issue in the obtained data (Podsakoff et al., 2016). Additionally, procedural solutions such as assuring secrecy to the respondent and reducing item uncertainty were executed before collection of data to further minimize latent method biasness.

MEASUREMENT SCALES AND MEASUREMENT MODEL

Measurement of Constructs

Though strategic public relations communication and destination image have been theorized as multifaceted concepts in a few strands of literature, earlier empirical research has established the suitability to specify these constructs as unidimensional underlying variables while the analytical emphasis is on overall evaluations of tourists as well as behavioral results instead of dimensional variation. In perceptual tourism kind of research, respondents incline to make incorporated decisions that integrate affective and cognitive assessments into a single overall evaluation, especially in pre-visit kind of environments in which direct experience does not exist. Regarding destination image as a single latent construct, it has regularly been functionalized to capture tourists' all-inclusive cognitive–affective assessment of a destination during the examination of intention making and behavioral eagerness (Stylidis et al., 2020; Afshardoost & Eshaghi, 2020). Likewise, public relations research theorizes strategy-centric communication as a combined institutional

insight depicting transparency, credibility and relationship-based aspects when the objective of the research is to test the theory at the structural ground (Valentini, 2021). In accordance with these recognized approaches and corresponding with the conceptual framework of the study, all concepts in the current study were particularized as one-dimensional underlying variables in order to increase conceptual clarity, closeness and model interpretation.

Moreover, the measurement of all constructs was furnished while employing earlier authenticated multi-item measuring scales adapted from the recognized tourism as well as public relations related literature. Trivial modifications in wording were furnished to confirm context-based relevance to the tourism background of Jordan not altering the genuine conceptual items' meanings. All these items were measured while utilizing a five-point Likert scale stretching from 1 (*strongly disagree*) to 5 (*strongly agree*) (Stylidis et al., 2020; Sabiote-Ortiz et al., 2024).

Strategic Public Relations Communication

The measurement of strategic public relations communication was made with the usage of five items adapted from previous strategic communication and public relations research theorizing communication as a transparency, credibility and relationship-generated institutional mechanism (Valentini, 2021; Ki et al., 2021). These items acquire tourists' all-inclusive perceptions connected to official destination-based communication as reliable, transparent and oriented towards long-standing relationships construction instead of short-time promotional prompt. All items were stipulated to map onto a unified underlying concept demonstrating strategic public relations communication.

Destination Image

To measure destination image, five items were used, taken and adapted from the scales extensively used for destination image in tourism-specified research (Stylidis et al., 2020; Marine-Roig & Huertas, 2020). The chosen items depict tourists' incorporated cognitive–affective assessment regarding the destination by encapsulating impressions, beliefs and emotional reactions and experiences. These evaluation-based constituents were conceptualized as gauges of an only underlying concept being representative of collective destination image.

Tourists' Behavioral Intentions

Accordingly, behavioral intentions of the tourists were evaluated utilizing four items taken and adapted from the tourism research conducted in the past measuring intention-based results, together with visit intentions and intentions in recommending destinations as argued by Afshardoost & Eshaghi (2020); Sabiote-Ortiz et al. (2024). These items prove capturing respondents' inclination to be engaged in upcoming travel-linked behaviors, and thus were made specific to map onto a unified underlying concept signifying behavioral intents.

Data Analysis Strategy

The study conducted data analysis employing Partial Least Squares Structural Equation Modeling (PLS-SEM). Two stages were managed while proceeding analysis. At first, the measuring model was tested to evaluate indicator trustworthiness, internal reliability, discriminant validity and convergent validity. Secondly, the testing of structural model was managed to investigate the hypothesized associations aligning with H1, H2, H3, and then mediation analysis was held to assess H4.

Similarly, the importance of both direct and indirect effects was evaluated by means of a bootstrapping process that offers healthy estimations not depending on assumptions regarding data distribution. Explanatory power of the employed model was assessed with the usage of determination coefficient (R^2) for constructs quantified as endogenous.

RESULTS

Demographic Profile of the Respondents

The following section provides the demographic characteristics of the respondents as participants in this study. For the final analysis, a total 526 valid questionnaires were engaged. Accordingly, the demographic profile offers an impression of the sample arrangement providing necessary context-based information in order to explain understandings, insights and behavioral intentions of the tourists. In data sample, both male and female respondents were included, which indicates a relatively balanced gender distribution. Regarding the age of the respondents, their majority were determined within the socially and economically active age groups consistently connected with advanced levels of worldwide destination assessment and travel participation. Such kind of age configuration is reliable with prior research on tourism investigating before travel decision taking and intention building. Most of the respondents, when discussing their educational proficiency, had not less than a university-level education.

This specific feature is specifically pertinent in perspective of the study's concentration on communication-based assessments. It reasons that individuals having such educational qualification of higher-level are expected to dynamically engage with digital tourism and institutional communication to proceed destination-centered information systematically. Regarding the experience of travelling, a significant respondents' proportion demonstrated their previous international-level travelling experience, whereas others claimed that they had actively been looking for information about latent travelling destinations. In this sense, it recommends that the data sample include the individuals who have familiarity with tourism-associated communication, and are as a result proficient in assessing the destination image, strategic public relations communication as well as behavioral intentions in a purposeful way.

Similarly, respondents' meticulous demographic features, including gender, their age, and travelling history, are reflected in Table 1**.** As a whole, the demographic profile demonstrates that the data sample facilitate a suitable empirical base for investigating communication-grounded tourist decision formation within this study's background.

Table 1. Demographic Profile of the Respondents (N = 526)

Variable	Category	Frequency	Percentage (%)
Gender	Male	268	50.9
	Female	258	49.1
Age	18–24 years	96	18.3
	25–34 years	214	40.7
	35–44 years	128	24.3
	45–54 years	62	11.8
	55 years and above	26	4.9
Education Level	High school or below	84	16.0
	Bachelor's degree	276	52.5
	Postgraduate degree	166	31.6
International Travel Experience	Yes	372	70.7
	No	154	29.3
Active Destination Information Search	Yes	401	76.2
	No	125	23.8

Measurement Model Results

Before the evaluation of the assumed structural relationships, the model of measurement was judged to investigate the validity and reliability of the theorized constructs of this study. Adhering the recognized strategies for partial least squares structural equation modeling (PLS-SEM), the assessment showed focus on internal constancy reliability, indicator consistency, and convergent validity as argued by Hair et al. (2022) and Leguina (2025). Likewise, indicator reliability was evaluated with the usage of factor loadings having standards; reliability in internal consistency was investigated through composite reliability and Cronbach's alpha, and finally the convergent validity was assessed utilizing the average variance extracted (AVE).

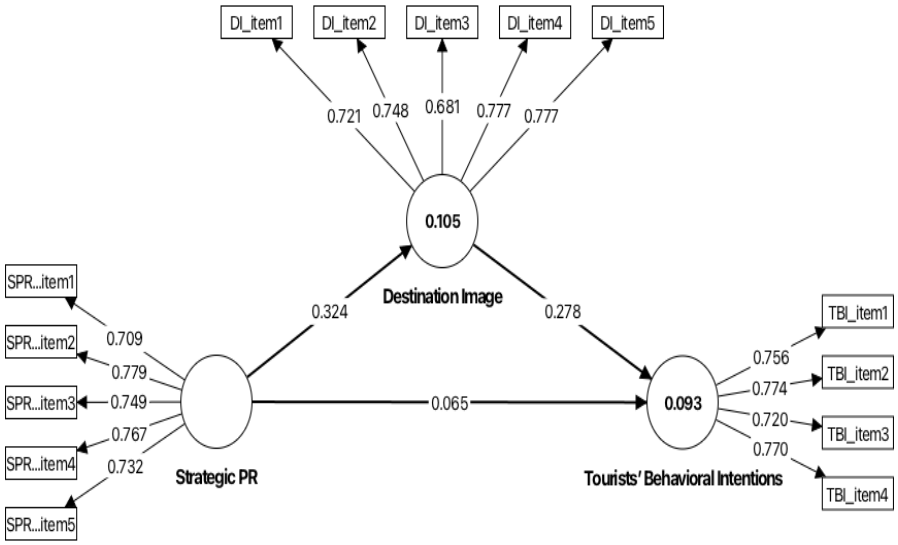


Figure 1. Measurement model with standardized factor loadings

In Figure 1, the study's measurement model has been presented, illustrating the associations found between the underlying constructs and their detected indicators together with loadings of standardized factor. All of the constructs were made specific as unidimensional and reflective, reliable with the adopted conceptualization in the current study. All the indicators, as shown in Figure 1, keep positively loading on their corresponding underlying specified constructs, with the consistent factor loadings going from 0.681 to 0.777 regarding destination image and from 0.709 to 0.779 for strategic public relations communication. Similarly, the ranging regarding tourists' behavioral intentions was from 0.722 to 0.770. These derived values demonstrate adequate indicator reliability, since the majority of loadings go above the suggested limit of 0.70 as suggested by Hair et al. (2022). One of the items related with destination image reflects a loading a little below 0.70; somehow, this derived value can be acceptable in the perspective of overall validity and reliability of the specified construct.

Table 2 the outcomes of the measurement model assessment have been stated in detail; it also includes Cronbach's alpha, factor loadings, composite reliability, as well as AVE derived values for each of the constructs. These results highlight that internal consistency reliability is positively determined. The table calculations show that Cronbach's alpha values move from 0.750 to 0.803, surpassing the generally acceptable at least edge of 0.70; it indicates adequate internal consistency existed among the measuring items (Nunnally & Bernstein, 1994).

Similarly, values of composite reliability further provide sustenance to this result along with all the constructs showing values more than 0.80. Moreover, the values ratify the consistency and stability of measuring scales. Accordingly, there exists also support for convergent validity; the AVE values for destination image are up to (0.550). Strategic public relations communication remains up to (0.559), and similarly tourists' behavioral intentions range (0.570), thus all surpass the conceptualized verge of 0.50. According to the derived results, it is judged that each construct explicates more than half of

the variance in its corresponding indicators; thus satisfactory level convergent validity is confirmed (Fornell & Larcker, 1981). There came further assessment of discriminant validity with the usage of the heterotrait–monotrait (HTMT) ratio, as it has been suggested as a vigorous standard regarding the evaluation of discriminant validity in variance-centered structural equation modeling. For all construct pairs, HTMT values were under the traditional verge of 0.85, highlighting that constructs of the study are empirically distinctive, and that the discriminant validity is established in satisfactory manner (Henseler et al., 2015). In Figure 1 and Table 2, the results indicate that the measuring model demonstrates internal consistency reliability, acceptable indicator reliability and convergent validity. The suitability of the measuring model offers a solid ground for the succeeding evaluation of the hypothesis testing as well as structural model.

Table 2. Measurement Model Results

Construct	Item	Factor Loading	Cronbach's α	CR (rho_c)	AVE
Destination Image (DI)	DI_item1	0.721	0.795	0.859	0.550
	DI_item2	0.747			
	DI_item3	0.681			
	DI_item4	0.777			
	DI_item5	0.777			
Strategic Public Relations Communication (SPRC)	SPRC_item1	0.709	0.803	0.864	0.559
	SPRC_item2	0.779			
	SPRC_item3	0.749			
	SPRC_item4	0.768			
	SPRC_item5	0.731			
Tourists' Behavioral Intentions (TBI)	TBI_item1	0.763	0.750	0.841	0.570
	TBI_item2	0.770			
	TBI_item3	0.722			
	TBI_item4	0.765			

Structural Model Results

The structural model, through the evaluation of the measuring model, was assessed to investigate the hypothesized expected associations among strategic public relations communication, behavioral intents of the tourists and destination image. According to the recognized guiding principles for partial least squares structural equation modeling (PLS-SEM), the assessment concentrated on the magnitude and importance of all standardized and normalized path parameters, together with the expounding model power as pointed out by the determination coefficient (R^2) (Hair et al., 2019; Hair et al., 2022).

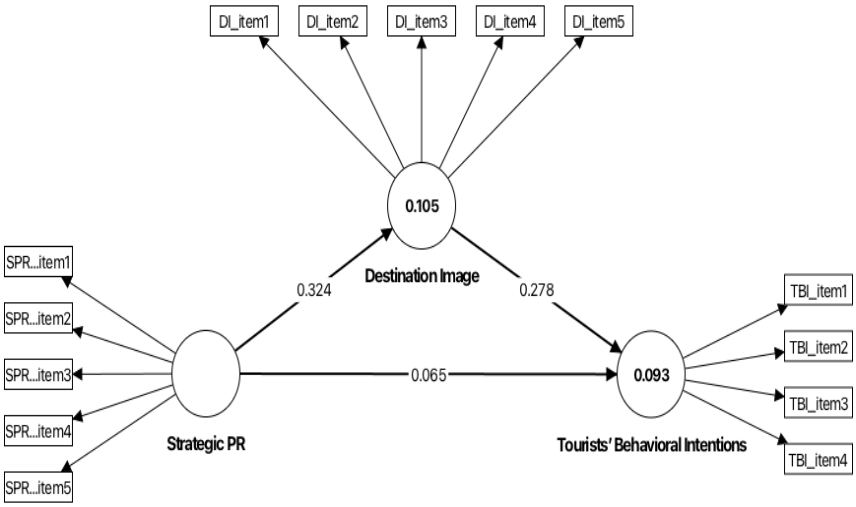


Figure 2. Structural model with path coefficients

In order to evaluate the statistical prominence of the hypothesized associations, a nonparametric bootstrapping process with 5,000 resamples was utilized, since it is suggested for the testing of hypothesis as well as mediation analysis in PLS-SEM as suggested by Hair et al. (2022); Preacher & Hayes (2008). In Figure 2 it is presented the structural model along with the standardized path coefficients and the endogenous constructs' explicated variance (R^2). Strategic public relations communication, as presented in the figure, elucidates a significant variance proportion in destination image ($R^2 = 0.105$), whereas strategic public relations communication and destination image together expound variance in behavioral intentions of the tourists ($R^2 = 0.093$). While these derived R^2 values show their appearance as being modest, such kinds of explanatory levels generally exist in perception-centered and behavioral tourism research, presenting the characteristically intricate and multi-driven feature of tourism-based decision-making process, in which intentions are formed by many contextual, psychological and situational dynamics beyond the constructs of communication field (Hair et al., 2019).

According to the results of Table 3, strategic public relations communication shows a statistically and positive important impact on the destination image ($\beta = 0.324$, $p < .001$), offering empirical sustenance to H1. The conclusion

highlights that practices at institutional communication, emphasizing transparency, credibility and relationship orientation, play an important role in forming overall perceptions of tourists regarding the destination.

Additionally, destination image leaves a statistical and positively prominent impact on behavioral intents of the tourists ($\beta = 0.278$, $p < .001$), providing support to H2. This result confirms that acceptable cognitive–affective assessments of a destination arise tourists' inclination to be engaged in upcoming travel-based behaviors like visiting or recommendations of the destination as visiting places. In comparison, the direct impact of the strategic public relations communication on tourists' behavioral intents is not statistically noteworthy ($\beta = 0.063$, $p = .182$). In accordance with it, no support is observed for H3. Such result recommends that strategic public relations communication reflect no direct interpretation into behavioral intentions as destination image of tourists is taken into consideration.

Mediation Analysis

In the perspective of this study's mediation-grounded conceptual framework, the destination image's mediating role in the connection existing between strategic public relations communication and behavioral intentions of the tourists was investigated while utilizing bootstrapping techniques. Bootstrapping can be largely considered as a strong approach to test indirect impacts in PLS-SEM, since it does not depend on suppositions of normality and thus offers more precise confidence intermissions for mediation impacts (Preacher & Hayes, 2008).

In Table 4, it has been shown that strategic public relations communication's non-direct impact on behavioral intentions of tourists through destination image remains positive and statistically prominent ($\beta = 0.090$, $p < .001$). As the concluded result is measured along with the insignificant direct impact described in Table 3, the statistical outcomes manifest that destination image completely mediates the relationship existed between strategic public relations communication and behavioral intentions of the tourists. The design of these results corresponds with existing mediation rationality, which identifies full mediation though there exists no noteworthy direct impact (Zhao et al., 2010). In this context, there remains support for H4.

Table 3. Structural Model Results

Hypothesis	Path	β	t-value	p-value	Result
H1	Strategic PR -> Destination Image	0.324	8.847	< .001	Supported
H2	Destination Image -> Tourists' Behavioral Intentions	0.278	6.635	< .001	Supported
H3	Strategic PR -> Tourists' Behavioral Intentions	0.063	1.334	0.182	Not supported

Table 4. Mediation Analysis (Indirect Effects)

Indirect Path	B	t-value	p-value	Mediation Type
Strategic PR -> Destination Image -> Tourists' Behavioral Intentions	0.090	5.309	< .001	Full mediation

Effect Size (f^2)

Along with the examination of the path importance, effect sizes (f^2) were measure for the evaluation of the relative effect of each exogenous concept on the endogenous factors (underlying variables). The derived results highlight that strategic public relations communication depicts a low-to-moderate impact on destination image, though destination image exhibits a small influence on tourists' behavioral intents. These impact-based sizes remain consistent with prospects in perception-related tourism research indicating that the perceived associations, though statistically important, exercise modest utilitarian impact (Hair et al., 2022).

Predictive Relevance (Q^2)

Model's predictive relevance was tested by using the blindfolding process. For both tourists' behavioral intentions and destination image, the Q^2 values were greater than zero. These values highlight that the prescribed model depicts satisfying predictive relevance having the capability of predicting endogenous concepts away from mere expounding power (Hair et al., 2019).

Model Fit

Ultimately, the model fit was assessed by employing the standard-based root mean square residual (SRMR). The derived value of SRMR was under the suggested verge of 0.08, recommending a satisfactory inclusive model fit for analysis of PLS-SEM and providing support to the appropriateness of the suggested structural model as prescribed by (Hair et al., 2019).

DISCUSSION

The current study's findings offer theoretically noteworthy perceptions into the institutional communication role in tourism decision-building practices. The present study began by investigating the way strategic public relations communication builds behavioral intentions of the tourists by clearly placing destination image as an interceding cognitive–affective process. With the incorporation of public relations theory into destination image-based research and empirically assessing a mediation-grounded structural model in Jordanian context, the current study contributes to long-term calls regarding more process-oriented and theoretically based clarifications of tourist decision-making action. Instead of just reinforcing accepted relationships, findings of the study provide in-depth understanding into *how* as well as *which way* institutional communication affects behavior of tourists in repute-centered and sensitive digitally mediated tourism environs.

Findings reveal that strategic public relations communication leaves a robust and statistically prominent impact on destination image, and provides strong favor to H1. Such kind of assessment corresponds intimately with in vogue public

relations academia, which theorizes strategy-centered communication as an institutional mechanism having an aim to construct trust, credibility as well as legitimacy with the help of relationship-focused and explicit interaction with the shareholders (Valentini, 2021; Ki et al., 2021). Similarly, in tourism background, where potential tourists often depend on mediation-oriented information instead of direct involvement experience, such kinds of communication come on the scene to play a determinative role in framing the way destinations are explained in a cognitive and affective way.

Notably, this finding plays a vital role in extending prior tourism-based research that has largely handled communication as a practical or promotional effort. Although, the studies in the past have shown focus on content quality, message disclosure, or labeling usefulness (Huerta-Álvarez et al., 2020), the current results recommend that tourists tend to respond healthier to communication considered as institutionally reliable and relationship-centered. Following this, this study empirically backs current concept-based argumentation that destination image is not just affected by promotion-grounded stimuli but is also dynamically formed with the help of institutional communication practices that indicate trustworthiness and legitimacy (Tasci et al., 2022). The derived finding, from a theoretical point of view, strengthens the pertinence of public relations theory for the research related to tourism; it also addresses the consistent dominating edge of marketing-oriented communication models. With the clarification that strategic public relations communication works as an important antecedent/predictor of destination image, the present study provides support to a more comprehensive insight of image formation that focuses on institutional trustworthiness not on persuasive messaging only.

Destination image, having consistency with H2, was observed in exercising a prominent constructive impact on tourists' behavioral intentions. The same result corresponds with the current outcomes highlighting that destination image functions as a strong explanatory component of tourist loyalty-based results, despite the fact that contextual and experiential factors are taken into consideration (Sobaih et al., 2024). This derived result validates a significant body of tourism research. Moreover, it specifies destination image as a core-determining factor of intention-oriented results, containing inclinations to visit and suggest travel destinations (Afshardoost & Eshaghi, 2020; Stylidis et al., 2020). The findings confirm by claiming that tourists' behavioral willingness is motivated initially by their collective cognitive–affective assessments not through objective destination qualities. In addition to validating this determined relationship, the current study shares to the destination image theory by strengthening its role as an explanatory framework instead of a static insight.

Similarly, in the digitally facilitated evaluation-judgement background, tourists repeatedly face split, and occasionally contradiction-based information. Additionally, destination image performs as a cognitive–affective framework incorporating these indications into an intelligible assessment-oriented decision making, thus making intention formation able to be formed (Marine-Roig & Huertas, 2020). Such explanatory role adopts itself especially as significant in destinations in which repute-base accounts and alleged risk build prior travel assessments.

Contrary to H1 and H2, on tourists' behavioral intents the direct impact of strategic public relations communication could not appear as statistically significant element, thus guiding to the H3 rejection. Although, communication's direct effects on intention formation have been testified in some tourism studies, especially within marketing efforts and branding the frameworks, the non-existence of a prominent direct path in the current model is hypothetically expressive instead of being problematical. Findings of the study recommend that strategic public relations communication have no proof to function as a direct convincing prompt of behavioral intents. Rather, its influence looks depending on the way tourists cognitively and affectively process the communication. This perception corresponds with direct-effect models' contemporary critiques in the research of tourism behavior, which claim that these kinds of models overgeneralize the process of decision-making by ignoring perception-based mediation processes (Li et al., 2025). The insignificant direct impact, when observed from a mediation-based logic lens, shows total consistency with contemporary perceptions of non-indirect impact. Additionally, the non-existence of a direct impact is unable to make theoretical relevance weak especially when there exists a prominent indirect source as claimed by Zhao et al. (2010). In the present study, the outcomes highlight that strategic public relations communication shows impacts on behavioral intents merely insofar as it frames destination image, highlighting the importance of perceptual explanation in tourism decision forming.

A strong empirical support is offered for H4 by managing mediation analysis. It also demonstrates that destination image serves entirely as a mediator for the relationship found between strategy-centered public relations communication and behavioral intentions of the tourists. The derivative result signifies one of the study's most significant theoretical implications. This study, by empirically authenticating a model of full mediation, goes beyond expressive relations providing a process-focus clarification of the way institutional communication interprets into behavioral results.

The current finding corresponds with contemporary tourism research, which accentuates mediation-oriented interpretations of a tourist behavior, specifically in the backgrounds categorized by perceived risk, ambiguity as well as reputation related feelings (Hassan & Soliman, 2021; Gorji et al., 2023). In order to build tourists' intents, strategic public relations communication comes ahead. It does not frame by directly inspiring action, but through affecting the emotions, meanings, and even assessments that construct destination image. While performing this, destination image serves as a cognitive–affective channel, which connects institutional indications to behavioral willingness. On theoretical level, this finding appears challenging for the consistent dependence on attitudinal frameworks like the Planned Behavior Theory in tourism backgrounds in which institutional communication leads to the formation of attitude. When strategic public relations communication is place as a pre-attitudinal construct, while destination image and exogenous construct as the key explanatory contrivance, the study provides a substitute illustrative framework, which depicts present-day, communication-guided tourism atmospheres in a better way. The current study overall provides a number of significant theoretical insights.

Firstly, it empirically and theoretically differentiates strategic public relations communication from marketing-centered when related to communication held in tourism research. Additionally, it signifies its exceptional role in the formation of destination image. Secondly, it develops the theory of destination image by replacing image as a mediating explanatory

process instead of a simple behavior antecedent. Thirdly, through empirical validation of a full mediation model, this study facilitates an expanding volume of research supporting process-centric and theory-led interpretations of a tourist judgement. Lastly, this study, while concentrating on the Jordanian background, increases the context-based strength of tourism communication theory by ranging it beyond the destinations of West and East Asia.

In the present study, there have been provided a number of significant theoretical implications regarding the research based on tourism communication and destination image. Firstly, it provides insights to the expanding volume of literature that advocates going away from marketing-focused conceptualizations of tourist-centered behavior by empirically incorporating strategic public relations communication into a destination image theoretical framework. Whereas prior studies conducted on tourism concerns have mainly theorized communication as promotion-based experience or marking activity, the present results validate that communication is grounded on transparency, credibility, and similarly, relationship orientation has to play an influential role in building tourists' perceptions instead of directly encouraging behavioral intents. Peculiarity of such nature makes theoretical clarity advanced by specifying strategic public relations communication as the antecedent of an institution instead of a normative purpose-driven approach.

Secondly, this study validates the theory of destination image by experientially substantiating its vital role as intermediary thought or emotional-affective mechanism instead of a simple behavior determinant. Similarly, finding based full mediation specifies that destination image performs as an explanatory channel by which institutional communication is interpreted into behavioral promptness. Such process-centered interpretation offers a respond directly to contemporary assessments of tourism behavior frameworks and models, which attach excessive emphasis to direct impacts however ignoring perceptual and meaning-making processes (Tasci et al., 2022; Li et al., 2025).

The third point is that the nonexistence of a remarkable direct impact found between strategy-based public relations communication and behavioral intentions of the tourists reflects significant theoretical contributions. Instead of putting communication theory into contradiction, the current finding corroborates existing mediation reasoning, which accentuates that the institutional directives or guidelines are surely cognitively and affectively managed before persuading intention building as argued by (Zhao et al., 2010). It interrogates the persistent dependence on linear, direct-impact presumptions rooted in attitudinal framework like the Planned Behavior Theory, especially in the context of tourism in which communication occurs to the attitude formation and development.

Lastly, testing the model through observation-based data in the Jordanian context, this study expands the geographical as well as context-centered space of the theory of tourism communication. Similarly, much of the contemporary literature focuses on East Asian and Western designed destinations, possibly restricting the generalizability of in vogue models. However, findings of the study recommend that in repute-based sensitive and institution-level facilitated destinations, the strategy-centric public relations communication tends to play a specifically prominent role in building destination image, thus supporting to a more context-oriented strong theoretical knowledge of tourist decision-choice.

The current study's findings provide a number of practical insights for destination management organizations (DMOs) and the policymakers of tourism industry. First, findings of the study highlight claims that strategic public relations communication in a sense must not be handled as a supplemental or peripheral activity; instead, it should be considered as an essential constituent of the destination management tactic. Communication efforts that prioritize transparency, credibility, and relationship building appear more effective in shaping favorable destination images than purely promotional messaging. Secondly, the nonexistence of a direct impact between the strategic public relations communication and behavioral intentions of the tourists recommends that DMOs should reconsider and adjust their prospects concerning communication results. Instead of trying to encourage for visit intentions with the help of advertisement-based campaigns, practitioners must concentrate on building trustworthy and coherent destination descriptions that increase collective cognitive–affective assessments of tourists. Regarding this, destination image appears as the main influential idea with which investments in communication produce behavioral outputs.

Thirdly, findings depict relevancy especially for destinations working in the environments categorized by highly observed risk, repute related sensitivity, or even geopolitical complication. Strategic public relations communication, in such kinds of environments, can perform as a legitimacy-framing process, which alleviates uncertainty while strengthening trust on the institutions. It emphasizes the significance of consistent, harmonized and institutionally trustworthy communication in all official tourism platforms, media relations, and digital channels.

Lastly, tourism related management should identify that the usefulness of communication strategies rests not merely on message content but on how communication related performances are observed on institutional level. Investing in interactional involvement, response tendency, and fairness may as a result give long-standing paybacks by reinforcing destination image, and indirectly, behavioral intentions of tourists.

CONCLUSION

To conclude, the research in future may have the capacity to extend the suggested model by integrating extra moderating or mediating variables like anticipated risk, trust, or media trustworthiness. Such kinds of extensions in research work would further increase perceptions of the multi-layered underlying processes with which institutional communication shows effects on tourist behavior in existing digital based mediated tourism contexts. The present findings further indicate that strategic public relations communication is relevant to the formation of destination image, while destination image plays an important role in explaining tourists' behavioral intentions. The absence of a significant direct relationship between strategic public relations communication and behavioral intentions, together with the significant indirect relationship through destination image, highlights the importance of considering the perceptual process through which institutional communication influences

tourism-related behavioral outcomes. In this regard, the study contributes to tourism communication research by positioning destination image as a mediating mechanism linking strategic public relations communication with tourists' behavioral intentions. Overall, the findings support a process-oriented understanding of tourism communication in which institutional communication influences behavioral intentions through the destination perceptions formed by tourists.

Limitations and Future Research

In spite of this study's support and contributions, it goes under a number of limitations that paves the avenues for research to be conducted in the future. Firstly, the study used a cross-sectional research pattern, which has the ability limitations in drawing general implications concerning the vigorous advancement of destination image as well as behavioral intentions with the passage of time. The studies in future can adopt experimental or longitudinal designs to engage changes in tourists' understandings following publicity to strategic public relations based communication.

Secondly, it may happen that due to the usage of online self-managed surveys there may emerge self-chosen bias; it reasons that individuals having higher digital engagement levels and keen interest in tourism-oriented content are more probable to show their participation. Additionally, the dependence on self-diagnosed perception-based measures may become under social desirability propensities, possibly manipulating respondents' assessments.

Such kinds of methodological restrictions should be brought under consideration while explaining the inferences and generalizing the findings to larger population of tourism. Thirdly, whereas the present study made strategic public relations communication conceptualize as a unidimensional concept to improve parsimony, the research in future may go to search its multidimensional structure with more deep-digging effort. While investigating particular communication-based practices such as two-way interaction involvement, transparency gesturing or crisis communication might offer more substantive and detailed understandings into which public relations communication perspectives perform most persuasively in building destination image. Finally, this study concentrated on a single destination context.

It may bound the generalizability of the study results. Studies, having comparative nature, throughout various political, cultural or institution-level contexts would support in evaluating the strength of the suggested model and recognizing the potential peripheral situations. Specifically, future research could be able to compare reputation-based sensitive destinations having well-known and strongly established tourism marketplaces.

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PLACE-BASED WELLNESS TOURISM ARCHITECTURE AT THE DEAD SEA: ENVIRONMENTAL RESOURCES, SPATIAL SYSTEMS, AND OPERATIONAL SUSTAINABILITY

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Abstract: Wellness and health tourism has experienced significant global growth, driven by increasing demand for integrated therapeutic experiences that combine natural resources, environmental context, architecture, and interior design. The Dead Sea is one of the world's most prominent wellness destinations due to its exceptional climatic and mineral properties. However, hotel architecture in the region often continues to follow conventional hospitality models that emphasize general leisure amenities rather than spatially integrated therapeutic systems rooted in the specificity of place. This study examines the role of architecture and interior design in supporting wellness tourism at the Dead Sea by analyzing the relationship between environmental context, natural resources, wellness-oriented spatial systems, tourist experience, and the operational sustainability of hotels. A Design-Based Mixed-Methods Approach was adopted, combining typological analysis of therapeutic spatial systems, spatial assessment of selected hotels, questionnaires distributed to guests (n = 260), and semi-structured interviews with owners and managers (n = 8), supported by descriptive data analysis. The findings reveal a clear gap between the Dead Sea's exceptional therapeutic potential and its actual spatial translation within existing hotels. Recreational functions were found to dominate over specialized and integrated therapeutic systems, resulting in fragmented wellness experiences. The results also indicate a substantial mismatch between guests' strong preference for integrated therapeutic components and their limited actual availability, negatively affecting satisfaction, revisit intention, and perceived hotel performance. In addition, owners and managers confirmed a direct relationship between the efficiency and integration of therapeutic spatial systems and the operational sustainability and competitiveness of hotels. The study concludes that adopting a place-based wellness-oriented hotel architecture model, in which therapeutic systems function as generators of spatial organization rather than secondary service features, represents a strategic pathway to enhance tourist experience and strengthen the operational sustainability of Dead Sea hotels.

Keywords: wellness tourism, place-based design, spatial systems, healing architecture, tourist experience, operational sustainability, Dead Sea

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INTRODUCTION

Wellness and health tourism has experienced accelerated growth over the past decades, becoming one of the most dynamic segments of the global tourism industry and exerting increasing influence on spatial planning, hotel architecture, and the design of wellness-oriented environments. Contemporary wellness tourism extends beyond the provision of isolated therapeutic services to encompass integrated spatial experiences that combine environmental resources, architecture, interior design, and therapeutic activities, thereby enhancing both physical and psychological well-being, increasing the length of stay, and strengthening tourist loyalty (Hall, 2011; Jawabreh et al., 2023; McGroarty, 2023; Smith & Puczkó, 2014).

Within this evolving paradigm, architectural space and interior design are no longer passive containers of services but active agents in shaping the therapeutic experience. This aligns with the theoretical foundations of healing architecture, which emphasize the influence of spatial configuration, natural light, air quality, and environmental integration on human health outcomes (Al Fahmawee, 2023; Gesler, 2003; Kaplan et al., 1989; Ulrich et al., 2008). In this context, the Dead Sea represents one of the most prominent global destinations for wellness tourism, due to its

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exceptional environmental characteristics, including its location at the lowest point on Earth, high concentrations of salts and minerals, therapeutic mud, and a unique climatic profile beneficial for dermatological, respiratory, and psychological conditions (Al Dein, 2021; Alhmoud & Alhmoud, 2024; Canton, 2021; Hassan, 2000; Organization, 2017). These attributes have established the Dead Sea as a distinctive place-based therapeutic environment, with significant potential for advanced wellness tourism development.

However, despite this exceptional environmental and therapeutic richness, hotel architecture in the Dead Sea region remains, in many cases, aligned with generic hospitality models focused on accommodation and leisure functions. Specialized wellness-oriented spatial systems are often implemented in a fragmented or symbolic manner, typically confined within conventional spa facilities, without being integrated as generative components of spatial organization or as drivers of the overall therapeutic experience (Jawabreh et al., 2025; Katz et al., 2014; Voigt & Pforr, 2013; Zmirou-Navier, 2021). This limits the ability of hotels to systematically activate local environmental resources and weakens the spatial and functional coherence of the wellness experience.This gap becomes more evident when considering contemporary approaches to place-based wellness tourism, which emphasize the importance of translating environmental resources—such as climate, water, minerals, and landscape—into structured spatial systems that reflect the identity of the place and enhance experiential value (Jawabreh et al., 2024; Lew, 2019; Smith & Diekmann, 2017). In such approaches, the place itself becomes an active therapeutic agent, rather than a passive environmental backdrop.

To clarify the spatial logic underlying this transformation, Figure 1 illustrates the proposed wellness spatial sequence, which organizes the visitor experience into a coherent progression from arrival and orientation, to treatment, recovery, and place-based experiential engagement. This sequence reflects the fundamental principle that therapeutic effectiveness is achieved through spatial continuity rather than isolated interventions. To situate the study within its geographical and environmental context, Figure 2 presents the location of the Dead Sea within the regional framework, highlighting the concentration of hotel development along the eastern shoreline and its relationship to key geomorphological features.

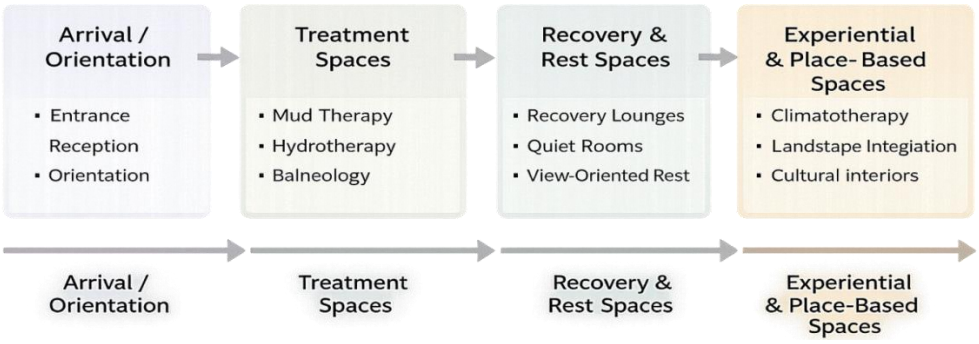


Figure 1. Wellness spatial sequence model illustrating the progression from arrival and orientation to treatment, recovery, and place-based experiential spaces within wellness-oriented hotel architecture at the Dead Sea

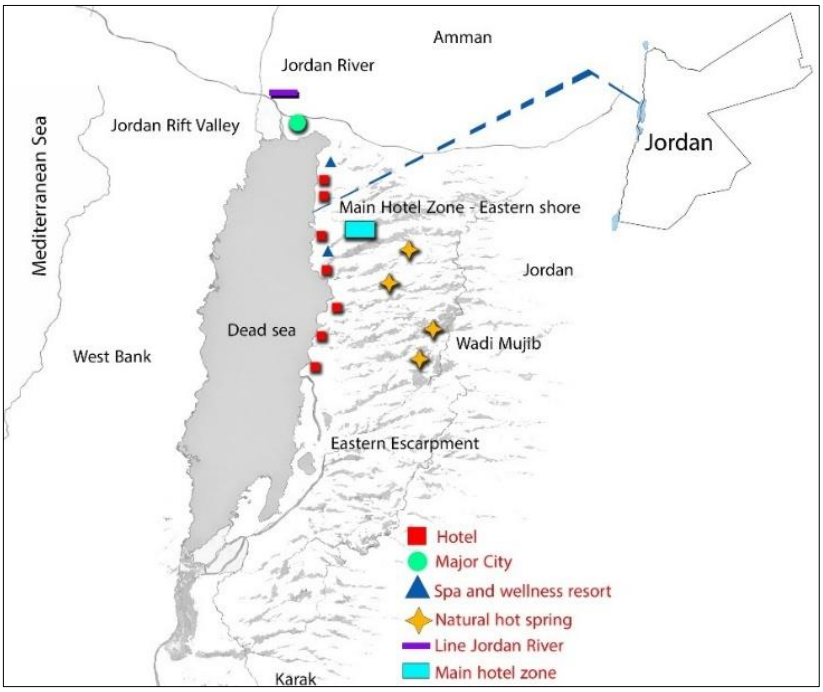


Figure 2. Location map of the Dead Sea region showing major geomorphological features and the main wellness-oriented hotel zone along the eastern shore in relation to key regional nodes



Figure 3. (Left) Freshwater cascades and natural pools within the Dead Sea hinterland landscape;
(Right) Crystalline salt formations along the mineral-rich shoreline illustrating the environmental basis of wellness tourism

In addition to its well-documented therapeutic properties, the Dead Sea region includes a diverse environmental system characterized by unique geological formations, mineral-rich shorelines, and natural landscapes that contribute to both sensory and therapeutic dimensions of the visitor experience (Al Dein, 2021; Ismail & Abd Elkader, 2023; Walls et al., 2011). These environmental features form the natural basis of wellness tourism in the region, as illustrated in Figure 3.

Despite this environmental richness, there remains a clear research gap in the absence of studies that systematically link environmental context, spatial organization, tourist experience, and operational sustainability within hotel architecture, particularly in contexts characterized by unique therapeutic resources such as the Dead Sea (Al Dein, 2022; Alhmoud, 2024; Pine & Gilmore, 2011; Pizam & Tasci, 2019).From an operational perspective, this gap is reflected in declining performance indicators in some Dead Sea hotels, including reduced occupancy rates and the closure of certain facilities in recent years, despite the strategic location of the region and its proximity to major urban and tourist centers (Aburamadan, 2022; Ministry of Tourism and Antiquities, 2024). From a broader national perspective, strengthening the competitiveness of Jordanian tourism activity remains important for supporting the sector's economic performance and sustainable growth (Saleh et al., 2023). This paradox suggests that the mere presence of environmental and therapeutic resources is insufficient to ensure sustained tourist demand or operational viability.

The core problem, therefore, lies in the absence of a systematic translation of these environmental resources into integrated wellness-oriented spatial systems within hotel architecture and interior design. This deficiency results in fragmented therapeutic experiences, reduced visitor satisfaction, limited repeat visitation, and weakened operational sustainability.

In response to this gap, this study investigates wellness tourism in the Dead Sea as both a spatial and design problem. It aims to analyze the relationship between environmental context and natural resources, the configuration of wellness-oriented spatial systems in hotel architecture and interior design, and their impact on tourist experience and operational sustainability.

To address this gap, the present study adopts a place-based architectural perspective and develops a typological framework that defines the essential wellness-oriented spatial systems required in therapeutic hotel environments. This framework, summarized in Table 1, links natural resources to therapeutic functions, spatial components, and organizational logic, providing an analytical benchmark for evaluating existing hotel conditions.To operationalize this relationship, the study develops a typological framework that identifies the core wellness-oriented spatial systems required in place-based therapeutic hotel environments. This framework is derived from the literature on wellness tourism, healing architecture, and place-based design, and serves as an analytical benchmark for evaluating existing hotel conditions.

Table 1. Typological framework of wellness-oriented spatial systems
(Source: Developed by the author based on Smith & Puczkó, 2014; Gesler, 2003; Ulrich et al., 2008)

Natural Resource	Therapeutic System	Required Core Interior Spaces	Spatial Logic
Dead Sea mud	Mud therapy system	Mud cabins, preparation rooms, wash-off areas, recovery lounges	Sequential therapeutic flow
Mineral water	Hydrotherapy system	Hydromassage pools, therapeutic baths	Controlled immersion sequence
Climate & low altitude	Climatotherapy	Solarium, aerarium, shaded decks	Exposure–recovery cycle
Saline air	Inhalation therapy	Aerosol rooms, breathing chambers	Controlled respiratory sessions
Landscape views	View-based recovery	Quiet lounges oriented to sea	Post-treatment restoration
Cultural identity	Narrative spaces	Interpretive interiors, material expression	Place-based storytelling
Physical rehabilitation	Therapeutic physical culture	Rehab gym, medical screening	Supervised recovery sequence
Family wellness	Inclusive wellness	Accessible pools, child therapy zones	Parallel therapeutic systems

Table 1 is used in this study not as a purely theoretical classification, but as an evaluative tool that supports the spatial assessment of existing Dead Sea hotels presented later in Table 2. To structure this investigation, the study adopts a conceptual framework that links Environmental Context → Natural Resources → Wellness-Oriented Spatial Systems → Tourist Experience → Operational Sustainability, as illustrated in Figure 4. Based on this framework, the research seeks to answer how environmental resources can be effectively translated into spatial systems that support integrated therapeutic experiences, and how this translation influences both visitor experience and the long-term operational performance of hotels.

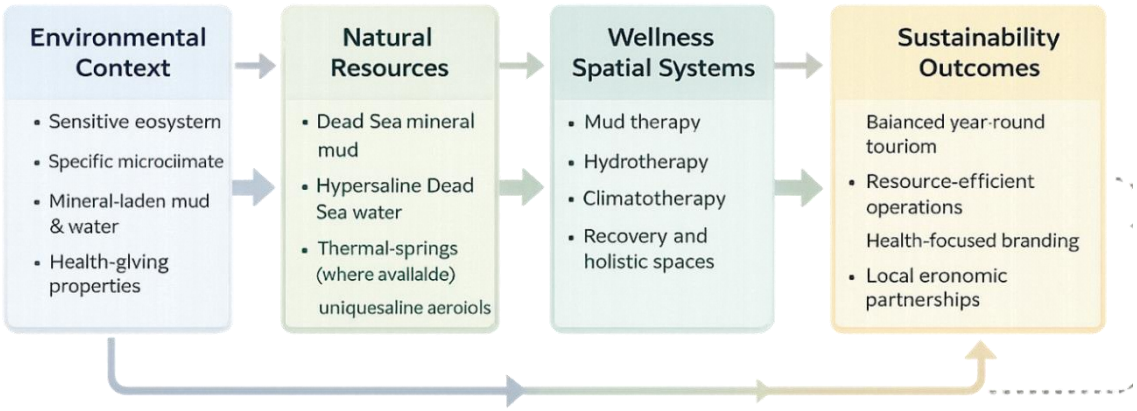


Figure 4. Conceptual framework linking environmental context, natural resources, wellness-oriented spatial systems, tourist experience, and operational sustainability in place-based hotel architecture at the Dead Sea

MATERIALS AND METHODS

This study adopts a Design-Based Mixed-Methods Approach to examine how the environmental and therapeutic resources of the Dead Sea are translated into functional wellness-oriented spatial systems within hotel architecture and interior design, and how this translation affects tourist experience and the operational sustainability of hotels. This methodological choice was deemed appropriate because the research problem is inherently interdisciplinary, situated at the intersection of architecture, interior design, tourism, and wellness studies. More specifically, the study does not treat spatial organization as a secondary design outcome, but as a central analytical variable that mediates the relationship between environmental resources and tourism performance.

The study area is defined by a distinct topographic condition that plays a critical role in shaping the spatial organization of hotel developments along the Dead Sea. The eastern escarpment forms a steep gradient descending toward the Dead Sea basin, creating a strong sectional relationship between plateau, slope, and shoreline.

This topographic configuration directly influences architectural massing strategies, circulation patterns, and visual orientation toward the sea. As illustrated in Figure 5, the descent from the escarpment to the shoreline establishes a spatial framework within which hotel architecture is often organized through stepped configurations that follow the natural terrain.

This condition is not merely a physical constraint but a generative design factor that reinforces the relationship between environmental context and spatial organization, forming a key component of place-based wellness-oriented hotel architecture.

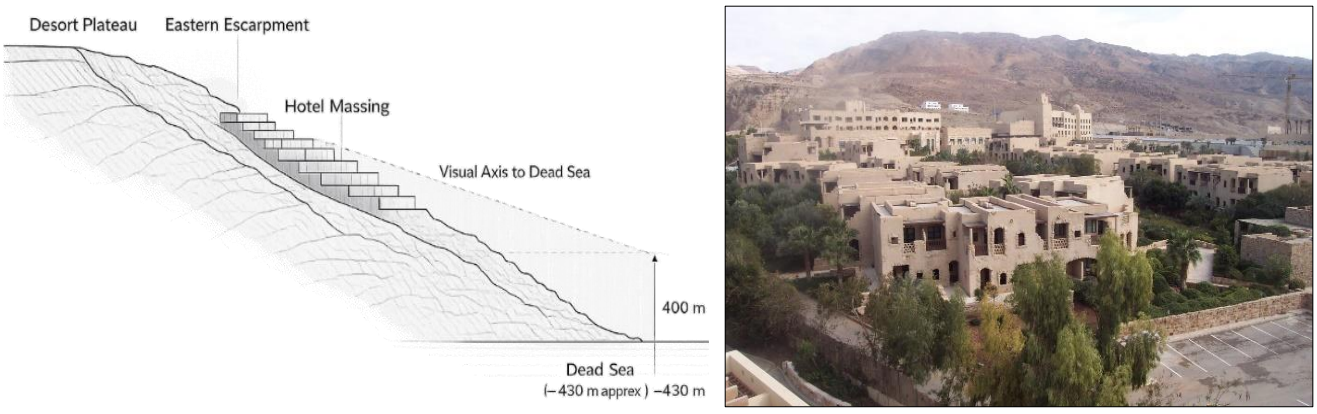


Figure 5. (Left) Topographic section showing the descent from the Eastern Escarpment to the Dead Sea basin as a key spatial and architectural condition; (Right) Stepped hotel massing along the eastern shore illustrating the role of topography as a generator of place-based, wellness-oriented hotel architecture. Source: Field photographs and analytical diagrams by the author

The methodological logic of the study is grounded in the conceptual structure introduced in the previous section, where the environmental context of the Dead Sea is understood as the starting point for the formation of therapeutic spatial systems, which in turn shape visitor experience and influence operational sustainability. In methodological terms, this logic is translated into a staged analytical process that begins with the derivation of a typological framework from the literature,

proceeds to the spatial assessment of selected hotels, and then incorporates empirical data from guests, owners, and managers in order to interpret the relationship between spatial organization and operational outcomes. Within this sequence, Table 1 functions as the analytical benchmark for therapeutic spatial systems, Table 2 as the spatial diagnostic tool for the assessed hotels, and Table 3 as the matrix through which analytical findings are translated into design implications. Likewise, the visual materials included in the manuscript support this methodological structure by linking environmental context, spatial sequence, and interpretive outcomes to the research process.

The study is based on three interrelated units of analysis. The first unit comprises the hotels themselves. The sample included six operating hotels in the Dead Sea region (n = 6), selected according to criteria that ensured analytical relevance rather than statistical representativeness. These criteria included hotel category, actual operation during the study period, the presence of spa or wellness-related facilities, and the ability of the selected cases to reflect diversity in current hospitality models within the region. Given the limited number of operational hotels with wellness-related facilities in the Dead Sea area, this sample size is methodologically appropriate for an in-depth spatial and design-oriented analysis.

The second unit of analysis consisted of hotel guests. A total of 260 questionnaires (n = 260) valid for analysis were collected from guests staying in the selected hotels. These questionnaires provided the empirical basis for assessing perceived availability of therapeutic spatial components, user expectations, elements of visitor experience, and the perceived relationship between spatial systems and hotel performance. The third unit of analysis consisted of owners and senior hotel managers, with eight semi-structured interviews (n = 8) conducted in order to represent the operational and investment perspective of the sector. This triangulated structure strengthens the reliability of the study by combining spatial diagnosis, user perception, and managerial interpretation within one coherent analytical framework.

Data collection relied on four complementary tools. First, a focused literature review was conducted to derive the analytical and typological basis of the study. The reviewed literature addressed wellness and health tourism, healing architecture, and place-based design, with the aim of identifying the main therapeutic spatial systems that should characterize hotels operating in destinations with distinctive therapeutic environmental resources. The outcome of this process was synthesized in Table 1, which links natural resources, therapeutic functions, required interior spaces, and the spatial logic of therapeutic sequencing. In this study, Table 1 is not treated as a purely theoretical classification, but as an evaluative analytical framework that supports subsequent spatial assessment.

Second, a spatial–functional assessment was carried out for the six selected hotels using the systems defined in Table 1. This process generated the comparative matrix presented in Table 2, which evaluates the extent to which core wellness-oriented spatial systems are present, absent, or only partially implemented in the case-study hotels. The assessment was based on multiple sources of evidence, including interviews with management, reviews of officially announced hotel services, and analysis of available operational and promotional materials. To reduce subjectivity in the classification, a clear operational criterion was adopted. Systems classified as Yes were those whose core spaces were available, functionally active, and organized through a recognizable therapeutic spatial sequence. Systems classified as Partial were those represented by scattered or symbolic elements without a coherent therapeutic sequence or direct relation to the specific resources of the Dead Sea. Systems classified as No were those for which no evidence of actual provision or operation could be identified. Accordingly, Table 2 should be understood as a comparative spatial diagnostic tool, not as a hotel ranking instrument.

Third, a structured questionnaire was developed and distributed to hotel guests. The questionnaire was designed to capture three main dimensions: the perceived availability of therapeutic spatial components, the experiential consequences of their presence or absence, and the operational implications as perceived by users. The survey instrument was therefore not limited to recording satisfaction in general terms, but sought to understand how guests evaluated the spatial and therapeutic completeness of the hotel environment and how this evaluation related to return intention, recommendation, and broader experiential quality. The quantitative data generated through the questionnaires provided the descriptive empirical basis for assessing the gap between actual spatial provision and user expectations.

Fourth, semi-structured interviews were conducted with owners and general managers of the selected hotels. These interviews focused on three interrelated themes: the current reality of therapeutic spatial provision within the hotels, the operational challenges associated with strengthening such systems, and the perceived relationship between wellness-oriented spatial systems and hotel occupancy performance. The interviews were analyzed through thematic analysis, allowing the extraction of recurring interpretive patterns related to spatial integration, investment logic, and operational sustainability. This qualitative component was particularly important because it enabled the study to connect spatial diagnosis and visitor expectations with the operational reasoning of decision-makers in the sector.

In order to ensure methodological rigor, the study addressed both validity and reliability. Content validity was supported through the review of research tools by specialists in architecture, interior design, and wellness tourism, ensuring that the questionnaire items and analytical categories were conceptually aligned with the objectives of the study. The internal consistency of the questionnaire was tested using Cronbach’s alpha, and the analysis showed an acceptable level of reliability for the overall scale. This supports the consistency of the empirical data used in the interpretation of guest perceptions and their relationship to spatial and operational variables. Data analysis combined quantitative descriptive analysis and qualitative interpretive analysis. Questionnaire data were analyzed using means and standard deviations in order to assess the perceived levels of therapeutic component availability, the degree of user preference for such systems, and experiential tendencies such as satisfaction and revisit intention. Interview data, by contrast, were subjected to thematic analysis in order to extract recurring patterns and managerial interpretations. The integration of these two forms of evidence was not treated as a mechanical combination of data types, but as an interpretive integration process through which spatial

observations, user perceptions, and managerial insights were brought together in the analytical matrices and figures of the study. In this way, the study moves from diagnosis to interpretation, and from interpretation to design implications.

Finally, the scope of the study is subject to several limitations that define its analytical boundaries. The research is limited to six operating hotels in the Dead Sea region and relies on descriptive and interpretive analysis, rather than advanced predictive statistical modeling. It is further limited to the spatial–functional analysis of therapeutic systems and does not extend into detailed structural engineering analysis or precise economic modeling.

Nevertheless, the study offers strong analytical transferability to other wellness destinations characterized by distinctive environmental resources, especially where the challenge lies not in the absence of therapeutic potential, but in the lack of its systematic architectural translation.

RESULTS

This section presents the empirical and spatial findings derived from the typological framework, spatial assessment of hotels, guest questionnaires, and semi-structured interviews. The results are structured in alignment with the analytical sequence of the study, ensuring consistency between the conceptual model, methodological framework, and empirical outcomes.To support the interpretation of these findings, Figure 6 illustrates the intended functional–spatial structure of wellness-oriented hotels, where therapeutic, accommodation, and recreational systems are integrated within a unified place-based spatial model derived from the environmental resources of the Dead Sea.

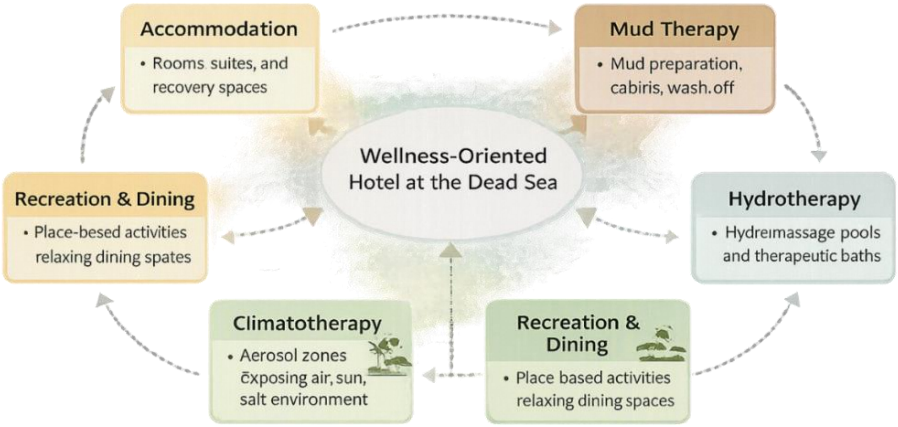


Figure 6. Functional–spatial structure of wellness-oriented hotels at the Dead Sea

Spatial Assessment of Wellness-Oriented Systems

The spatial evaluation of the selected Dead Sea hotels reveals a consistent pattern of partial or absent integration of wellness-oriented spatial systems, as summarized in Table 2. The results show that existing hotels predominantly implement wellness components in a fragmented and non-sequential manner, where therapeutic functions are embedded within conventional spa facilities rather than organized as integrated spatial systems.

Table 2. Spatial assessment of wellness-oriented systems in Dead Sea hotels

Wellness Spatial System	Core Spatial Components	Presence	Current Spatial Implementation	Key Spatial Gap
Mud therapy system	Mud cabins, preparation, wash-off, recovery	Partial	Symbolic spa-based treatments	No integrated treatment sequence
Dead Sea bathing sequence	Controlled sea access, hygiene, shaded rest	Partial	Direct sea access only	Missing safety and recovery zones
Hydrotherapy system	Therapeutic baths, hydromassage	Partial	Generic spa pools	Not resource-specific
Thermal bathing system	Thermal pools, rest zones	No	Not available	Entire system absent
Climatotherapy spaces	Aerarium, solarium, shaded decks	No / Partial	Leisure terraces only	Climate not used therapeutically
View-based recovery spaces	Recovery lounges with views	Partial	Views limited to restaurants	No post-treatment recovery logic
Inhalation / aerosol therapy	Inhalation rooms	No	Not provided	Entire function absent
Drinking cure facilities	Drinking hall, walking gallery	No	Not provided	Therapeutic ritual absent
Therapeutic physical culture (LFC)	Rehab gym, wellness screening	Partial	Fitness gym only	No wellness integration
Inclusive therapeutic pools	Accessible therapeutic pools	No	Standard pools only	Exclusion of disabled users
Narrative / identity spaces	Interpretive interior elements	No	Neutral hotel interiors	No sense of place
Cultural & evening spaces	Cultural halls, low-noise leisure	Partial	Entertainment lounges	Not wellness-integrated
Family wellness support	Children centers linked to wellness	No	Play areas only	No family-therapy logic

Guest Perception of Wellness Availability

The results of the questionnaire analysis indicate that the perceived availability of therapeutic spatial components is generally low to moderat**e**, while the desire for such components is consistently high**.** Specifically:

- Systems such as hydrotherapy, mud therapy, respiratory therapy, and psychological therapy recorded low availability levels.
- In contrast, recreational facilities (e.g., swimming pools) recorded the highest availability levels.

This divergence reflects a clear expectation–availability gap**,** where user demand for integrated therapeutic systems is not met by the current spatial configuration of hotels.

Visitor Experience Outcomes. The evaluation of visitor experience reveals that:

- Overall satisfaction levels are moderate
- Return intention is low
- Recommendation intention is limited**,** particularly for therapeutic purposes

These findings indicate that the current hotel environments do not deliver a fully integrated wellness experience, but rather a partial leisure-based experience with limited therapeutic depth**.**

Operational Insights from Interviews. The results of semi-structured interviews with hotel owners and managers show a strong recognition of the relationship between therapeutic spatial systems and hotel performance. Key insights include:

- The absence of integrated wellness systems limits the ability of hotels to attract long-term demand
- The integration of therapeutic spatial systems is perceived as essential for increasing length of stay and occupancy rates
- There is a clear need for a fully specialized wellness-oriented hotel model in the Dead Sea region

At the same time, the findings reveal a gap between strategic awareness and actual spatial implementation**,** where most hotels continue to operate under conventional hospitality models.

Synthesis of Key Findings. The results of the study can be synthesized into five core findings:

- Wellness-oriented spatial systems are largely absent or partially implemented
- Recreational functions dominate over therapeutic spatial systems
- There is a significant gap between user expectations and actual spatial provision
- The current spatial configuration negatively affects visitor experience and loyalty
- There is a strong perceived link between spatial systems and operational sustainability

These findings provide a robust empirical and spatial basis for the subsequent interpretive discussion.

DISCUSSION

This section interprets the findings of the study in relation to the conceptual framework (Figure 4) and the therapeutic spatial sequence (Figure 1), linking spatial assessment results, user perceptions, and managerial insights within a unified explanatory structure.

From Environmental Resource to Spatial System: A Design Gap

The results demonstrate that the primary challenge facing Dead Sea hotels is not the absence of environmental or therapeutic resources, but the lack of their systematic translation into integrated wellness-oriented spatial systems.

Although the Dead Sea possesses exceptional therapeutic assets, the spatial assessment results (Table 2) show that these resources are rarely organized within coherent therapeutic sequences. Instead, they are implemented as isolated or symbolic functions embedded within conventional spa environments.

This finding aligns with the literature on healing architecture and place-based wellness tourism, which emphasizes that therapeutic value emerges not from the presence of resources alone, but from their integration into structured spatial systems linking arrival, treatment, recovery, and place-based experience (Al Maani & Mubaideen, 2024; Bell, 2018; Dilani, 2008; Gesler, 2003; Smith & Puczkó, 2014; Sthapit et al., 2025; Ulrich et al., 2008). Accordingly, the identified gap in Dead Sea hotels can be defined as a design-structural gap, rather than a resource or location-based limitation.

Fragmentation of Spatial Systems and Loss of Therapeutic Depth

The dominance of recreational functions over specialized therapeutic systems represents a critical structural imbalance. The results show that facilities such as swimming pools and general spa services are widely available, while specialized therapeutic components—such as climatotherapy, respiratory therapy, and integrated recovery spaces—are either absent or weakly implemented (Table 2). This imbalance reduces the spatial depth of the wellness experience**,** transforming it into a short-term leisure-oriented stay rather than an integrated therapeutic journey.

Consistent with healing architecture theory, the absence of a clear therapeutic spatial sequence limits both the effectiveness of treatment and the experiential connection between the visitor and the place (Ritchie, 2003).Thus, fragmentation at the spatial level directly translates into fragmentation at the experiential level.

Expectation–Reality Gap and Its Impact on Tourist Loyalty

The questionnaire results reveal a clear divergence between high user demand for therapeutic components and their low level of actual availability**.** This expectation–reality gap is directly reflected in visitor experience indicators, where satisfaction remains moderate and both return intention and recommendation levels are relatively low.

These findings confirm that the current spatial configuration of Dead Sea hotels does not support a complete wellness experience, limiting the potential for developing long-term relationships between visitors and the destination. This observation is consistent with global wellness tourism trends, which indicate that spatial coherence and experiential completeness are key determinants of tourist loyalty and length of stay.

Spatial Integration as a Driver of Operational Sustainability

One of the most significant contributions of the study lies in establishing a direct relationship between spatial organization and operational performance. The results of interviews with hotel owners and managers indicate a strong awareness that improving therapeutic spatial systems contributes to increasing occupancy rates, extending length of stay, and diversifying demand. This finding shifts the role of architecture from a passive container of functions to a strategic operational driver, where spatial integration becomes a key mechanism for enhancing competitiveness and reducing seasonality. In this sense, the relationship between design and occupancy is not merely associative, but structurally embedded in how the therapeutic experience is organized. While the study adopts a design-based interpretive approach, the identified relationships are supported by converging evidence from spatial assessment, user perception, and managerial insights.

Design Implications: From Diagnosis to Spatial Strategy

Based on the spatial gaps identified in Table 2, the study translates its findings into a set of design-oriented implications, summarized in Table 3**.** The implications emphasize that improving wellness tourism performance does not necessarily require large-scale construction interventions, but rather a reorganization of spatial relationships. Key principles include:

- Reconstructing the therapeutic spatial sequence from arrival to recovery
- Integrating environmental resources (climate, views, minerals) as active spatial systems
- Prioritizing recovery spaces as essential components of the therapeutic process
- Enhancing place identity through material, narrative, and spatial strategies

These principles demonstrate that wellness-oriented spatial systems should function as generative elements of architectural organization, rather than as secondary service additions.

Table 3. Design Implications Derived from Spatial Gaps in Dead Sea Hotels

Identified Spatial Gap (from Table 2)	Design Implication	Spatial Strategy	Expected Impact on Tourist Experience	Expected Impact on Operational Sustainability
Absence of integrated treatment sequences	Reinforce therapeutic spatial sequencing	Organize spaces as Preparation → Treatment → Recovery → Experience	Enhanced therapeutic continuity and user comfort	Increased length of stay and repeat visitation
Symbolic or fragmented wellness functions	Transition toward place-based wellness systems	Integrate Dead Sea resources into the core spatial organization	Strengthened authenticity and sense of place	Improved destination differentiation and competitiveness
Underutilization of climate and views	Activate environmental resources as therapeutic assets	Develop climatotherapy zones and view-oriented recovery spaces	Improved psychological restoration and environmental immersion	Cost-efficient enhancement of wellness value and reduced seasonality
Missing post-treatment recovery spaces	Prioritize recovery as a core spatial phase	Introduce dedicated recovery lounges linked to treatment zones	Increased relaxation, satisfaction, and perceived quality	Improved treatment effectiveness and customer retention
Generic spa implementations	Replace generic spa logic with resource-specific systems	Design hydrotherapy and mud therapy around local environmental conditions	Unique and place-specific wellness experience	Stronger competitive positioning in wellness tourism markets
Absence of specialized therapeutic systems	Introduce targeted therapeutic components	Integrate inhalation therapy, respiratory treatments, or drinking-cure facilities	Expanded therapeutic scope and user relevance	Diversification of demand and improved market resilience
Lack of narrative and identity expression	Embed place-based narrative within spatial design	Integrate cultural, environmental, and material storytelling elements	Increased memorability and emotional attachment	Strengthened branding and destination identity
Exclusion of specific user groups	Promote inclusive wellness environments	Design accessible therapeutic pools and family-oriented wellness zones	Broader accessibility and inclusive user experience	Expansion of target market segments and improved occupancy stability

Toward a Place-Based Wellness Hotel Model

Figure 7 synthesizes these implications into a conceptual transformation from a generic hotel model to a place-based wellness-oriented model. This transformation is not limited to adding therapeutic facilities, but requires a fundamental reconfiguration of spatial logic, where environmental resources become structurally embedded in the organization of space and experience. Accordingly, the study contributes to the literature by proposing an integrated framework that connects:

- Environmental context
- Spatial systems
- Tourist experience
- Operational sustainability within a unified architectural perspective.



Figure 7. Conceptual transformation from a generic hospitality model to a place-based wellness-oriented hotel architecture model, illustrating the integration of environmental resources into spatial systems and experiential outcomes. (Source: Authors)

CONCLUSION

This study demonstrates that the challenges facing wellness tourism in Dead Sea hotels are not rooted in the absence of environmental or therapeutic resources, but in the lack of a coherent spatial logic capable of translating these resources into integrated wellness-oriented spatial systems. By combining a typological framework with spatial assessment and empirical analysis, the findings reveal that the fragmented or symbolic implementation of therapeutic components significantly weakens the continuity of the wellness experience and limits the operational sustainability of hotel performance.

In contrast, the results confirm that the effectiveness of wellness tourism depends on the extent to which therapeutic systems are treated as generative elements of architectural organization, rather than as secondary service functions.

The study further establishes a direct relationship between place-based design, the depth of the therapeutic experience, and key indicators of operational performance, particularly occupancy stability and visitor retention.

This relationship highlights the role of spatial integration as a mediating mechanism through which environmental resources are transformed into measurable experiential and economic value. In this sense, the research contributes to the literature by proposing an integrated analytical–design framework that links environmental context, spatial systems, tourist experience, and operational sustainability within a unified model. Beyond the specific case of the Dead Sea, the findings provide transferable design principles applicable to other therapeutic destinations characterized by distinctive environmental resources. Ultimately, the study repositions architecture and interior design from a passive supportive role to a strategic operational driver, capable of structuring therapeutic experience, enhancing destination identity, and supporting long-term sustainability in wellness-oriented tourism environments.

Limitations and Future Work

This study is subject to several limitations that define its analytical scope and should be considered when interpreting the results. First, the research is limited to a sample of six operating hotels in the Dead Sea region. While this sample is appropriate for in-depth spatial and design-oriented analysis, it does not aim to provide statistical generalization, but rather analytical insights into the relationship between spatial systems and wellness tourism performance within a specific environmental context. Second, the study relies on a Design-Based Mixed-Methods Approach combining spatial assessment, user perception, and managerial insights. Although this triangulated methodology strengthens the interpretive

validity of the findings, the quantitative component is primarily based on descriptive statistical analysis, without the use of advanced predictive or causal modeling techniques. Third, the research focuses on the spatial–functional dimension of wellness-oriented systems and does not extend to detailed economic modeling, cost–benefit analysis, or long-term financial performance indicators. As such, the operational implications discussed in the study should be understood as analytically derived relationships rather than fully quantified economic outcomes.

Despite these limitations, the study provides a robust analytical framework that can be adapted and extended in future research. Further studies may build on this work by incorporating advanced statistical modeling approaches (e.g., structural equation modeling or predictive analytics) to quantify causal relationships between spatial systems and operational performance. Additionally, expanding the geographical scope to include comparative case studies across multiple wellness destinations would enhance the generalizability of the findings.

Future research could also explore the economic dimension of place-based wellness design, including investment feasibility, return on spatial interventions, and long-term performance metrics. Moreover, deeper investigation into user-centered design variables, such as behavioral mapping and physiological response to therapeutic environments, would further strengthen the integration between architecture, health outcomes, and tourism experience.

In this regard, the present study establishes a foundation for a more integrated research agenda linking environmental context, spatial design, user experience, and operational sustainability in wellness-oriented tourism environments.

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Institutional Review Board Statement: The study was reviewed by the Research Ethics Committee of the Faculty of Art & Design, Applied Science Private University (Reference No. REC/FAD/ASU/2025/04-012, dated 18 April 2025). The Committee determined that the study constituted minimal-risk research and qualified for exempt review. The study was conducted in accordance with the applicable institutional ethical requirements and internationally recognized ethical principles for research involving human participants.

Informed Consent Statement: Informed consent was obtained from all participants involved in the study. Participation was voluntary, and participants were informed of the purpose of the research prior to completing the questionnaire.

Data Availability Statement: The data supporting the findings of this study are available from the corresponding author upon reasonable request. The data are not publicly available due to privacy and ethical considerations related to participant confidentiality.

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Conflicts of Interest: The authors declare no conflicts of interest.

Use of Generative AI: Generative AI tools were used for minor language editing, grammar, punctuation, formatting assistance, and limited assistance in the preparation and refinement of graphical materials. The tools were not used for data analysis, study design, or interpretation of the research findings. All AI-assisted outputs were reviewed and verified by the authors, who take full responsibility for the accuracy, integrity, and originality of the final manuscript

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REGIONAL INTEGRATION AND TOURISM DEVELOPMENT: INSIGHTS FROM THE KAZA TRANSFRONTIER CONSERVATION AREA

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Abstract: Governance is recognised as crucial for supporting transfrontier conservation and regional cooperation; however, how governance processes translate into regional destination development outcomes across the different scales of the TFCA grounds the premise of this research. Attention is drawn to the Kavango Zambezi Transfrontier Conservation Area (KAZA TFCA) in Southern Africa, which, although formally institutionalised in 2011, has been under development since 2006, thereby providing an opportunity to examine the progress of tourism development in the region since the signing of the Memorandum of Understanding (MoU). This research aimed to explore the progress of tourism and community development as shaped by governance and stakeholder processes. This qualitative research draws on insights from interviews with tourism and governing authorities, community organisations, and community representatives located in tourism-dependent destinations in the TFCA, namely Kasane in Botswana, Livingstone in Zambia, and Hwange in Zimbabwe. The findings demonstrate that the KAZA TFCA has created an enabling environment for regional tourism development through improved cross-border mobility, regional cooperation, destination marketing, and tourism-supporting infrastructure. However, the translation of regional integration into local tourism development remains constrained by policy inconsistencies across member states, limited tourism-specific support, weak integration between regional governance structures and local tourism stakeholders, and challenges affecting tourism businesses. Overall, the findings suggest that the effectiveness of Transfrontier tourism governance depends not only on establishing regional agreements and structures, but also on their effective coordination, harmonisation, and implementation across national and local levels to ensure that regional tourism growth generates inclusive and equitable socioeconomic benefits.

Keywords: transfrontier conservation areas, meta-governance theory, regional tourism development, KAZA TFCA

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INTRODUCTION

A considerable amount of research has been published on Transfrontier Conservation Areas (TFCAs), with studies focusing on their progress towards ecological outcomes (Naidoo et al., 2022; Trezza et al., 2026; Köhler & Bollig, 2025), or their contributions to poverty alleviation and community development (Mpofu et al., 2025; Bourgeois et al., 2023). This is due to the underlying goals of these transboundary protected areas; being to balance nature conservation with community livelihoods and development (Lekgau & Tichaawa, 2026; Mpofu et al., 2026).

Certainly, since their initial conception in 1920, TFCAs have become globally recognised as innovative means for broadening nature conservation, with such initiatives strengthened by the underlying collaboration and sharing of resources to tackle escalating, interrelated and intersecting concerns related to biodiversity conservation, poverty alleviation and regional development (Munthali, 2007; Usman et al., 2023). Notably, Southern Africa is a global leader in TFCA development, with TFCAs covering over 10% of the land mass of the region (Southern African Development Community [SADC], 2025). Currently, TFCAs in the region are facing a myriad of emerging challenges, including rising human and wildlife populations, human-wildlife encroachment into each other's spaces and subsequent conflict, and changing natural processes, such as changing and extreme rainfall patterns, temperatures and vegetation.

These challenges require multilevel governance and collaboration to address, while simultaneously balancing other goals, including community development, economic growth, regional cooperation and peace, and tourism (Lekgau & Tichaawa, 2021, 2026; Mpofu et al., 2026). As the latter goal is foregrounded to support the attainment of these other goals, the current study deviates from the predominant environmental focus on TFCAs in the region and shifts attention towards regional cooperation, tourism development and community development.

Communities in Southern Africa have utilised wildlife and wilderness resources for livelihood benefits, including subsistence hunting, harvesting of wild plants and other natural resources, livestock grazing, small-scale agriculture, and participation in wildlife- and tourism-related activities, with the latter considered a sustainable form of livelihood that can

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generate substantial economic returns and growth. Wildlife tourism is a key lucrative market in Southern Africa, taking two primary forms: consumptive and non-consumptive (Lekgau & Tichaawa, 2026; Van der Merwe & Slabbert, 2025).

The region offers numerous wildlife experiences, with the dissimilarity of tourism products, including the diversity of wilderness and cultural landscapes, key attractions and experiences in the region, and the establishment of TFCAs, being key to stimulating cross-border tourism movement and collaboration (Blasco et al., 2014). This is especially the case in the Kavango Zambezi (KAZA) TFCA, which has been utilising well-known natural attractions such as the Okavango Delta, Victoria Falls and Hwange National Park to maximise tourist stays in the region and trigger scaffolding effects for rural development and community livelihood support. Undeniably, recent research has underlined governance as a mechanism to stimulate and support this process, with governance across borders constituting a complex task of recognising, coordinating and collaborating with several countries, communities, businesses, NGOs and various levels of government authorities (Blasco et al., 2014; Mpofu et al., 2026; Dittmann & Muller-Mahn, 2023; Tichaawa & Lekgau, 2025).

Governance and institutional perspectives on tourism at regional scales posit that the development of tourism for regional socioeconomic growth should be viewed as a process rather than an end goal (Stoffelen & Vanneste, 2017).

Accordingly, this study considers the KAZA TFCA, which, although formally institutionalised in 2011, was under development since 2006 through the signing of a Memorandum of Understanding (MoU), which laid the groundwork to formally establishment this TFCA which is the largest TFCA in the world shared by Angola, Botswana, Namibia, Zambia and Zimbabwe. There is therefore an opportunity to explore the progress of tourism development in this TFCA region since the signing of the MoU. This TFCA was primarily designed to foster cross-border conservation and tourism development, and therefore an intellectual opportunity exists to understand the effects of supranational governance processes on regional and local tourism dynamics. While existing research has increasingly recognised the role of governance in supporting Transfrontier conservation and regional cooperation, less attention has been given to understanding how these governance processes translate into regional destination development outcomes across the different scales of the TFCA. In particular, there remains limited understanding of how regional agreements and governance structures are translated into tourism development at national and local levels, and how the coordination, harmonisation and collaboration amongst different stakeholders influence the development of an integrated regional tourism destination.

This is particularly important in the context of TFCAs, where tourism development is expected to contribute to broader objectives of regional integration, community development and socioeconomic growth, but where tourism stakeholders operate within different national policy and institutional environments. This study therefore draws on a meta-governance perspective to explore the regional tourism development process within selected KAZA TFCA sites, with particular attention to how Transfrontier governance processes enable and constrain regional tourism destination development and the extent to which regional tourism objectives are translated into local tourism and community development outcomes.

LITERATURE REVIEW

From cross-border tourism to Transfrontier tourism

Cross-border tourism has increasingly been conceptualised as more than the movement of tourists across national boundaries, but, a process through which geographically proximate territories in different jurisdictions can be experienced, marketed and potentially governed as an integrated tourism destination (Studzieniecki et al., 2016; Makkonen & Williams, 2024). This perspective challenges conventional approaches to destination development that remain largely organised around administrative and national boundaries (Su & Li, 2021). Blasco et al. (2014), for example, argue that tourism destinations should increasingly be understood according to tourists' consumption patterns rather than administrative boundaries, particularly where neighbouring destinations are geographically proximate and offer complementary attractions. From this perspective, cross-border tourism emerges where the functional geography of tourism extends beyond the political geography of the state. The cross-border character of tourism can consequently create opportunities for destinations to combine attractions, infrastructure, markets and tourism resources across jurisdictions (Makkonen & Williams, 2024; Stoffelen & Ioannides, 2025). Cross-border collaboration can also provide opportunities for destinations to develop joint products, strengthen destination competitiveness, exchange knowledge and practices, and potentially increase visitor flows and tourism income (Kozak & Buhalis, 2019). In this respect, cross-border tourism can be understood as a mechanism for overcoming the fragmentation created by political boundaries and creating a broader tourism space that corresponds more closely to how visitors experience destinations (Su & Li, 2021).

However, the literature cautions against assuming that geographical proximity automatically translates into an integrated cross-border tourism destination. In their study, Stoffelen & Vanneste (2017) found that local cross-border tourism projects do not guarantee positive regional-development outcomes and may, under certain circumstances, reinforce existing socioeconomic asymmetries between neighbouring territories. Their findings as such as others suggest that the developmental contribution of cross-border tourism depends less on the number of tourism projects undertaken and more on the institutional arrangements through which these projects are embedded (Wong Villanueva et al., 2022; Stoffelen & Ioannides, 2025; Lekgau & Tichaawa, 2019). Accordingly, governance represents a central theme within the cross-border tourism literature. Cross border cooperation, and subsequently governance has become a common and fundamental strategy used to leverage on opportunities within border territories, through their integration (Wong Villanueva et al., 2022; Blasco et al., 2014; Ferrer-Roca et al., 2022). In Eastern and Southern Africa, this integration is primarily through TFCAs, which seek to leverage collective resources for broad scale conservation interventions and promoting complementary sustainable livelihoods, through wildlife tourism. Transfrontier tourism, or transboundary tourism, therefore, represents the development and organisation of a regional tourism destination within TFCAs (Mayer et al., 2019). Indeed, while many

studies have made the argument that wildlife, natural resources and their ecosystems transcend territorial and political borders and therefore require transboundary approaches to their protection and conservation, this study goes further to contend that the leveraging of these resources for tourism should also transcend national boundaries. This requires tourism development and governance processes to similarly reflect the transboundary nature of the resources upon which the tourism industry depends. Therefore, in understanding the complexities in politics and governance of multiple places and networks operating at various scales individually and collectively, with variable socio-spatial and socio-temporal articulations in the local destination, we leverage the meta-governance theory, which is unpacked in the discussion below.

Meta-governance and the TFCA perspective

Meta-governance is considered an evolutionary form of government and governance perspectives, where the latter gained much academic interest in the 1980s and typically represents a shift from hierarchical decision-making models to network-based and collaborative decision-making arrangements (Yankson, 2024). The criticisms of the governance model and its policies lie in the related market, network and state failures, which have led to attempts at redesigning governance arrangements to balance the various models of governance, thereby situating meta-governance within this discourse (Jessop, 2016; Jones, 2023). Meta-governance emerged as a response to these governance complexities by recognising the continuing strategic role of the state in coordinating diverse governance arrangements rather than directly controlling them (Bornemann et al., 2025; Ek Österberg & Qvist, 2022). Accordingly, meta-governance has been defined as "a practice by (mainly) public authorities that entails the coordination of one or more governance modes by using different instruments, methods and strategies to overcome governance failures" (Gjaltema et al., 2020:1771).

Rather than replacing governance networks, meta-governance provides the institutional architecture through which governments facilitate collaboration, manage competing interests and steer collective action towards agreed policy objectives (Ek Österberg & Qvist, 2022). Applied to tourism, this perspective suggests that the role of government in a cross-border destination is not necessarily to directly control tourism development, but to create the institutional conditions through which collaboration becomes possible (Lindström, 2024). This may include establishing enabling policies, facilitating partnerships, providing funding, connecting actors across administrative scales, developing common planning frameworks and addressing institutional asymmetries (Jessop, 2016).

The relevance of meta-governance is particularly evident within TFCAs, where conservation, tourism development and community development are negotiated across multiple sovereign states and diverse stakeholder groups. The KAZA TFCA represents a complex governance landscape comprising national governments, the KAZA Secretariat, conservation authorities, tourism organisations, community representatives, traditional leaders, non-governmental organisations and international development partners. These actors possess distinct mandates and priorities, yet are expected to collectively pursue shared objectives relating to biodiversity conservation, regional integration, tourism development and livelihood improvement. Therefore, grounding this research in the meta-governance framework enables an examination of how diverse stakeholders and coordination mechanisms operate under a consolidated governance structure within cross-border destinations, particularly those guided by several interconnected objectives. In particular, this research seeks to understand the ground-level tourism effects of meta-governance processes. The meta-governance perspective therefore provides a lens through which to examine how institutional mechanisms shape the conditions under which cross-border tourism development becomes possible.

METHODOLOGY

Study areas

The study was conducted in three tourism nodes within the KAZA TFCA, namely Kasane in Botswana, Livingstone in Zambia and Hwange in Zimbabwe. These sites were purposively selected based on their proximity to prominent tourism attractions within the KAZA landscape, namely Chobe National Park, Victoria Falls and Hwange National Park, respectively. The three locations represent important tourism destinations within the KAZA TFCA and are characterised by established wildlife and nature-based tourism activities, making them appropriate sites for examining tourism development within the Transfrontier context. The selection of these sites was also informed by their relative geographical proximity to one another, despite being located across three different national jurisdictions.

This proximity provides an appropriate context for examining the cross-border dynamics associated with tourism development, including tourist mobility, interactions between tourism stakeholders, regional tourism linkages and the influence of Transfrontier governance processes. By focusing on tourism nodes that are geographically connected through the broader KAZA landscape but administratively separated by national borders, the study was able to explore how regional tourism development processes are experienced and implemented at national and local levels.

Research approach

We followed a qualitative research approach, drawing data from semi-structured interviews with governing officials representing tourism and conservation departments, tourism businesses owners and managers as well as tourism entrepreneurs in the formal and informal economy, traditional and recognized community leaders, community-based tourism organisations' leaders and some members, and community members directly involved in the tourism industry. The interview questions were developed from a synthesis of literature on TFCA governance and community development, cross border tourism integration, and wildlife tourism and community. Accordingly, the questions were grouped under three interrelated categories; perceptions towards KAZA governance, tourism developments under the KAZA regime and

challenges hampering regional tourism growth. The semi-structured interview approach allowed for the researchers to probe further, ensuring full elaborations on each key thematic areas. The participants were selected using a purposive sampling technique, where participants were targeted based on their direct involvement, knowledge and expertise in wildlife tourism in the study sites. In terms of operationalization, key individuals representing the targeted sample groups were identified and approached and time spent in the field revealed other participants who were not on the original list, for instance, the researchers found a local tourism association in Zambia representing in informal market, of which its position in the town as well as goals of the KAZA necessitated it inclusion. We conducted a total of 59 interviews and group interviews in Kasane, Lusaka and Hwange, as shown in Table 1 below.

Table 1. Participant profiles

Participant code	Stakeholder group	Location
P1-2	Tourism and conservation authority representatives	Kasane
P3-4	Community trusts' representatives	Kasane and Kazungula
P5-9	Informal tourism entrepreneurs	Kasane
P10-11	Local traditional authorities	Kasane
P12 – 17	Formal tourism businesses	Kasane
P18 - 22	Community members involved in wildlife tourism	Kasane
P23-25	Conservation NGOs representatives	Livingstone
P26	Conservation authority representative	Livingstone
P27	Tourism association representative	Livingstone
P28 – 31	Informal tourism entrepreneurs	Livingstone
P32- 37	Formal tourism business owners/ managers	Livingstone
P38 - 41	Community members involved in wildlife tourism	Livingstone
P42 – 46	CAMFIRE representatives	Hwange
P47 – 49	Tourism and conservation authority representatives	Hwange
P50 – 55	Informal tourism entrepreneurs	Hwange
P56 – 59	Formal tourism business owners/ managers	Hwange

In most cases, interviews were conducted in English, however some participants preferred local languages which led to some interviews being conducted in Setswana in Kasane, Bemba in Lusaka and Ndebele and Shona in Hwange. The research obtained ethical clearance prior to its commencement and participants were assured of their voluntary involvement, confidentially of information and were asked for their consent in the recording of the interviews.

Data recordings were loaded onto Otter.ai for transcription, of which the output was reread and edited to ensure consistency and that contexts were captured in the transcripts. Following, the transcripts were loaded onto Atlas.ti, in which a descriptive line by line coding technique was utilized.

This process yielded 539 codes, which were subsequently reread and merged to reduce repetition. Following, similar codes were grouped together, forming the key themes which are discussed in the following section.

RESULTS

Regional integration and conservation governance

Perceptions of the KAZA TFCA revealed mixed responses on their understanding of this regional initiative, particularly as there were a significant portion not aware of the TFCA agreement amongst the five countries, through were aware of the outcomes of this transboundary collaboration. Participants that aware of the KAZA TFCA agreement described the TFCA has a means to recognise the shared ecosystems amongst the five member states. Certainly, participants alluded to the inherent collaborative nature of the partnership, underscoring the significance of its premise to conservation, tourism development and economic growth, goals which bare crucial implications for community livelihoods in the study areas.

> Because this protocol [is] between countries, a bilateral agreement between five countries because they share the waters, they share the wildlife and everything. There's also community involvement and stakeholder involvement, they [KAZA management committees] do public education. At the kgotla, here we go, they educate people and they are quite collaborative [P10 - Kasane]

Certainly, the few participants who understood this agreement, and its outcomes, had an optimistic view on its contribution towards various facets of development in the region. Largely, this optimism was directed towards harmonizing the relationships between communities and protected areas, communities and tourism as well as facilitating cooperation and social capital amongst communities in the different member states. One participant in Hwange, aptly explains:

> Because for instance, we are giving an opportunity for the TFCA, in this community, to work together and lower barriers between people in the [member] countries. And instead of us promoting conflict between the community and the Transfrontier [conservation area] [P48- Hwange]

While the understanding of KAZA TFCA as an entity was not widely understood across the study sites, the creation of wildlife corridors, being one of the key objectives of the TFCA, was widely acknowledged amongst many participants involved in this study. This may have been attributed to the information and training occurring at the local destination scale, with limited explicit linkages to the KAZA agreement, that neighbouring countries share ecosystems and subsequently wildlife, which belong to the region and not necessarily the individual states. This understanding was determined in the discussions with communities' representatives in the study sites, and captured with the quotes below:

KAZA [TFCA] is the five countries [that] have come together. They are being brought together, like their story in Germany, it was to discuss and have agreements and we have those agreements. So if animals leave Zimbabwe, they are not Zimbabwean animals, they become Zambia animals. Yes, if the leave Zambia they do to… that's how it is works. So those are just like agreements, that KAZA made. [P24 – Livingstone]

KAZA also created key wildlife corridors and free space for wildlife movement, thereby improving the gene pool for the benefit of wildlife populations and also conservancies, which will always continue to get wildlife coming from other rich protected areas like the Hwange National Park. [P47 - Hwange]

Interestingly, the study participants in Hwange underscored the centrality of inclusivity and trust in the transboundary conservation body, owing to the resources provided to support community development goals. Notably, these participants explained that CAMPFIRE was an integrated early on in the initial discussions around the KAZA, owing to the community based organisation being forefront in highlighting the concerns with the then practices of nature conservation and related community development support.

[The] relationship between the Transfrontier conservation area and the community can be served as collaborative, partnership based, trust based, empowering, respectful, inclusive and supportive in the sense that TLCA provides support and resources to help the community achieve their goals [P48 – Hwange]

That's why they came up with this Transfrontier, KAZA. It came reality through the communities exposing those irregularities [between park management and community needs]. So now KAZA is a solution to bring national parks, forestry, [those] who advise [and are] involved council together. [P33ZW

Though the KAZA TFCA is a partnership amongst five member states, a few participants reflected on the long-term aspirations of this partnership towards the future generations, *'As you know, it's like a vehicle which is being used to serve our needs, necessities to the future generations, so that our grandchildren, what overcome our generation will be now be for them'* (P42 – Hwange) as well as the broader continent and what it could someday represent. In this light, the success of the TFCA was perceived as a positive movement a more unified African continent, with some participant espousing "*If other presidents could hear the President's speech, the support, once you build yourself like that, other countries will start joining if it works out then as you can continue to have one Africa'* P26 – Livingstone.

However, despite the importance underlined above, it is important to report that a couple of participants expressed concerns over the KAZA management structure, particularly in relation to the prevalence of international donor funding organisations. One participant especially viewed this TFCA as a form of neocolonialization, stating:

I'll tell you this not because I have got a political path, but because KAZA for me is like a colonial kind of rule. And I'll explain this to you soon, KAZA is connected to like five countries. We have in the indigenous people in those countries, you know, you know, how their system works, they get in Zambia, they get, like they exchanged like leadership, and whatnot. But those are controlled by foreigners [P39 – Livingstone].

These concerns were directed towards the conservation ideologies and practices that would be utilized in the collaborative governance of nature and wildlife conservation, and relatedly tourism sector, and the implications for the role of the community in these interrelated sectors, particularly in terms of equity, representation, ownership and empowerment.

Regional tourism product development and destination competitiveness

One of the major outcomes and achievements of the KAZA TFCA agreement since its formalization, is the related to the easing of movement between the countries. On the tourism development front, the member states have introduced the concept of the KAZA UniVisa, which seeks to enable easier and seamless movement between the member states. While, this is currently being piloted between Zimbabwe and Zambia, participants attribute this as a positive step towards developing a regional tourism product. Some governing officials explained that this is still in its developmental stages:

They are also bilateral agreements between the countries. Of note also is the univisa that is currently being piloted, which is being piloted between Zimbabwe and Zambia. So if you get a visa from one of the countries you are allowed to go to all the five member states without having to reapply for another visa, it is the case. Because now, we're still piloting, like still at pilot stage, so we haven't fully rolled out. [P1 – Kasane]

Indeed, the easing of the border movements is greatly perceived as an enabling factor to leveraging on the unique resources of the individual states and forming a stronger destination product, enabling tourism growth within each state. Participants mentioned the proximity of the key destinations to one another and ability to build a travel itinerary that cross multiple countries in one day, with one tour operator highlighting the distinctiveness of such experiences in the broader Southern Africa region:

And we're also situated in an area where you can visit the three countries [in] one day, you can have breakfast in Kasane in Botswana have lunch in Zimbabwe have dinner in Zambia and be back in bed in Botswana. And nowhere else in the Southern Hemisphere can you do that. One guest just argued to me and said 'but you know in South Africa you can go to Lesotho and that's it'. That's true. I've just said Botswana, Zimbabwe, Zambia, Namibia, you can get your passport stamped four times in one day. So here's the beauty of operating in this area [P16 – Kasane]

Similarly, participants further mentioned the infrastructural improvement of the Kazangula border post, connecting Botswana and Zambia as facilitating easier border crossing and movement between the two countries. Notably, other participants underline the missed opportunity to integrate Zimbabwe in this border, '*Right now, one of our other challenges is that since Zimbabwe was not part of the Kazungula border*.' (P22- Livingstone). Generally, the efforts undertaken thus far have enabled the development of a unified destination brand, leveraging on the share wildlife resources and wilderness spaces. In this light, the cultural resources pose another resource that can be leveraged to support the existing primary

wildlife tourism product. In this regard, participant point to the cultural differences amongst the three countries as opportunities to be explored by tour operators and tourism marketers for the region, stating:

And cultures. Because it's not only wildlife tourism that caused this to tie within our communities, you know, the difference in Angola, difference in Namibia, difference in Zambia and difference in Zimbabwe. So we could target those things, you know, as the community of tour operators, or the governments, you know, to sell this product, which we think, you know, is quite unique. Yeah. But we're not there yet. [P2 – Kasane]

So many villages here, the government helps to establish like a cultural village, where all the ladies, old people can showcase their talent through weaving, basket weaving, having making skills, so tourists will come see dances, culture, dresses, showcasing their culture [P49 – Hwange].

The promotion of cultural resources, products and experiences as part of the KAZA tourism landscape was grounded to being another means to extend the potential of tourism to provide livelihood benefits to residents that are not able to enter the wildlife tourism market. Evidently, the discussions on regional tourism product development revealed some missed opportunities. Also, while participants recognise that there has been increased marketing of the region, both by individual states, businesses as well as the collective KAZA TFCA, more awareness of the region is required, particularly for natural and cultural experiences supporting the key attractions.

While this was not explicitly linked to the TFCA establishment, there was a general consensus amongst study participants, more especially in Botswana and Zambia, the tourism economy is growing and subsequently providing more income-generating opportunities for residents, largely in terms of employment and entrepreneurship developments. Similarly, some participants have alluded that the growth of tourism, the attractive natural assets and established attractions, coupled with relative stability of certain countries and focus on foreign investment policies, larger integrated tourism market due the KAZA TFCA agreement, have attracted some investors to the areas, which represent the opportunity for local communities to evolve their livelihood activities from predominantly subsistence levels. One tourism business owner cautioned that these investors need to be met openly the communities:

I think being open minded and welcoming investors. The community's understanding that people that come in here are not here to take away anything from them but to add value more than anything in what is already there. You understand? So many areas I've seen ethnic tribes be like ‘now we don't want you’ you know ‘we are just okay with our fishing’ But you can allow us to operate in your area. And we will provide a quality lifestyle both in health care and employment and you know [P16 - Kasane]

Interestingly, a number of tourism businesses owners involved in study were considering expanding their business to neighbouring countries to capitalize on the growing regional tourism market, and working with local partners in other KAZA TFCA member states:

The last year I went to Namibia because I'm trying just to on my own to try and scout for opportunities just across [the border], so that in future I know where I know where to diversify and grow my business into. [P34 - Livingstone]

However, the movement towards facilitating regional tourism development and strengthening the destination is severely hampered by the accessibility challenges in entering the region, for international tourists.

Airlines has been a major, major problem when it comes to us in the tourism industry. These is less of disadvantages. I mean, advantages. And challenges are few. But it's how the properties react towards that. Yeah, like I say, if we are working with an agent in the UK, and that person is unable to put flight together to complete their itineraries, then it means business won't materialize. We cant receive business from that particular agent. Yeah, yeah. So those are some of the challenges. [P3 - Kasane]

Similarly, a few participants recognized that the easing of border/travel barriers have already led to heightened competition amongst tourism businesses, particularly for accommodation businesses, across borders. Therefore, subsequent concerns that may arise could be related to pricing of tourism services, considering the wider destination options available for guests. In this regard, one tourism business owner already noted this issue with Zimbabwe and Zambia due to their sharing of the Victoria Falls as a key attraction, stating: “*I think the bed space, pricing, I think, we have been informed that we are a little on the higher side in comparison to our counterparts in Zimbabwe*” (P37 – Livingstone). Furthermore, other participants recognized that this regional collaborative relationship, and its benefits, are largely dependent on the vitality of the natural ecosystems, in which subsequent adverse climate changes impacts could threaten the tourism landscape, owing to its dependency on wildlife and natural resources such as extensive river systems.

I think the only thing that could destabilize is when that river dries out, Because we get that water comes all the way from Angola. Or in case where our international relations, I was with Angola, and they decided to block the water. I don't know I think government sometimes I think that is the only thing that I'm thinking of, in terms of that could that could greatly shake the tourism landscape because it's all about the wildlife and then that river sustains everything else it doesn't. So that's that river is the source of tourism its the core. (P6 – Kasane)

Governance tensions limiting tourism development

Despite the positive shift noted in the development of a regional destination product through the KAZA TFCA arrangement, however, uneven policy harmonalisation and implementation constrains tourism integration. Some of the challenges highlighted refer to the management of policies affecting local tourism businesses, border concerns, as well as political influences and nature of support for tourism businesses. The efforts to improve the accessibility amongst the countries was perceived to be hampered by the process at the borders’ posts. Some participants recall guest to have complained over the long waiting times at the border as well as some uncertainties in procedures which may cause

confusion for visitors. One participant further stated that some individuals have been exploiting this uncertainty by making false promises to guests and assisting with border paperwork. This is not permitted for agents who are not authorised to enter the border building, see quotes below:

'Okay, I think from our guests point most… the borders. Okay. They always complain about the delays of the borders. Because you know, the guys will especially the guys who drive from South Africa to here, will leave Joburg maybe about five o'clock in the morning, get to this border, maybe at six at night and spend another three hours. So we're only getting 10 at night, some 11 at night, depending on the chaos they find there.' [P33 – Livingstone]

'So I've got friends who are clearing agents. So we're just trying to see for, maybe next month, for the guys coming in from South Africa, and stuff if I could have my guy meet him there just to show them how to do the paperwork and tell them not to pay [anyone outside] because that's the process we're just supposed to do. yeah because even with that come in in the agents actually not even allowed inside the border area to clear account that needs temporary import permit and stuff. But these guys they find them outside say 'no I can do it for you' and all that so we trying to see how we can help the guests make it easier for them to come through.' [P36 – Livingstone]

Some discussions with representatives from Kasane suggest that these complaints are recognized by some government officials and under consideration by the relative authorities in the country. Another matter participants expressed concern on, and requirement of government attention was the issue of unregulated tour guiding. These concerns were largely expressed by tourism entrepreneurs in Kasane and Livingstone, where they highlight the injustice of competing with guides who have not completed the required certification and programmes and the influence this has on the guiding experience as well as income generated from the tourism industry.

'They [registered guides] are active but it's only that its hard to have those licenses, it's very hard to have those licences in tourism operations' [P12 – Kasane]

'I decided to register but then I'm paying fees, I'm legal I pay for my own licenses. It's a cost but then there are others who are doing all these things unregistered and don't have any legal consquences. Its very unfair.' [P34 – Livingstone]

'We don't have a uniform amount, legal operators will have a uniform amount. Like game drives, its $75 for internationals, so as we know it, but if you go to these that are illegal [operators], they will take $30. You know, they are putting the value down. And they make it seem like we're overcharging the client but actually that's the price.' [P37 - Livingstone]

In addition to the competition amongst legal and illegal tour guides, which extend towards how other tourism businesses, such as accommodations and activity providers are exacerbating this issue, participants underlined the importance of ensuring that national policies and their implementation are aligned with local realities and priorities. Largely, these concerned were centred on the prevalence of foreign owned businesses in the study sites, which affected local enterprises in a couple of ways. In Livingstone, some participants questioned the investor friendly policy environment created by national government, which limited the tax revenue generated from businesses that could better assist the country, while other participants noted the unfair competition amongst informal creative art traders and larger scale accommodations in selling local arts and crafts:

'So most of them [internationally owned hotels] when they come here, they come with licenses to do activities, maybe lodge, may be restaurants, but after seeing that the people that [have] visited , most of them want to buy souvenirs, they [hotels] also start selling souvenirs. So this is a good big block because they're [hotels] the people receiving guests. So it becomes a bit of contention. So those are some of the challenges, the intolerance. I think we don't have deliberate policies that can stop that.' [P29 - Livingstone]

'We need policy of some kind, you cannot go to American and start selling indigenous American art? I don't see that, it is only here in Africa where you can do that. But giving them land and they are making money out of that land. Because they are only paying their workers, the electricity and roads. So why are they encroaching in this land?' [P30 - Livingstone]

In Hwange, participants postulated that concerns with the national governing party, and the administrative challenges, had led to delays in being rewarded funds and other benefits through the KAZA TFCA, of which these support mechanisms were supposedly geared towards assisting local communities. Relatedly, participants in all study areas contended for the need to empower local entrepreneurs and local businesses, to be able to establish and grow their business and compete the tourism market. In this regard, the lack of funding opportunities from government authorities was a contentious matter, with several participants espousing the lack of financial capital experienced by a large share of the local population.

'Some of the barriers to participation is the lack of startup capital of the people, most of the people are poor, the local people don't have the capital to start companies like safari lodges, camp sites, so its the lack of funding.' [P12 - Kasane]

'I think the most top one would be funding constraints. Like the tourism department hardly gets funds. So the amount is kind of limited to bigger projects and things like that you can't really expand if you don't really have the capital' [P57 - Hwange]

'People like myself [entrepreneur] at the start, I need money to have a variety of things to do. Because let's say I want to venture into car hire, I don't have that money. Things are expensive, the dollar is high. I need like a loan or capital basically. So how it can go is if maybe they [government] are able to fund us, of course, maybe with a minimal interest?' [P37 - Livingstone]

Some governing authorities' representatives indicated the existences of several interventions and opportunities for fundings, though acknowledging the inherent limitation in such public funds. Furthermore, support structures in the sector have been under scrutiny over their internal problems that have resulted in their inefficiency in assisting locals involved in the tourism industry, with a participant in Livingstone espousing '*There are associations, Zambia tourism association, and*

Livingston tourism association but they are not doing anything' (P34 – Livingstone), while in Kasane, the misuse of funds by the community trust was frequently mentioned,

'So most of the trusts have collapsed because of that. Yes. Yeah, I guess you've seen in Maun, some of them have been fired because they used money from the trust, they'll be borrowing themselves money from the trust.' [P5 – Kasane]

One of the key strategies to action KAZA TFCA goals at the local scale is through education and training. Notably, previous studies have found this education to largely revolve around wildlife protection and harmonizing community and conservation relationships. In this regard, participants underline the significance of tourism specific skills and knowledge to enable a locally inclusive and competitive industry. For instance, some responses on this matter were communication skills development and foreign language proficiency skills, to accommodate international guests:

'For instance, you might need to have maybe, translators in case of maybe Spanish speaking people. To provide a channel for communication. And that's where communities can they can be willing to venture into what tourism activities.' [P49 – Hwange]

Participants generally agreed that even entry-level employment requires training and specific skills, and the priority on the absorption of the local labour market needs to recognise this fact:

'Because for them [communities] to be involved, there's a certain level of skills [required]. You realize that some of them are not that much educated. So that's what makes it a bit difficult. For instance, for one to be a waitress, you just have to be able to have to bring your certificate.' [P17 – Kasane]

Finally, the awareness of KAZA TFCA as a meta-governance entity was not widely known by study participants, of which those that were familiar explained that it largely operated at a supranational scale, with little integration with local stakeholders. The discussions above illustrate while that the deliverables of the collaborative arrangements were seen in the destination, the explicit linkage to the KAZA TFCA ecosystem was not apparent. This raised several questions on the localized effectiveness of the entity, particularly in Kasane and Livingstone, where participants noted the apparent disconnect between tourism and conservation outcomes of the TFCA agreement, where a few people perceive them as solely conservation governing bodies and not focused on tourism businesses, with one tourism business owner stating '*They deal with animals there, counting animal problems and all the like. I never saw myself as an operator sitting down with KAZA .I know they're operating out there'* (P5 – Kasane). Another tourism business owner had the following input:

'I think they are not driving their mandate on how as [tourism] operators we can benefit from them, and how they can also benefit from us. I don't know how to put it but if you ask me about KAZA, I won't tell you anything about KAZA, as compared to other board like BTO [Botswana Tourism Organisation] , Africa's Eden, where if you go there and meet other business operators, you know, you have a chance of getting business from them.' [P13 – Kasane]

Interestingly, in Hwange, some CAMPFIRE representatives outlined the existence of working groups fostering the integration of local stakeholders and localized imperatives to the KAZA management structure, with one such representative affirming;

'For example, if it's the KAZA, we've got working groups that have representatives of the nations, like Zimbabwe, Zambia, Namibia, Angola and Botswana. They have working groups for every sector. Can it be tourism? Can it be finance? Can it be law enforcement? They do bilateral meetings, and we have bilateral meetings at ministerial level and at the state, state aid level, and their exchange programs for the community leaders.' [P40 – Hwange].

DISCUSSION

This study sought to explore the regional tourism development process in selected KAZA TFCA sites, considering the meta-governance processes. Generally, the study found that the Transfrontier governance has fostered an enabling environment for tourism growth primarily though the easing of tourist mobility through cross border agreements and infrastructure. Cross border literature confirms the necessity of alignment amongst governing states to enable cross border tourism (see Dittmann & Müller-Mahn, 2023; Stoffelen & Vanneste, 2017; Clark et al., 2026).

In the case of Southern Africa, this alignment is grounded from the policies and agreements signed at SADC level, enabling the creation of TFCAs and and subsequently the facilitation of supporting mechanisms to grow tourism in the region. These mechanisms including facilitation of visa and cross-border formalities, improved transportation networks and transport arrangements, varied experiences and the development of tourism ecosystems, all of which Kozak & Buhalis (2019) constitute factors propelling cross border travel. From a meta-governance perspective, these developments demonstrate the role of regional governance actors in creating the institutional conditions through which tourism actors can operate across national boundaries, rather than directly controlling tourism development.

However, the study also found that while movement within the KAZA TFCA member states have become somewhat easier, regional tourism growth is hindered by the ease of travel to the region, in which case airline connectivity as well as the problems associated with national airline carriers were deemed to be key challenges. This highlights an important limitation of regional meta-governance, where progress in one component of regional integration does not necessarily result in corresponding integration across the wider tourism system.

The findings demonstrate the growth of regional tourism, supported by a previous study (see Lekgau & Tichaawa, 2025). Blasco et al. (2014) and Badimo & Matlhola (2026) recognise that political influences and relations can influence cross border regional flow. In this way, the TFCA provides several advantages in providing access to destinations that could be considered political unstable by tourists, as well as the opportunity leverage on the different pulling power of destinations in the region and then diverse this flow to other destinations. This provides a strong foundation for future plans to growth tourism beyond frequently visited areas, should such plans be supported by adequate tourism support. From a

destination marketing standpoint, research suggests that regional tourism marketing provides cost advantages to the destination through the sharing of marketing expense (Kozak & Buhalis, 2019; Clark et al., 2026), which is particularly crucial in resource constrained contexts. As such the financial assistance leveraged through the KAZA TFCA and their international donor network provides the ability for tourism to develop further and deliver on socioeconomic outcomes. These findings further illustrate the steering function of meta-governance, whereby regional actors and supporting institutions create opportunities for collective action that individual destinations may struggle to achieve independently.

However, the study highlights some implications to the structure of tourism development, particularly the extent to which guidance and support has been provided for tourism entrepreneurs. The study found heightened competition amongst tourism establishment within individual member states and across borders, often arising from the prevalence of similar tourism product development. Studies such as Park et al. (2022), Tichaawa & Lekgau (2020) and Clark et al. (2026) have underscored diversity and distinctive tourism experiences as central to promoting regional tourism growth. Local cultures are seemingly seen as an avenue to preserve distinctions amongst the states, which could assist in fostering the integration of regional wildlife tourism product but preserving the uniqueness of each destination (Park et al., 2022).

Earlier on, Tosun et al. (2005) affirmed the creation of a joint cross border tourism organisations, and increasing involvement of business stakeholders and NGOs necessary to effectively success in this endeavor. Park et al. (2022) made the same assertion, stating that this shared governance, through the introduction of robust governance mechanisms, facilitates synergistic collaboration amongst the partner states. This is clearly evident in the present study, owing to the need to facilitate the further regional tourism growth by having regional tourism development priorities being purposively integrated various scales the meta-governance structures. The findings, however, suggest that the existence of regional governance structures alone is insufficient to achieve this integration. Meta-governance requires the effective connection of regional, national and local governance levels, as well as the incorporation of actors who are directly involved in tourism development. In this regard, the limited visibility of tourism within local understandings of KAZA indicates a potential vertical governance gap between regional priorities and local tourism realities. The local perceptions of KAZA seems to predominantly focus on conservation. While this is understandably so, considering that the protection natural resources is the foregrounding motivation for the establishment of the TFCA, the tourism industry is that which can generate socioeconomic returns that support the attainment of the other goals of the agreement.

Similarly, previous studies have found that there are several education initiatives for local community members, directed to conservation matters, such as fostering positive and protective human-wildlife dynamics, or introducing wildlife tourism and conservation as potential careers (Lekgau & Tichaawa, 2025a, 2025b).

However, tourism specific education, which considers the local labour market is not as widely shared through governance structures, thereby falling onto the responsibility of businesses owners and managers. This creates a gap in the tourism environments, and the lack of cohesion amongst meta-governance structures and the local tourism industries compromises the sustainable and equitable growth of the tourism industry. Relatedly, one of the key challenges facing the KAZA TFCA, and similar transboundary agreements, is the harmonlisation of policies. Past studies have found this disconnect to be centred on conservation policies and practices (Lekgau & Tichaawa, 2025b, whereas this present research demonstrates this issue to extend to tourism and tourism affected policies and policy imperatives and adversely affect the development and growth of local tourism businesses. Policy harmonisation represents a particularly important meta-governance mechanism in this context, as the creation of a regional tourism destination requires some degree of consistency in the institutional conditions within which tourism businesses operate. Although member states may participate in a shared regional governance arrangement, differences in policy implementation, administrative procedures and institutional capacities can continue to produce fragmented tourism environments.

CONCLUSIONS

Overall, the findings demonstrate that the KAZA TFCA has contributed to creating an enabling environment for regional tourism development by facilitating cross-border mobility, strengthening regional cooperation and creating opportunities to leverage the complementary tourism resources and attractions of the five member states. The development of cross-border infrastructure, visa and border arrangements, regional marketing initiatives and donor-supported programmes demonstrates the potential of transfrontier governance to support tourism development beyond national boundaries. However, the findings also demonstrate that the existence of a transfrontier governance structure does not necessarily translate into integrated tourism development. Certainly, the effectiveness of KAZA as a meta-governance arrangement is influenced by the extent to which regional priorities are translated into coordinated actions at national and local levels. In particular, the limited visibility of tourism development within local understandings of KAZA, compared with its stronger association with conservation, raises questions about the extent to which tourism is sufficiently embedded within the broader governance processes of the TFCA.

The findings therefore suggest that strengthening tourism development within KAZA requires a shift from viewing tourism primarily as an outcome of conservation and regional integration towards recognising it as an explicit component of transfrontier governance. This requires stronger vertical coordination between regional, national and local governance structures, as well as greater horizontal collaboration between governments, conservation agencies, tourism businesses, communities and other tourism stakeholders, of which policy harmonisation is particularly important in this regard. Theoretically, this study extends the application of meta-governance to Transfrontier tourism by demonstrating that the effectiveness of transboundary governance depends not only on the establishment of regional coordination mechanisms, but also on their translation and implementation across multiple governance levels.

The study therefore conceptualises tourism development as an important outcome through which the effectiveness of meta-governance within TFCAs can be assessed, highlighting the importance of vertical coordination, policy harmonisation and local stakeholder integration in translating regional governance objectives into equitable tourism and community development outcomes.

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DEVELOPMENT OPPORTUNITIES FOR SUSTAINABLE TOURISM LOGISTICS IN THE KARABAKH AND EAST ZANGEZUR ECONOMIC REGIONS OF AZERBAIJAN

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Abstract: In recent decades, sustainable development, environmental protection, and decarbonization have become global priorities, making the transition toward sustainability in the tourism sector a key challenge that shapes the future development of tourism destinations. The development and implementation of tourism products, the design of tourism routes, and the integration of innovative approaches to transport and logistics issues along these routes are essential components. This study explores the potential for implementing sustainable tourism logistics in the Karabakh and East Zangezur economic regions of Azerbaijan. The main objective is to assess how green logistics solutions can support post-2020 reconstruction, reduce carbon emissions, and ensure sustainable tourism development aligned with national climate commitments. An exploratory mixed-methods approach was applied, combining literature review, field observations, and a questionnaire survey among tourists. The study evaluated ecological load, transport chains, tourism facilities, accessibility, seasonality, and tourists' awareness of green practices. Findings indicate strong prospects for sustainable tourism logistics due to newly rebuilt transport infrastructure, smart settlement initiatives, and high tourist interest. However, increased demand raises environmental management challenges. The adoption of low-carbon supply chains, green transport routes, and alternative energy solutions can minimize ecological risks, strengthen sustainable behaviours, and contribute to Azerbaijan's long-term green development agenda. Additionally, fostering collaboration between public authorities, private stakeholders, and local communities will be crucial to ensure the effective implementation and long-term success of sustainable tourism logistics in these regions.

Keywords: tourism, Karabakh, East Zangezur, sustainable tourism logistics, green tourism

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INTRODUCTION

In recent years, the global agenda on sustainable development, environmental protection, and climate change mitigation has increased the importance of transitioning toward sustainability in all sectors of the economy, including tourism. Sustainable tourism development requires an integrated approach that considers economic, social, and environmental dimensions while ensuring long-term resilience and competitiveness of tourism destinations. Numerous researchers have emphasized the strategic relevance of sustainable tourism and tourism logistics for regional development, particularly in post-conflict territories where reconstruction and territorial rehabilitation create new planning challenges (Budeanu et al., 2016).

Following the restoration of Azerbaijan's control over the Karabakh and East Zangezur economic regions in 2020, large-scale reconstruction processes were initiated with the aim of re-establishing socio-economic activity, rebuilding critical infrastructure, and enabling the return of internally displaced persons. These efforts align with national priorities related to climate change mitigation and the Sustainable Development Goals (United Nations, 2015; United Nations in Azerbaijan, 2016). Within this broader context, tourism has been identified as a key sector for the future development of these regions, given their historical cultural value, natural landscapes, and potential to attract domestic and international visitors.

Existing scholarship on sustainable tourism highlights the importance of incorporating environmental considerations, local community interests, and resource-efficient development models into tourism planning (Lagodiienko et al., 2022). Researchers have also emphasized that environmentally responsible transport systems, energy-efficient infrastructure, and sustainable logistics solutions play a critical role in shaping modern tourism destinations.

Contemporary approaches increasingly stress the necessity of integrating sustainability principles into road network planning, tourism route design, accommodation services, and regional mobility systems.

Although these studies offer valuable insights into the conceptual and operational foundations of sustainable tourism, there remains a significant research gap concerning the application of sustainable tourism logistics in newly reconstructed or post-conflict regions**,** particularly in the context of large-scale redevelopment initiatives. In the case of Karabakh and East Zangezur, the almost complete destruction of pre-existing infrastructure, settlements, and transport systems during the

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period of conflict makes the integration of sustainability principles into reconstruction especially relevant. The emerging "smart village" and "green energy zone" models currently being implemented in these territories further reinforce the importance of sustainable logistics strategies for supporting long-term tourism development (Guliyeva & Museyibov, 2022).

Given the renewed interest in the tourism potential of Karabakh and East Zangezur, a strategic approach to the green transition—encompassing sustainable mobility, eco-friendly logistics solutions, and environmentally responsible tourism products—is essential for the successful revitalization of the region. Sustainable tourism logistics can serve as a core component in facilitating visitor mobility, reducing environmental pressure, improving transport efficiency, and supporting climate-resilient destination planning. The aim of this study is to explore the potential for implementing sustainable tourism logistics in the Karabakh and East Zangezur economic regions. It also seeks to identify strategic and sustainable solutions that can support tourism development in the post-conflict reconstruction context.

LITERATURE REVIEW

Sustainable tourism logistics is increasingly recognized as a crucial factor for enhancing the competitiveness and sustainability of tourism destinations. Lanfant et al. (1995) define tourism logistics as the strategic planning and execution of transporting tourists and their goods from origin to destination, ensuring efficiency and seamless travel experiences. Tairova et al. (2019) emphasizes that tourism logistics includes planning, controlling, and coordinating resources to facilitate the flow of people, goods, services, and information within the tourism sector. Study Smarter (2025) further highlights that tourism logistics ensures the necessary infrastructure, transportation, and support mechanisms are in place to offer a smooth and enjoyable travel experience. Bowersox & Closs (1996) note that logistics in tourism should be understood in terms of physical and information flow, emphasizing cost reduction, safety, and convenience through coordination and collaboration. Butler (1980) and Theppitak (2018) also support this perspective, linking logistics to accommodations, transportation, and the overall flow of tourists. Conlin & Baum (1995) demonstrate a direct relationship between the adoption of logistics management in the tourism industry and the success of sustainable tourism development. Theppitak (2018) argues that logistics management facilitates planning for hotels, accommodations, and transport networks, enhancing eco-tourism and tourist satisfaction. Resource Orchestration Theory (ROT) has been applied in tourism contexts to understand how strategic resource bundling and coordination create competitive advantages

Peuscher (2016), Erbaş (2019) Milwood & Roehl (2018) further explain that ROT supports collaborative innovation networks, trust-building, knowledge mobility, and infrastructure development in tourism destinations. Coordination Theory, as discussed by Messori & Volo (2025), emphasizes the interdependence of tasks among tourism firms, requiring alignment of processes and stakeholder collaboration. Figini (2022) illustrates that effective coordination between destination management and tour operators improves local development outcomes, while Marques (2016) highlights the importance of balancing transport and tourism capacities to optimize infrastructure costs and efficiency. Chen (2014) emphasizes the role of coordination at a regional level, integrating supply, demand, and support subsystems to improve overall tourism logistics performance. Aksu (2025) notes that sustainable tourism logistics incorporates environmental, economic, and social dimensions. Environmentally, logistics strategies aim to reduce carbon emissions, optimize energy efficiency, and promote biodiversity conservation. Economically, they encourage long-term growth through eco-friendly business models, while socially, they engage local communities and preserve cultural heritage.

Rutaba & John (2026) argue that transportation infrastructure, when effectively optimized through logistics, enhances tourist accessibility and flow. Ivasyshyna (2024) further highlights the role of digitalization and smart transport systems in improving logistics efficiency. Akhirson et al. (2025) point out gaps in current research, including limited empirical evidence, neglect of local contexts, insufficient stakeholder perspectives, and challenges in implementing innovative technologies. Theppitak (2018) and Conlin & Baum (1995) emphasize that in special economic zones, economic, political, and technological factors significantly influence the effectiveness of tourism logistics planning.

Finally, innovations such as low-emission transport, bicycle pathways, energy and water recovery systems, composting, and food waste-to-biogas solutions are highlighted by Aksu (2025) as key strategies to enhance environmental sustainability, economic benefits, and social engagement in tourism. These approaches provide significant opportunities for the development of sustainable tourism logistics in the Karabakh and East Zangezur economic regions.

Recent research in GeoJournal of Tourism and Geosites confirms that transport accessibility is a basic condition for regional tourism development (Omirzakova & Wendt, 2025), while digital technologies can strengthen sustainable tourism marketing and planning in Azerbaijan (Hajiyeva et al., 2026).

METHODOLOGY

The study investigated the potential for implementing sustainable tourism logistics in the Karabakh and East Zangezur economic regions of Azerbaijan. Due to the exploratory nature of the research, a mixed-methods approach was deemed most appropriate, combining literature review, field observation, surveys, and analysis of transport and tourism infrastructure data. Firstly, a review of scientific sources and international best practices in sustainable tourism logistics was conducted to establish a theoretical framework. Secondly, the ecological load of existing tourism attractions, including environmental impacts of transport chains and tourism facilities, was assessed through field observations and site visits.

To gather primary data, a questionnaire survey was carried out among tourists visiting or planning to visit the Karabakh and East Zangezur regions. The survey included questions on tourists' demographic characteristics (age, gender, occupation, country of origin), travel preferences, and awareness and willingness to adopt "green" practices during their trips. Additionally, the study examined the existing composition of tourism products, including seasonality, distances from

major transport hubs and cities (Baku, Ganja), and the accessibility of tourist facilities. Opportunities and risks associated with applying sustainable logistics solutions, such as green transport routes and alternative energy sources, were also evaluated. The methodological sequence applied in this study is summarized in Figure 1.

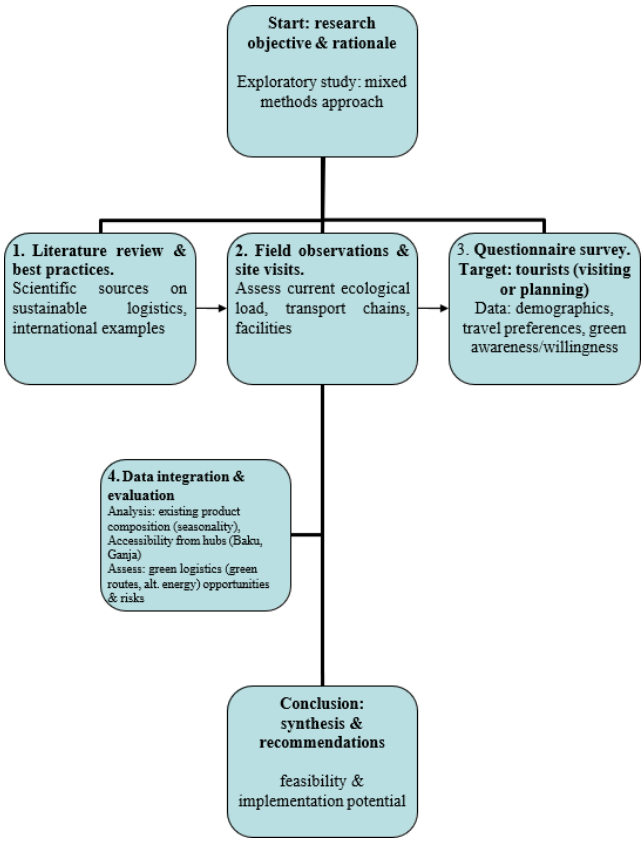


Figure 1. Research methodology flowchart (Source: Prepared by the author)

RESULTS AND DISCUSSIONS

Logistics has evolved into a strategic planning and management tool aimed at achieving synergy during the flow of goods and services from producers to end consumers within a competitive global market. Modern logistics can be analyzed through three primary lenses: managerial, economic, and financial perspectives (Imanov, 2005).

From these perspectives, key objectives include the integration of logistics processes, strategic coordination, meticulous planning, and operational control. Such approaches enhance system flexibility and enable the continuous refinement of logistics practices within the framework of a defined market strategy. At the regional level, logistics assumes a more localized, dynamic, and adaptive role (Maharramov, 2021). The primary tasks here include minimizing product storage time to facilitate faster delivery at tourism service points, reducing transportation time, optimizing vehicle allocation, responding swiftly to consumer demands, and ensuring effective processing and transmission of information. These tasks are central to the functional scope of logistics, encompassing the formation and regulation of economic relations for goods and service provision, rationalization of resource distribution, and determination of material flow volumes and directions. Importantly, regional logistics operations must also address environmental sustainability, climate change mitigation, and the transition toward a green economy (Doğan, 2020). One of the most significant contemporary applications of logistics is in the tourism sector. The role of logistics in tourism is determined by the geographic distribution of tourism resources, the characteristics of tourism products, and the accessibility of these products to consumers (Yankovenko, 2014).

Consequently, the development and growth of tourism in any region are closely tied to the attractiveness of available resources, the quality of socio-cultural and tourism infrastructure, and the strategic utilization of tourism routes. In practice, tourism logistics focuses on optimizing the interaction between tourist movement, accommodation facilities, and food service points. This involves planning, controlling, and managing operations within the tourist region, ensuring that the final tourism product reaches consumers efficiently while satisfying their preferences and requirements. Moreover, tourism logistics encompasses the transfer, storage, and processing of relevant information, as well as minimizing costs for tourists during travel from their origin to temporary destinations. It also involves optimizing the distribution of tourism products from sellers, such as tour operators or travel agents, to end consumers (Edirisinghe et al., 2021).

The relationships among the principal tourism-logistics actors are presented in Figure 2. In essence, tourism logistics functions as a service-oriented system in which multiple stakeholders—suppliers of tourism components, transport enterprises, tour operators, agents, and tourists—actively participate in decision-making processes. Effective tourism logistics ensures not only the operational efficiency of the tourism system but also enhances the overall consumer experience, thereby serving as a critical enabler for sustainable tourism development.

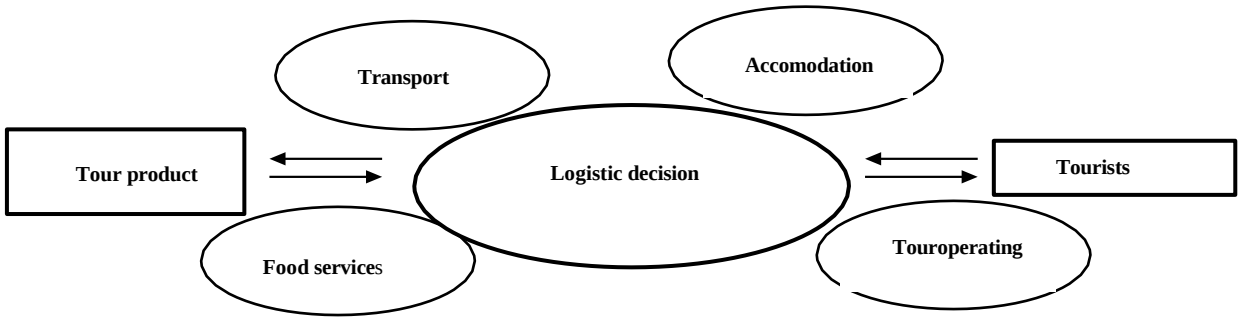


Figure 2. Tourism logistics framework (Source: Prepared by the author based on Zhang et al., 2009)

This can be described as follows: As can be seen, tourism logistics is a necessary component for the tourism industry to function as a complete system. The need to apply sustainable logistics in tourism is explained by the close connection of this area with the state policy implemented in general socio-economic and regional development, the active movement of tourists, the diversity of tourism services, and the international relations existing here.

In particular, the geographical location of the tourism region, the electric vehicles used by tourists during their travels here from various directions, as well as the use of walking and cycling opportunities, increase the importance of "sustainable logistics" in this area. On the other hand, in the context of modern industrial development, depletion of raw materials and traditional energy sources, minimizing environmental damage, and reducing waste during tourism travel are also becoming more relevant, which is explained by the fact that tourism creates an integrative relationship with many areas. All of these are issues that increase the importance of applying green logistics when organizing tourism travel.

Currently, "sustainable tourism logistics" (Akhirson et al., 2025) refers to the organization of tourism trips with sustainable use of tourism resources, less environmental impact, and low-carbon and zero-waste tours. When looking at research on sustainable tourism logistics, it is considered not only to reduce emissions during tourism trips, but also to improve the sustainable management of the destination through smart transportation, waste reduction, and energy efficiency (Budeanu, 2007). As can be seen, the highest goals set by the state in the field of tourism are taken as a basis here. Thus, the ultimate goal of planning in tourism is based on the sustainable development of the destination. According to another author (Hunter, 2002), sustainable tourism logistics is an important component of sustainable tourism development, especially in ecologically sensitive regions. Summarizing these, the activities of the elements during "sustainable tourism logistics" as a component of tourism logistics are summarized in Figure 3.

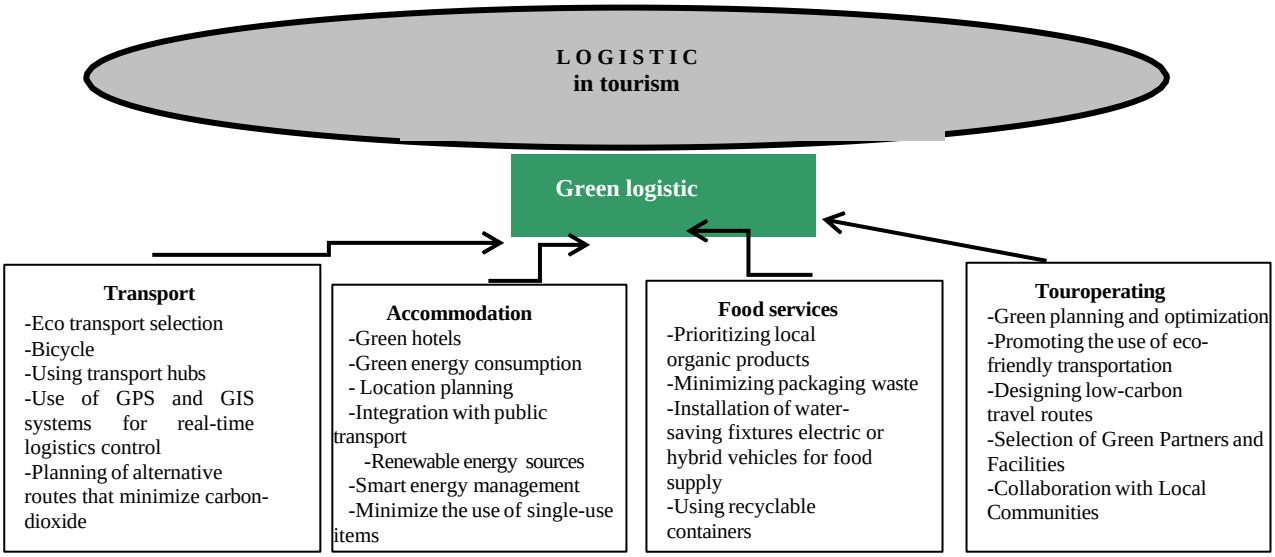


Figure 3. Sustainable tourism logistics components
(Source: Prepared by the author based on Christopher, 2016, and adapted to the sustainable tourism logistics context)

The application of tourism logistics and especially green tourism in Karabakh and East Zangezur can be explained by the current situation of these regions and the future development prospects of tourism here. Following the liberation of regions previously affected by long-term conflict, where both the economic and ecological conditions were severely impacted and tourism resources were degraded, the development of tourism has become a key priority for regional reconstruction in Azerbaijan. The return of displaced populations to these areas highlights the need for ecological restoration and sustainable development measures. As of July 2025, internally displaced persons have been successfully resettled in six cities and villages across these regions, with over 50,000 individuals now living, working, and studying locally (President of the Republic of Azerbaijan, 2025). The areas currently exhibit minimal industrial and agricultural waste; however, decades of occupation led to significant environmental degradation, including deforestation, disruption of irrigation systems, and soil erosion

(Nesirova, 2022). These conditions indicate that the implementation of sustainable tourism logistics could play a crucial role in mitigating the ecological footprint of tourism activities, promoting sustainable tourism development, and supporting the restoration of local ecosystems. Karabakh and East Zangezur economic regions: overview

The Karabakh and East Zangezur economic regions are located in the southwest of Azerbaijan, sharing borders with the Islamic Republic of Iran and the Republic of Armenia. These regions were formally established by the Decree of the President of the Republic of Azerbaijan on July 7, 2021. According to this decree, the East Zangezur economic region—encompassing the liberated Zangilan, Gubadli, Jabrayil, Lachin, and Kalbajar districts—and the Karabakh economic region—which includes Agdam, Shusha, Fuzuli, Tartar, Khojavand, Khojaly districts, the city of Khankendi, as well as Agjabedi and Barda districts—were created to ensure the restoration and sustainable development of the Karabakh economic region (President of the Republic of Azerbaijan, 2022; Figure 4).

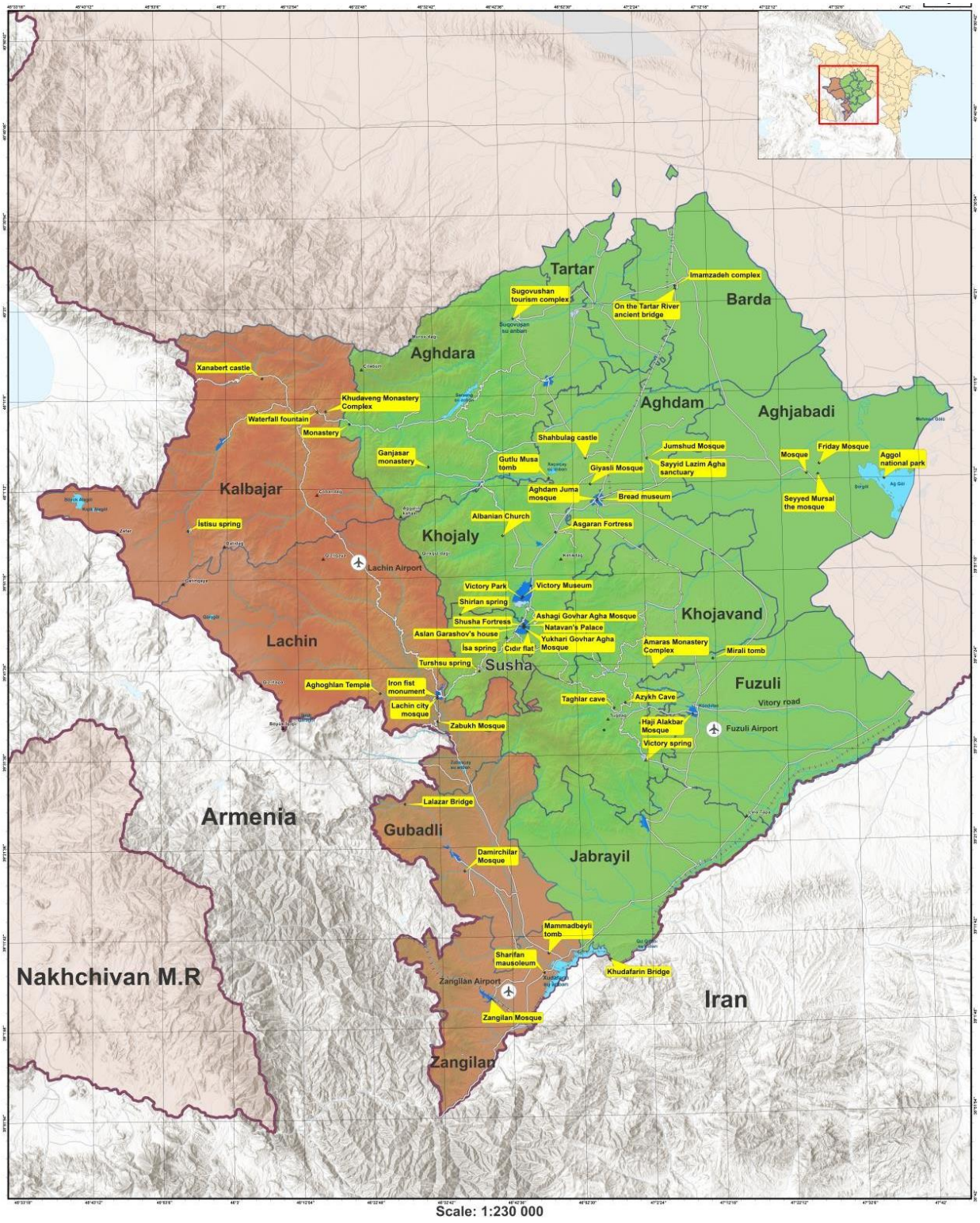


Figure 4. Map of East Zangezur and Karabakh economic regions (Source: The map was prepared by the author)

The establishment of these new economic regions aims to implement comprehensive measures for the rehabilitation of territories liberated from occupation, facilitate their long- term development, develop essential infrastructure, support the return of residents to their former homes, and promote balanced regional growth. This initiative leverages the rich economic potential, natural resources, and extensive tourism opportunities of these regions. In addition to abundant natural resources and a favorable geostrategic position, the Karabakh and East Zangezur economic regions are historically notable for their natural and cultural tourism resources, which had been prominent even prior to the occupation. During the Soviet era, a wide-ranging tourism and recreational infrastructure was established in the area. However, political conflicts since 1988 have caused substantial impacts on the tourism sector, as well as other economic activities, in both regions.

The total area of the Karabakh and East Zangezur economic regions is approximately 8.99 thousand km² and 7.47 thousand km², respectively, with a network of highways extending over 900 kilometers. Although modern railways are currently underutilized for tourism, the newly developed railway infrastructure offers opportunities for the application of sustainable tourism logistics and the transition to a sustainable economy. In particular, the Horadiz–Aghband railway line is expected to play a key role in regional integration via the Zangezur corridor and could support low-carbon tourist transportation. Another line is planned to connect Barda–Agdam–Khankendi. Existing airports in these regions, including the Fuzuli, Zangilan, and Lachin international airports and Khojaly Airport, are already accessible to tourists. The routes currently actively used by tourists in the region are presented in Table 1 (Our Road to Karabakh, 2026; Raimbekov et al., 2018).

Table 1. Road routes and their lengths in the Karabakh economic region
(Source: The table was prepared by the author based on the official data of the State Agency of Azerbaijan Automobile Roads)

№	The name of the road	Length (km)
1	Talysh – Tapgaragoyunlu – Gashalti Road	**22.0 km**
2	Gubadlı – Eyvazli Road	**28.0 km**
3	Tartar – Sugovushan – Talysh Road	**28.5 km**
4	Istisu – Kalbajar Road	**31.5 km**
5	Shukurbayli – Jabrayil – Hadrut Road	**42.0 km**
6	Fuzuli – Hadrut Road	**55.0 km**
7	Gubadlı – Lachin Road	**66.0 km**
8	Kalbajar – Lachin road	**72.8 km**
9	Toganali – Kalbajar – Istisu (general route)	**~80.7 km**
10	Toganali – Kalbajar Road	**80.7 km**
11	Fuzuli – Shusha Road	**81.6 km**
12	Zafar Road	**101.0 km**
13	Horadiz – Aghband Road	**110.4 km**
14	Barda – Agdam – Minjivan – Aghband Road	**123.6 km**
15	**Barda – Agdam – Khankendi Road**	**124.7 km**

Table 2. Cultural and green tourism potential in Karabakh economic region (Source: Prepared by the author)

№	Name of tourism resources	Location (district)	Type
1.	Khankendi Kurgans	Khankendi	Cultural tourism resources
2.	Aggol National Park	Agjabadi	Eco-tourism resources
3.	Aghdam Juma Mosque	Aghdam	Cultural tourism resources
4.	Shahbulag Castle	Aghdam	Cultural tourism resources
5.	Palace of Panahali Khan and the Imarat complex	Aghdam	Cultural tourism resources
6.	Aghdam Bread Museum	Aghdam	Cultural tourism resources
7.	Gutlu Musa Tomb	Aghdam	Cultural tourism resources
8.	Uzarliktepe settlement	Aghdam	Cultural tourism resources
9.	Barda Imamzadeh Complex	Barda	Cultural tourism resources
10.	Sheikh Babi's Tomb	Fuzuli	Cultural tourism resources
11.	Shah Abbas Caravanserai	Fuzuli	Cultural tourism resources
12.	Mirali Tomb	Fuzuli	Cultural tourism resources
13.	Asgaran Castle	Khojalı	Cultural tourism resources
14.	Azykh Cave	Khojavand	Cultural tourism resources
15.	Amaras Monastery	Khojavand	Cultural tourism resources
16.	Taghlar Cave	Khojavand	Cultural tourism resources
17.	Ancient bridge over the Tartar River	Tartar	Cultural tourism resources
18.	Sugovushan Tourism Complex	Tartar	Cultural tourism resources
19.	Khudaferin bridges	Jabrayil	Cultural tourism resources
20.	Khudaveng Monastery Complex	Kelbajar	Cultural tourism resources
21.	Lalazar Bridge	Gubadli	Cultural tourism resources
22.	Damirchilar Mosque	Gubadli	Cultural tourism resources
23.	Aghoghlan Monastry	Lachin	Cultural tourism resources

The Karabakh and East Zangezur economic regions of Azerbaijan are endowed with abundant tourism resources. During the Soviet era, these regions—second only to Baku in terms of tourist visits (excluding areas bordering the capitalist

state of Iran)—were recognized for their rich historical, cultural, and natural attractions. Notably, the city of Shusha, designated as the cultural capital of Azerbaijan, holds particular significance. As a symbol of Azerbaijan's victory in the 44-day Second Karabakh War, Shusha has experienced a marked increase in tourist numbers since 2020. Since 2020, thousands of tourists have traveled on regular bus flights organized by the Azerbaijan Land Transport Agency (ALTA) to the liberated territories. Currently, the main direction of movement of tourists in the Karabakh economic region is Fizuli-Khojavand-Shusha-Khankendi-Aghdam. In the East Zangezur economic region, the main tourism resources are located in the direction of Jabrayil-Gubadli- Lachin. The alternating location of historical-cultural and natural tourism resources in both regions and the landscape structure of these areas are also factors affecting tourism logistics here. Official restoration initiatives are also reshaping access to major heritage sites (Karabakh Revival Fund, 2026).

The tourism resources available in Karabakh and East Zangezur are presented in Tables 2 and 3.

Table 3. Tourism attractions and heritage sites in Shusha city (Source: prepared by the author)

№	Object name	Tourism resources
1.	The Upper Govhar Agha Mosque	Cultural tourism resources
2.	The Lower Govhar Agha Mosque	Cultural tourism resources
3.	Natavan's Palace	Cultural tourism resources
4.	The Karabakh Khan's Palace	Cultural tourism resources
5.	Molla Panah Vagif's Mausoleum	Cultural tourism resources
6.	Shusha Cave Camp	Cultural tourism resources
7.	Shusha Fortress	Cultural tourism resources
8.	Uzeyir Hajibeyov's House- Museum	Cultural tourism resources
9.	Bulbul's House- Museum	Cultural tourism resources
10.	Gara Boyuk Khanum Tower	Cultural tourism resources
11.	The Caravanserai of Agha Qahraman, Son of Mir Siyab	Cultural tourism resources
12.	Two-story Caravanserai	Cultural tourism resources
13.	Kazanchi Church	Cultural tourism resources
14.	İsa Spring	Natural tourism resources
15.	Cıdır Flat	Natural tourism resources
16.	Turshsu	Natural tourism resources
17.	Shirlan	Natural tourism resources
18.	Chatir Waterfall	Natural tourism resources

The implementation of sustainable tourism logistics in Karabakh and East Zangezur is based on the movement of tourists to this area and the use of tourism services through the airports, roads, bridges, tunnels created here. Also, in the form of smart settlements created here, the local population and, in general, all citizens of the Republic of Azerbaijan have the opportunity to get acquainted with new living standards in the form of new types of settlements. When looking at the services that can be provided to tourists in terms of existing tourism resources and transport logistics opportunities in these regions, the problems that arise can be shown as follows. Thus:

- Insufficient existing infrastructure at the initial stage to meet the tourist interest in Karabakh and Eastern Zangezur after its liberation;
- Uneven location of hotels, restaurants and other socio-cultural institutions to manage tourist flows along the existing road and transport network to reach tourist attractions during trips in Karabakh;
- Despite the attractive tourism resources available in the Karabakh economic region, there are restrictions on individual travel here;
- According to tourists' social media impressions, the traces of destruction (former settlements, monuments, infrastructure, landscape, etc.) that still exist around most of the attractions located on their travel routes create negative emotional feelings (Figures 5 and 6); The documented destruction of the Aghdam Bread Museum is one example (ArmenianCrimes, 2026; Ministry of Culture of the Republic of Azerbaijan, 2026).
- The threat of mine explosions remains as a result of the contamination of the territory with mines by Armenia (Mine safety).

Diversification of the routes for tourists to reach Karabakh and East Zangezur, the establishment of roadside stops, and the construction of hotels are among the prerequisites for the development of the tourism industry created in Karabakh and East Zangezur during the post-occupation recovery and return period based on the principles of sustainability. In addition, there is the issue of training personnel who will organize tour operators and excursion services for tourists in the Karabakh and East Zangezur territories. In terms of logistics, the Shusha, Agdam, Kalbajar, Lachin, Khankendi, and Zangilan routes are of primary interest for tourists traveling to Karabakh and East Zangezur. Thus, the integration of the Khojaly Airport, which previously existed in the region, and the Fizuli, Zangilan and Lachin international airports built here after the liberation of the region from occupation, as well as the newly built railway with more than 10 highways here can be considered a convincing argument in terms of green logistics research. Research in this area allows us to draw conclusions about the optimal ratio of carbon dioxide emissions reduction when using air, rail and land routes (Wang et al., 2024; Trevisan & Bordignon, 2020; EUROCONTROL, 2021; Lomachynska & Andrushchenko, 2025).

In order to conclude in this area, it is also possible to consider the socio-economic basis of the application of green logistics in tourism, and green logistics in general, according to another study (Doğan, 2020). Thus, considering that in a

period when tourism demand is increasing, up to 40 percent of the global energy market's oil demand is transported by land, and air transport accounts for up to 3 percent of global warming, it is necessary to take into account the minimization of carbon dioxide emissions caused by tourists during their travels.



Figure 5. Bread Museum destroyed in Aghdam during the occupation period (1992–2020) (Source: The author)



Figure 6. Caravanserai of the Safarov brothers destroyed in Shusha city during the occupation (1992–2020) (Source: The author)

The issues of applying green logistics during tourism activities in Karabakh and East Zangezur can be explained by the state support for this area, planning for transport hubs, hotels, food establishments, tourist camps, and the awareness of travelers about sustainable tourism logistics and their interest in walking and cycling. It should be noted that currently, the declaration of the Karabakh and East Zangezur economic regions of Azerbaijan, along with the Nakhchivan Autonomous Republic, as green energy zones, and the large-scale projects implemented here towards the transition to a green economy indicate state support for this. In these regions, as well as in the Nakhchivan Autonomous Republic, the transition to green energy, the replacement of traditional means of transport with electric vehicles, and the optimization of tourism routes indicate state support for the application of sustainable tourism logistics.

In addition, the government of the Republic of Azerbaijan expresses its support for the development of this sector through international cooperation in the field of joint fight against climate change, the transition to a digital economy in most sectors of the economy, including tourism logistics, and the adoption of an artificial intelligence strategy. The government of the Republic of Azerbaijan pays special attention to these issues in the reconstruction of Karabakh and East Zangezur, demonstrating the priority position of these regions in the transition to a green economy with the smart settlements they have built. In addition, the tunnels being built on the roads leading to Shusha, an important tourism center of Karabakh, also have an impact on green logistics. These priorities are consistent with Azerbaijan's green-economy policy agenda (COP29 Azerbaijan, 2025; Qasimli et al., 2021; Tang et al., 2017).

Planning issues for sustainable tourism logistics include increasing the share of low- carbon transport in the supply chain between tourists and tourism products and selecting optimal routes and stopping points for tourists moving from one attraction to another. According to one study, 24 percent of global carbon dioxide emissions are generated by logistics activities (Doğan, 2020). The fact that tourism ranks 3rd-4th in the global economy (UN Tourism, 2024) suggests that green logistics can make a significant contribution to reducing emissions. These issues also require resolving conflicts arising from the individual behavior of tourists, who want to see more attractions in a given travel period and at the same time spend less money by spending their time rationally.

In many developing countries, including Azerbaijan, tourists often prioritize personal leisure interests over environmental considerations, frequently traveling in hydrocarbon- fueled private vehicles and contributing to pollution and waste generation. However, organizing large group tours with lower carbon footprints—such as bus tours accommodating 18 to 45 passengers, and optimizing routes between key destinations (including hotels, restaurants, and designated rest stops) can result in more environmentally sustainable tourism practices.

Furthermore, government support for the transition to electric vehicles, along with the development of necessary infrastructure (such as electric charging stations) beyond the capital city, particularly in the Karabakh and East Zangezur economic regions, can significantly contribute to achieving these sustainability goals. In addition, prioritizing walking and cycling for individual or family travel could also be more environmentally efficient. This would allow for the regulation of carbon dioxide emissions per tourist with quotas and their alignment with international standards as environmental indicators in the logistics chain applied during tourism activities in the region.

In this context, if we refer to the analysis of the survey results (Isayeva, 2025), conducted to arrive at predictive results on sustainable tourism logistics in the Karabakh and East Zangezur economic regions, we see that the main purpose of the visits to Karabakh of respondents aged 18-25 (89.3 percent) was education (Karabakh University). At this time, it was found that 75 percent of the respondents planned their trips themselves, 46.4 percent preferred a private car, and used taxi

and private car services more often at the place of travel. 39.3 percent of the respondents reported the lack of public transport during their trip to Karabakh, 50 percent reported that logistics problems affected their stay here longer, and 46.2 percent of respondents said that this would be possible with the opening of more public transport routes in terms of how to improve tourism logistics in the region. Then, to the question about the use of environmentally friendly means of transport in Karabakh and East Zangezur, 74.1 percent of respondents answered "no".

Interestingly, 19.2 percent of those asked about the development of green means of transport in the region chose walking, and 65.4 percent of people gave a positive answer to the question about the impact of environmentally friendly transport on tourism if it were widespread in the region.

84.6 percent of respondents gave a positive answer to the question about the impact of this on tourism travel. When asked about the direction of which tourism routes green transport could be applied more in the region, 46.4 percent of respondents chose the answer "Khankendi".

Finally, respondents participating in the survey stated that 50 percent of Khankendi, 35.7 percent Shusha, 10.7 percent Lachin, and 3.6 percent Agdam were suitable for the logistics of tourism routes in the region.

Findings

To summarize all this, it can be noted that in order to achieve "green results" during tourism activities, sustainable tourism logistics to be implemented in the Karabakh and East Zangezur economic regions of Azerbaijan can be considered as an important part of the restoration and construction work carried out here after 2020. In order to achieve the target of reducing carbon emissions by 40 percent by 2050 within the framework of the commitments undertaken by the Republic of Azerbaijan in the field of combating climate change, the work to be done in this direction in the tourism sector will also be one of the main priorities. Considering the interest of Karabakh and East Zangezur in both ecotourism and cultural tourism resources, the implementation of operations with less carbon emissions in the supply chain, in terms of realizing the tourism product created here in accordance with the principles of sustainable development will create a need for the application of green logistics. The road and transport infrastructure (airports, roads and railways) created in these regions over the 5 years after 2020, relevant service facilities for overnight stays and meals for tourists, and the work carried out to create "smart settlements" in the region also reveal the prospects for the application of sustainable tourism logistics.

Although it is thought that "sustainable tourism logistics" will be applied later in the realization of the tourism potential of Karabakh and East Zangezur than traditional logistics, it is possible to predict that this will be a common context in terms of future goals for the state, private sector, local community and tourist interests.

The tourism activity created in Karabakh and East Zangezur will be an integral part of the tourism policy implemented in the Republic of Azerbaijan in general, and will lead to more positive results with the application of the completely rebuilt infrastructure and previously existing management experience.

Since the Karabakh and East Zangezur economic regions have been under occupation for 30 years and are inaccessible to citizens of the Republic of Azerbaijan, the tourist interest here is greater than in other parts of Azerbaijan, which creates corresponding problems in the management of tourism in the area, which makes the issues of environmental protection even more relevant. In this sense, "sustainable tourism logistics" on tourism routes in these two regions can be useful in minimizing environmental risks. Management models for "sustainable tourism logistics" to be applied in highly prestigious tourism regions such as the Karabakh and East Zangezur economic regions of the Republic of Azerbaijan can also strengthen the population's inclination towards hiking, cycling and group tours in the future by shaping "green behaviors" in tourists traveling there. The results achieved in the Karabakh and East Zangezur economic regions on "sustainable tourism logistics" are important in terms of prestige, in addition to their economic and social benefits, which, as a developing country, can take an important place in the "green agenda" of the Republic of Azerbaijan and allow the application of the experience gained in other parts of the country.

CONCLUSIONS

This study demonstrates that sustainable tourism logistics is a key component for the restoration, development, and future growth of the Karabakh and East Zangezur economic regions. The implementation of green logistics in these areas is closely linked to post- occupation reconstruction, socio-economic revitalization, and environmental sustainability. Investments in airports, railways, highways, tunnels, and smart settlements provide the foundation for low-carbon and efficient tourism logistics. Integration of air, rail, and road transport helps reduce CO_2 emissions while improving accessibility to cultural and natural tourism resources. Sustainable tourism logistics reduces carbon emissions, promotes eco-friendly transport, encourages responsible tourist behavior, supports resettlement of displaced populations, revitalizes local economies, and enhances tourist experiences. Survey results indicate growing interest in environmentally friendly transport and walking/cycling options, suggesting that promoting group-based, low-carbon tourism can strengthen green logistics outcomes. Government support through green energy zones, smart infrastructure planning, and integration of digital/AI tools reflects a strategic commitment to sustainable tourism logistics and provides a replicable model for other regions. Overall, applying sustainable tourism logistics in Karabakh and East Zangezur represents a unique opportunity to combine ecological, social, and economic objectives, transforming post-conflict regions into sustainable tourism hubs with minimized environmental impact.

This study has several limitations. Data primarily covers the post-liberation period (2020–2026); long- term trends in tourist behavior, infrastructure use, and environmental impact may evolve differently. The survey focused on young tourists (18–25 years) and education- related travel, which may not fully represent broader tourist demographics. While significant

progress has been made, some tourism infrastructure is still under development, and certain routes or services may not yet reflect long-term conditions. CO_2 emissions and ecological impacts are based on transport modes and routes; future empirical data will be needed to validate these estimates. Addressing these limitations in future research will enable a more comprehensive assessment of sustainable tourism logistics and its long-term environmental, social, and economic impacts in Karabakh, East Zangezur, and other post-conflict regions.

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NAVIGATING MULTI-LEVEL GOVERNANCE IN ZIMBABWE'S ECOTOURISM SECTOR

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Abstract: Ecotourism governance requires coordination among public agencies, local authorities, communities, tourism businesses and conservation organisations whose mandates often overlap. This paper examines how multi-level governance shapes institutional coordination across Victoria Falls, Hwange and Binga, Zimbabwe. Using an interpretivist multiple-case design, the study draws on 39 semi-structured interviews with government and parastatal officials, conservation organisations, tourism businesses and community representatives, supported by analysis of tourism, wildlife and environmental policy documents. Four connected challenges emerged: overlapping mandates and competing priorities created uncertainty and delay; inter-agency collaboration was irregular and constrained by limited staff, budgets and follow-through; decision-making remained predominantly top-down, with weak local influence and feedback; and coordination problems differed by destination. Victoria Falls faced congestion among numerous institutions, Hwange relied strongly on protected-area networks, and Binga had fewer institutional connections and weaker access to national decision-making. These contrasts suggest that the number of institutions involved is less important than the quality, reach and consistency of their coordination. NGOs and businesses bridged some gaps but could not replace consistent public-sector coordination. The study shows that a common national framework operates differently across destinations. Governance quality therefore depends as much on working relationships and implementation capacity as on formal mandates. It recommends clearer roles, routine and resourced coordination, stronger feedback mechanisms and targeted support for destinations with weaker institutional capacity. The comparison of destinations governed through the same national framework offers evidence that coordination reforms must be adapted to differences in institutional presence, administrative access and local implementation capacity.

Keywords: ecotourism governance, multi-level governance, institutional coordination, stakeholder participation, destination governance, Zimbabwe, Southern Africa

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INTRODUCTION

Ecotourism governance rarely sits within a single institution, tourism promotion and licensing, environmental assessment, protected-area management, land-use planning, local development, community participation and private-sector implementation are usually distributed across organisations with different mandates and priorities (Forje et al., 2022; Wondirad et al., 2020). Although this distribution can broaden expertise and participation, weak coordination can produce duplicated procedures, inconsistent decisions and uncertainty over responsibility (Kodir et al., 2020; Sentanu et al., 2023). The practical question is therefore not simply how many actors participate in ecotourism governance, but whether they are able to work together consistently enough to translate policy into coherent action.

Coordination is important in nature-based destinations where conservation, community livelihoods and commercial tourism are closely connected (Forje et al., 2022; Mpofu & Van Der Merwe, 2025). Previous research in sub-Saharan Africa continues to identify stakeholder participation, institutional capacity, accountability and collaboration as important conditions for effective ecotourism governance (Dangi & Petrick, 2021; Makhanyela et al., 2024; Wondirad et al., 2020). Collaborative arrangements can improve knowledge exchange and legitimacy, yet their effects are limited when responsibilities remain unclear, forums are under-resourced or participation does not influence decisions (Dangi & Petrick, 2021; Sentanu et al., 2023). Recent tourism-policy studies similarly show that power and institutional position shape which actors can influence policy networks (McLeod, 2023). These issues make coordination a central part of implementation rather than an administrative concern separate from sustainability.

Zimbabwe provides a strong setting in which to investigate this variation. Ecotourism is shaped by the Tourism Act [Chapter 14:20], Parks and Wild Life Act [Chapter 20:14], Environmental Management Act [Chapter 20:27], National Tourism Policy and local natural-resource governance arrangements, including the Communal Areas Management Programme for Indigenous Resources (CAMPFIRE) (Government of Zimbabwe, 1975, 1995, 2002, 2014). The

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institutional field includes the Ministry of Tourism and Hospitality Industry, Zimbabwe Tourism Authority (ZTA), Ministry responsible for environment and wildlife, Environmental Management Agency (EMA), Zimbabwe Parks and Wildlife Management Authority (ZimParks), local authorities, community structures, NGOs and tourism enterprises (Government of Zimbabwe, 1975, 1995, 2002, 2014; Mpofu & Van Der Merwe, 2025). These bodies are functionally interdependent, but their statutory mandates do not automatically specify how competing priorities, joint approvals, information exchange or local feedback should be reconciled (Mpofu & Van Der Merwe, 2025).

The three cases examined in this paper reveal different expressions of this shared national system. Victoria Falls is an internationally visible tourism hub with a comparatively dense regulatory, commercial and civic presence; research in Zimbabwe also shows that sustainability practices vary geographically and are more widely adopted in this internationally oriented destination than in several domestic-market destinations (Shereni & Rogerson, 2023).

Hwange is organised strongly around a major protected area and the networks linking conservation agencies, operators, NGOs and surrounding communities (Mpofu & Van Der Merwe, 2025).

Binga is a more remote lakeside district where promising cultural and nature-based resources coexist with thinner institutional presence and weaker connectivity to national decision centres; research on Binga's VaTonga communities similarly identifies weak local representation, constrained access rights and limited capacity in natural-resource governance (Matsa et al., 2024). Comparing these three cases makes it possible to distinguish the existence of institutions from the territorial fit of their relationships (Guo & Li, 2025; Novalia et al., 2025).

Tourism-policy research has examined collaboration, participation, policy networks and destination management, but implementation remains under-studied, with important geographical, theoretical and practical gaps (Kifworo & Dube, 2024). Studies have examined protected-area partnerships, community-based natural resource management and local participation in particular parks or districts in Zimbabwe (Musakwa et al., 2020; Shereni & Saarinen, 2021; Forje et al., 2022; Mpofu & Van Der Merwe, 2025). What remains less developed is a comparative account of how national institutions, local authorities, non-state actors and communities coordinate across ecotourism destinations with contrasting institutional conditions. This paper addresses that gap by raising the following key questions: How do relationships among institutions and stakeholders at different levels shape coordination in ecotourism governance across Victoria Falls, Hwange and Binga, and what practical reforms could strengthen that coordination?

This study contributes a within-country comparison of how one national governance framework operates across destinations with different institutional conditions. The study shows how coordination challenges vary by place and identifies practical reforms focused on clearer roles, stronger feedback and differentiated institutional support, through combining government, business, conservation and community perspectives.

LITERATURE REVIEW

Multi-level governance in tourism refers to interaction among national institutions, subnational authorities and non-governmental stakeholders whose responsibilities intersect in policy design and implementation (Hooghe & Marks, 2003; Guo & Li, 2025). In ecotourism, such interaction is important because tourism development depends simultaneously on environmental safeguards, conservation management, local planning, infrastructure, community relationships and private investment. Tourism governance can therefore be understood as a networked process in which the effectiveness of individual organisations is partly shaped by their relationships with government, private-sector and civil society (Hartman, 2023; McLeod, 2023; Wondirad et al., 2020).

A multi-level perspective draws attention to how national decisions are translated into local action and how interactions between national and local actors affect policy implementation (Guo & Li, 2025; Novalia et al., 2025).

Institutional coordination concerns the practical arrangements through which these interdependent organisations align responsibilities, exchange information, resolve conflicting priorities and act on shared decisions (Sentanu et al., 2023; Wondirad et al., 2020). Previous studies have shown that collaboration can support sustainable destination management, but it is not effective simply because committees, partnerships or meetings exist (Dangi & Petrick, 2021; Sentanu et al., 2023; Wondirad et al., 2020). Clear institutional roles, open communication, adequate resources, continuity and commitment are important for turning collaboration into coordinated action (Harilal et al., 2025; Sentanu et al., 2023; Serruto-Perea & Zapata-Mendoza, 2026; Wondirad et al., 2020). Public–private network quality can also influence destination-management performance (Serruto-Perea & Zapata-Mendoza, 2026).

Harilal et al. (2025) demonstrate how unclear responsibilities and weak communication can reduce stakeholder coordination, while McLeod (2023) shows how the distribution of power within tourism policy networks shapes the roles that different actors perform. Coordination should therefore be assessed through actual working relationships and implementation practices rather than formal institutional structures alone (Hartman, 2023; Sentanu et al., 2023; Wondirad et al., 2020). Participation is closely connected to coordination because local knowledge is more likely to inform policy when communities have meaningful channels through which to contribute to decision-making (Dangi & Petrick, 2021; Mpofu & Van Der Merwe, 2025). Community-based tourism and conservation research shows that consultation without meaningful influence can leave local actors underrepresented and excluded from important planning and resource-management decisions (Dangi & Petrick, 2021; Mpofu & Van Der Merwe, 2025; Shereni & Saarinen, 2021).

This is particularly important in ecotourism because communities and local businesses directly experience the effects of conservation restrictions, tourism development and natural-resource management decisions (Shereni & Saarinen, 2021; Wondirad et al., 2020). Recent evidence from Hwange identifies weak legislation, fragmented institutional arrangements, limited information and inadequate local capacity as barriers to meaningful community participation in

tourism planning (Mpofu & Van Der Merwe, 2025). Effective coordination therefore requires two-way communication: institutions must communicate policies and responsibilities clearly, while communities and implementers need accessible opportunities to raise concerns, contribute knowledge and receive responses (Harilal et al., 2025; Mpofu & Van Der Merwe, 2025; Sentanu et al., 2023). Place also matters because destination governance is shaped by different combinations of institutional capacity, infrastructure, actor networks, resources and administrative relationships (Hartman, 2023; Guo & Li, 2025; Novalia et al., 2025). Research shows that common national policies can produce different local implementation pathways when institutional capacity and stakeholder relationships vary across places (Guo & Li, 2025; Khanduri, 2026; Novalia et al., 2025).

Research from Zimbabwe similarly reveals geographical differences in sustainability practices, community participation and experiences of conservation governance (Mpofu & Van Der Merwe, 2025; Shereni & Rogerson, 2023; Shereni & Saarinen, 2021). A uniform governance arrangement may therefore not be equally suitable for every destination (Guo & Li, 2025; Novalia et al., 2025; Shereni & Rogerson, 2023).

Actor-dense tourism destinations may require stronger mechanisms for coordinating numerous organisations, whereas poorly resourced or remote destinations may also require capacity building, stronger institutional access and more reliable connections with national agencies (Hartman, 2023; Novalia et al., 2025; Wondirad et al., 2020). This paper examines how institutional responsibilities are coordinated in practice, how government agencies work together, and whether local actors have meaningful opportunities to participate and provide feedback. It compares Victoria Falls, Hwange and Binga to explore how these governance processes vary across destinations with different institutional conditions.

MATERIALS AND METHODS

Institutional and geographical context

The ecotourism architecture in Zimbabwe combines national legislation with implementation by specialised agencies, local authorities and non-governmental actors. The Tourism Act [Chapter 14:20] establishes the Zimbabwe Tourism Authority (ZTA) and assigns its responsibilities relating to tourism development, promotion, research, standards, and the registration and grading of designated tourism facilities (Government of Zimbabwe, 1995).

The Parks and Wild Life Act [Chapter 20:14] establishes the Zimbabwe Parks and Wildlife Management Authority (ZimParks) and provides for the management of protected areas, wildlife and associated tourism activities (Government of Zimbabwe, 1975). The Environmental Management Act [Chapter 20:27] establishes the Environmental Management Agency (EMA) and provides for environmental impact assessment, environmental monitoring and pollution control (Government of Zimbabwe, 2002). The National Tourism Policy provides broader strategic direction for sustainable tourism development, community participation and the distribution of tourism opportunities beyond established destinations (Government of Zimbabwe, 2014).

At the local level, Rural District Councils (RDCs) and traditional institutions perform functions relating to local development, land-use planning, community representation and natural-resource governance (Government of Zimbabwe, 1988, 1998). The Parks and Wild Life Act also allows qualifying RDCs to exercise appropriate authority over wildlife in communal areas, providing the legal basis for local wildlife-management arrangements such as CAMPFIRE (Government of Zimbabwe, 1975; Shereni & Saarinen, 2021).

Tourism businesses, NGOs and community organisations contribute through tourism investment and operations, conservation partnerships, technical assistance, training and community engagement (Musakwa et al., 2020; Mpofu & Van Der Merwe, 2025). The study's document analysis found that, although these instruments assign substantial responsibilities to individual institutions, they provide limited operational detail on how overlapping mandates should be reconciled in routine ecotourism decisions. Table 1 summarises the principal institutions and their coordination needs.

Table 1. Institutional architecture of ecotourism governance in Zimbabwe (Source: Authors' analysis)

Level / domain	Principal actors	Principal roles	Main coordination need
National tourism	Tourism ministry; ZTA	Policy, promotion, facility regulation and standards	Alignment with environmental, wildlife and local-planning decisions
National environment and wildlife	Environment ministry; EMA; ZimParks	Environmental assessment, monitoring, protected areas and wildlife	Integration of conservation, tourism and local-development priorities
Subnational and local	Local authorities / RDCs; traditional and community institutions; CAMPFIRE structures	Land use, local services, community representation and local resource governance	Upward feedback, implementation resources and links to statutory agencies
Non-governmental	Tourism businesses; NGOs; associations	Investment, implementation, technical support, monitoring and training	Predictable participation, transparent decisions and public accountability

The cases were selected purposively to compare governance under a common national framework but contrasting destination conditions. Victoria Falls combines international market visibility, concentrated tourism investment and frequent interaction with regulatory institutions (Masimba, 2024; Shereni & Rogerson, 2023). Hwange is structured strongly around protected-area governance and conservation partnerships involving ZimParks, operators, NGOs and neighbouring communities (Mpofu & Van Der Merwe, 2025). Binga is more remote from major tourism and administrative

centres and relies more heavily on local government, community leadership and project-based relationships to connect with external institutions (Dahl & Tevera, 2019; Matsa et al., 2024). Figure 1 locates the three study sites.

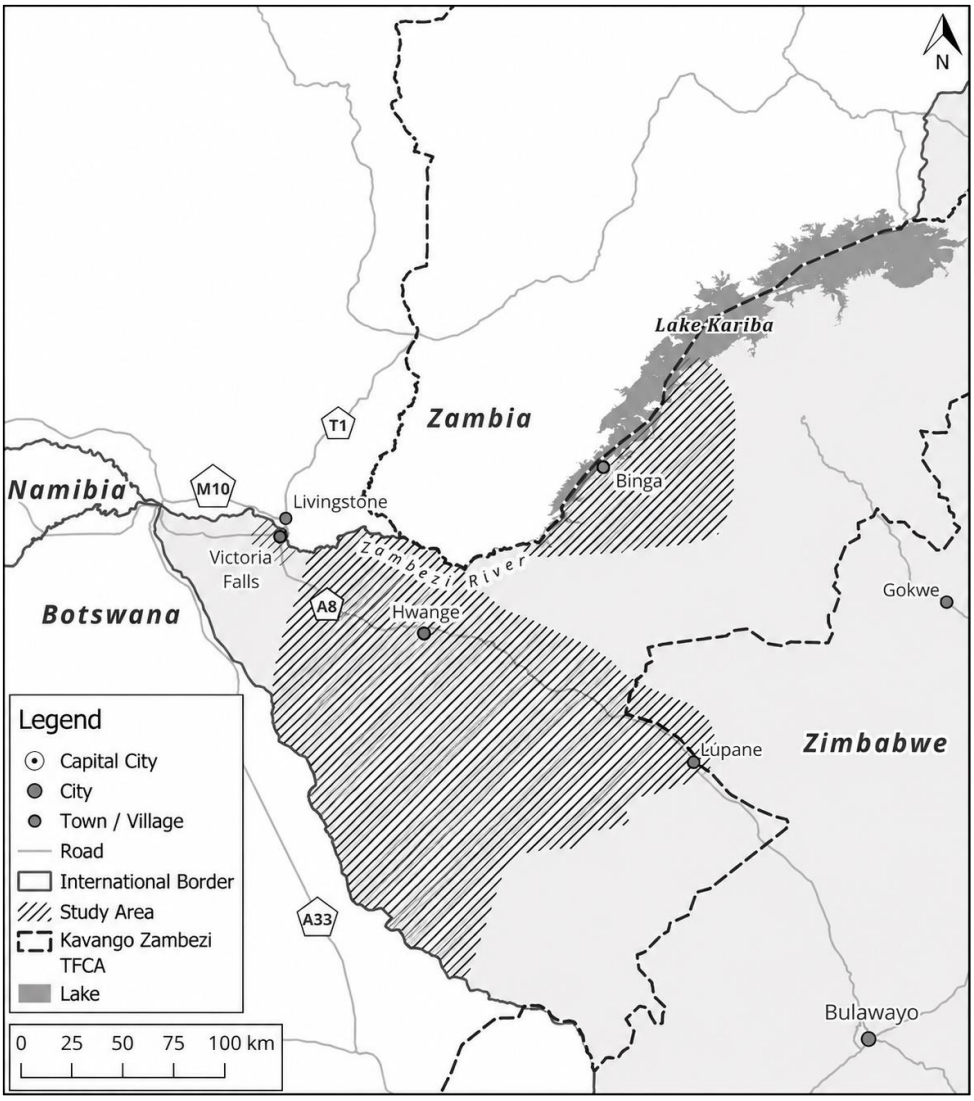


Figure 1. Location of Victoria Falls, Hwange and Binga in Zimbabwe (Source: Authors' own)

RESEARCH DESIGN

The research adopted an interpretivist qualitative multiple-case design, appropriate for examining governance processes within their institutional and geographical contexts (Ridder, 2017; Yin, 2018). The study drew on 39 semi-structured interviews across four stakeholder groups: 12 government and parastatal officials, 5 representatives of environmental and conservation organisations, 14 tourism business actors and 8 community representatives. Participants were selected purposively for their knowledge of policy design, regulation, conservation, tourism operations or community experience, consistent with the logic of purposive sampling in qualitative research (Campbell et al., 2020).

Snowball referrals complemented purposive recruitment where specialised institutional knowledge was difficult to access. Interviews were conducted in person and online during the fieldwork period, audio-recorded with consent and transcribed for analysis. Table 2 presents the distribution of the 39 interviews used in this paper.

Table 2. Distribution of the study sample by stakeholder group (Source: Authors' analysis)

Stakeholder group	Interviews
Government and parastatal officials	12
Environmental NGOs and conservation stakeholders	5
Tourism businesses	14
Community representatives	8
Total	**39**

Interview evidence was triangulated with qualitative document analysis of the principal statutory and policy instruments governing tourism, wildlife, environmental management and community-based resource use. Documents

were examined for institutional mandates, coordination requirements, participation provisions, monitoring responsibilities and areas of overlap. Documentary analysis was used to compare formal institutional design with stakeholder accounts of implementation, drawing on recent guidance for systematic policy-document analysis (Dalglish et al., 2020). Ethical clearance was granted by the University of Johannesburg School of Tourism and Hospitality Research Ethics Committee. Participation was voluntary and based on informed consent. Participant codes identify stakeholder category rather than individual identity: GOV for government and parastatal participants, NGO for environmental and conservation organisations, BUS for tourism businesses and COM for community representatives. Interview transcripts were read repeatedly and analysed thematically. Open inductive coding was first undertaken manually and then organised in ATLAS.ti to support systematic retrieval and comparison. Related codes were grouped into themes addressing institutional roles, overlapping mandates, inter-agency collaboration, participation, feedback, implementation capacity and differences among the three cases. Themes were refined by comparing evidence across stakeholder groups and sites and by examining divergent examples where coordination did work.

This process was consistent with contemporary guidance on thematic analysis and emphasised coherence between the research questions, coding decisions and interpretation (Braun & Clarke, 2021). Interview and documentary evidence were then brought together to compare formal responsibilities with reported governance practice. All direct quotations used in the paper were checked against the study records for accuracy.

RESULTS

Institutional mandates and coordination

Zimbabwe's ecotourism system contains numerous institutions with legitimate but intersecting responsibilities. Tourism agencies focus on sector development, promotion and standards; EMA regulates environmental assessment and environmental management; ZimParks oversees protected areas and wildlife; and local authorities carry planning, service and community-facing responsibilities. Participants described examples of cooperation among these bodies, including environmental assessments, inspections and conservation initiatives. The problem was therefore not a complete absence of collaboration, but uncertainty and delay when several mandates applied to the same issue. Different institutional priorities complicated coordination, a government participant explained:

“Sometimes, our priorities don't align perfectly, to mention an example, the Ministry of Tourism might be focused on increasing visitor numbers, while we at ZTA are more concerned with sustainability, but obvious we can always try to make sure that we are on the same track” (ZTA official, national level).

The comment illustrates how disagreement can occur even among institutions working within the tourism field. Participants also described situations in which tourism development, conservation and environmental requirements were considered through separate administrative processes. Although each process served a legitimate purpose, the absence of a consistently understood pathway for resolving overlaps could create duplication, slow approvals and make it difficult for operators or communities to know which institution was responsible for a final response.

Inter-agency collaboration and resource constraints

Participants from government reported working relationships among the tourism ministry, ZTA, EMA, ZimParks and local-government institutions. Joint inspections and environmental assessments showed that agencies could coordinate when a specific need arose. One official described the practical pattern as follows:

“We try to work with EMA and ZTA. We go together sometimes to check, but not all the time. Sometimes it’s hard because everyone [each organisation] is busy, you know? But we try to meet and talk about the problems.” (Tourism ministry official, national level)

The distinction between occasional cooperation and routine coordination was important. Participants described collaboration as dependent on the issue, available staff, transport and project resources. This limited continuity and made follow-through difficult. A government participant discussing proposed coordination structures captured the problem directly:

“One of our more recently proposed initiatives is the inter-ministerial committee on tourism sustainability, which aims to bring together representatives from various ministries. We can have all the committees and meetings we want, but if we don’t have the resources to follow through, we’re not going to see the results we need.” (Tourism ministry official, national level)

These accounts suggest that institutional forums alone cannot solve coordination problems. Without staff time, budgets, shared work programmes and clear responsibility for implementing decisions, meetings may improve communication temporarily but without changing routine practice.

Tourism businesses experienced this weakness through slow approvals and the need to engage several authorities sequentially, increasing the time and effort required to develop or adjust tourism activities.

Governance processes and local feedback

Participants consistently described a governance system in which rules and policy directions moved more clearly from national institutions to destinations than local experience moved back into decision-making. Businesses and communities attended consultations and interacted with local authorities, but several participants were uncertain whether their contributions influenced final decisions. A Victoria Falls business participant stated:

“We are occasionally consulted, but not as often as we should be. Sometimes it feels like decisions are made without fully understanding the practical challenges we face. Operators like us have firsthand experience with what works and what does not, so our input could definitely help shape more effective regulations.” (Tourism business representative, Victoria Falls)

The problem was not whether consultation occurred, but whether it occurred early enough to influence decisions and whether participants received feedback on the outcome. In Binga, a participant similarly described consultations that did not reliably shape higher-level decisions:

"We need to be asked what we think about tourism developments, not just told what is happening after the decisions are made." (Community representative, Binga)

This shows that stakeholders were not entirely excluded from decision-making, but opportunities to provide feedback were irregular and rarely followed by a clear response. Participants could not identify a consistent process for communicating whether locally raised concerns had been addressed, declined or referred to another institution. Access to formal meetings was also uneven, as established organisations were generally better placed to participate than small businesses and geographically dispersed communities. Thus, practical experience from the local level did not always reach the institutions responsible for policy and regulatory decisions.

Destination-level variations in institutional coordination

The cross-case comparison shows that a common national framework does not generate identical governance conditions. The same laws and national agencies interact with different levels of institutional presence, stakeholder networks and administrative access in each destination. Table 3 summarises these differences.

Table 3. Place-specific coordination conditions across the three study sites (Source: Authors' analysis)

Site	Institutional setting	Main coordination challenge	Priority response
Victoria Falls	Dense presence of regulators, established operators and environmental actors	Multiple agencies and sequential processes create congestion and delays	Coordinate approvals, monitoring and operator feedback
Hwange	Strong protected-area and conservation partnership networks	Local government and community influence is uneven within a park-centred system	Link conservation networks to a broader destination forum
Binga	Thinner institutional presence and greater administrative distance	Weak routes for local concerns, support and follow-up	Strengthen district coordination, outreach and formal feedback channels

Victoria Falls had the densest interaction among regulators, operators and environmental actors. This institutional presence improved access to agencies and made joint activity more feasible, but it also created coordination pressure because several authorities could become involved in the same proposal or issue. Businesses described administrative delay and consultation that did not always lead to visible responses. The central problem in Victoria Falls was therefore coordination among co-present institutions rather than the absence of governance actors. Hwange displayed strong conservation relationships centred on the protected area. Tourism businesses described partnerships with conservation organisations that supported monitoring, compliance, training and community initiatives. These networks provided practical capacity, yet formal governance remained strongly shaped by protected-area priorities.

Participants still reported top-down communication and limited influence over some regulatory decisions. The main challenge was to connect existing conservation networks more consistently with local government, tourism enterprises and community interests at destination level. In Binga, fewer institutions were directly involved in tourism governance, coordination therefore relied mainly on the local authority, community leaders and relationships developed through individual projects. Participants reported limited opportunity to influence policy, weaker implementation support and greater distance from national institutions. Remoteness was not the only problem, but it made coordination more difficult because there were fewer routine opportunities through which local concerns could be transmitted, interpreted or followed up. Therefore, Binga faced both a coordination problem and a capacity problem.

Bridging roles of NGOs and tourism businesses

Across the cases, NGOs and tourism businesses helped connect institutions and stakeholder groups. NGOs supported environmental assessment, training, community engagement and advocacy, while businesses translated regulatory requirements into day-to-day operations and sometimes contributed to conservation monitoring and local development projects. One NGO participant described this intermediary role directly:

"Feedback is provided to government on how these laws are being implemented on the ground, which helps to make sure that our advocacy is not only aligned with the laws and policies but also practical and reflective of community needs." (Environmental NGO representative, national level)

These bridging roles strengthened communication where formal channels were weak, but their limitations were also clear. NGO projects depend on funding, business participation varies, and neither group can guarantee that public agencies will respond to local concerns. Non-governmental actors can therefore support coordination, but they cannot replace clear public responsibility, predictable institutional processes or sustained government presence across destinations.

DISCUSSION

The findings suggest that Zimbabwe does not lack institutions or regulations for governing ecotourism. Responsibilities are already distributed among specialised government agencies, local authorities, community structures and non-state organisations. The main difficulty lies in coordinating their work when mandates intersect. Differences in

priorities, infrequent joint activities and limited resources often weaken implementation, even though formal institutions and regulations are in place. Comparable research on developing-country and forest-based ecotourism identifies fragmented governance, overlapping regulation and uneven institutional capacity as recurring implementation barriers (Forje et al., 2022; Lawasi et al., 2025; Wondirad et al., 2020). Sentanu et al. (2023) likewise found that participation and communication contribute to tourism governance only when they are supported by arrangements that enable stakeholders to coordinate decisions and carry them through. The findings help explain why establishing another committee would not, on its own, resolve coordination problems. Participants were already aware of joint initiatives, meetings and inspections, but reported that these activities were irregular and often limited by a lack of resources. Improving coordination therefore depends less on creating new structures than on making existing arrangements work consistently. Institutions need clearly defined roles, workable procedures for making and implementing joint decisions, and sufficient resources to undertake shared activities. This finding is consistent with Harilal et al. (2025), who identify communication, clarity of stakeholder roles and cohesion as important to inclusive tourism development.

The findings also indicate that decision-making within Zimbabwe's ecotourism governance system remains largely top-down. Although consultation took place, participants generally felt that they had little influence over final decisions and received limited feedback afterwards. Being invited to meetings did not necessarily amount to meaningful participation, what mattered was whether the views and practical knowledge shared by communities and implementers were considered, and whether institutions explained how this input informed their decisions.

Attendance at meetings did not necessarily amount to meaningful participation; influence, responsiveness and evidence that local knowledge shaped decisions mattered more. Similar patterns of centralised decision-making and passive community participation have been reported in South Africa and Uganda (Makhanyela et al., 2024; Nabalegwa et al., 2025). Dangi & Petrick (2021) similarly identify representation, responsiveness and collaborative participation as important elements of sustainable community-based tourism governance. Mpofu & Van Der Merwe (2025) also emphasise the need for more meaningful community participation in tourism planning in Hwange. Comparable evidence from KwaZulu-Natal shows that centralised administration, fragmented stakeholder relationships and weak coordination can limit meaningful community participation in ecotourism development (Makhanyela et al., 2024).

Improving participation may therefore depend less on creating additional consultation forums and more on ensuring that existing consultations lead to clear responses. Local authorities, community organisations and tourism businesses often encounter implementation problems first and can bring these concerns to the attention of responsible institutions. However, their contribution has little effect when issues raised during consultation are not recorded, referred or followed up. Institutions could address this by documenting the main concerns raised, assigning responsibility for each issue and reporting back on the action taken. NGOs may help communicate community and technical concerns, but the relevant public institution should remain responsible for providing a response.

The comparison shows that coordination challenges take different forms across the three destinations. In Victoria Falls, the large number of institutions involved can lead to overlapping procedures and difficulties in aligning their activities. Hwange benefits from established conservation partnerships, although coordination needs to extend beyond institutions and organisations centred on the national park. In Binga, links with national institutions are less frequent, leaving local actors with less access to the institutional support needed to address tourism and conservation issues. These findings support recent studies showing that multi-level governance is shaped by local conditions and that the same national policy may be implemented differently from one destination to another (Guo & Li, 2025; Novalia et al., 2025). They are also consistent with Zimbabwean studies that identify geographical differences in sustainability practices and continuing challenges surrounding community participation in Hwange (Mpofu & Van Der Merwe, 2025; Shereni & Rogerson, 2023).

This does not mean that each destination requires separate environmental or tourism legislation. Common national standards remain necessary to ensure consistency and public accountability. However, the support required to meet those standards will differ between destinations. Victoria Falls may benefit from clearer procedures for coordinating the many institutions already present, while Hwange requires stronger connections between park-centered partnerships and the wider district. Related research within the KAZA conservation network shows that local and sectoral partnerships vary with community agency, institutional context and power, supporting stronger links between local collaboration and higher governance levels (Tichaawa & Lekgau, 2025). In Binga, the priority is to improve access to national institutions and strengthen local administrative capacity. Applying the same administrative response across all three destinations could therefore place those with fewer resources and weaker institutional connections at a further disadvantage.

This study makes an empirical contribution by bringing together evidence from 39 interviews with government and parastatal officials, environmental and conservation organisations, tourism businesses and community representatives.

Considering these perspectives together shows how the same coordination problem can be experienced differently across the sector. Overlapping responsibilities within government may result in delays for tourism operators, limited opportunities for communities to influence decisions and additional pressure on NGOs to connect institutions and local stakeholders. The study therefore presents a broader account of how ecotourism governance operates in practice rather than examining it from the perspective of a single group. The comparison of Victoria Falls, Hwange and Binga also adds an important geographical and comparative contribution. Although all three destinations are governed under the same national legal and policy framework, coordination does not work in the same way in each place. Victoria Falls illustrates how the presence of many institutions can create overlapping procedures and make coordination difficult.

Hwange benefits from established conservation partnerships, but these relationships remain largely centred on the national park. In Binga, distance from national institutions and limited institutional presence reduce access to support

and opportunities to provide feedback. The findings therefore show that governance can vary considerably within one country, even where the same laws and policies apply (Guo & Li, 2025; Novalia et al., 2025).

The findings also have practical contribution, they suggest that Zimbabwe's immediate priority is not necessarily to create additional institutions, but to improve how the existing ones work together. This requires clearer responsibilities where mandates overlap, more regular and adequately resourced joint activities, stronger obligations to respond to concerns raised by local stakeholders, and greater support for destinations with limited institutional capacity.

The study shows that effective ecotourism governance depends on more than the existence of appropriate laws and organisations. It also depends on the working relationships through which institutions coordinate decisions, respond to local concerns and implement policy in different destinations.

The findings suggest four practical steps for improving coordination; at the national level, institutions responsible for tourism, environmental management and wildlife should develop a shared protocol for handling ecotourism proposals and recurring governance issues. This protocol should identify the lead institution, the information required from each agency, expected timeframes and procedures for resolving disagreements. Where a proposal requires approval from several agencies, assessments should be coordinated as far as the law allows to reduce unnecessary duplication for applicants. Coordination also needs to be strengthened at the destination level. Existing forums and partnerships should operate through agreed work programmes, designated responsibilities and sufficient budgets for implementation, rather than meeting only when a particular issue arises. The focus should reflect local conditions. In Victoria Falls, priority should be given to coordinating approvals, monitoring activities and responses to concerns raised by operators. In Hwange, conservation partnerships need stronger links with local government and community interests. Binga would benefit from more regular engagement and stronger connections between district institutions and national agencies.

Consultation should also be followed by a clear response, records of engagement should state the concern raised, the institution responsible for addressing it, the decision reached and any further action required. Communities and local businesses should be involved early enough for their knowledge to inform decisions, especially where proposed developments may affect land use, livelihoods or conservation responsibilities. The allocation of coordination resources should consider administrative distance and local institutional capacity, rather than being determined mainly by tourism volumes. More remote destinations may need additional technical assistance, visits from national officials and opportunities to participate remotely if they are to meet national requirements. NGOs and tourism businesses can continue to provide technical support and assist communication among stakeholders. However, responsibility for public decisions and for responding to concerns raised by stakeholders should remain with the relevant public institution.

CONCLUSION

This paper examined how relationships among institutions and stakeholders at different levels influence ecotourism governance in Victoria Falls, Hwange and Binga. Zimbabwe has an extensive set of laws, public agencies, local authorities and non-state organisations involved in tourism, environmental management, wildlife conservation and local governance. However, these arrangements do not always work together effectively during implementation.

Participants described overlapping responsibilities, competing institutional priorities, irregular joint activities and limited resources. They also reported that concerns raised locally did not always reach the institutions responsible for making decisions or receive a clear response. The comparison shows that these challenges differ across destinations, in Victoria Falls, the involvement of many institutions can result in overlapping procedures and difficulties in coordinating approvals and monitoring. Hwange benefits from established conservation partnerships, but these relationships remain largely centred on the national park and need stronger connections with local government, businesses and communities. In Binga, local actors have fewer regular links with national institutions and less access to technical support and decision-makers. The same national governance framework is therefore implemented under very different local conditions.

The findings do not point to an immediate need for additional institutions. Instead, they show the importance of improving how existing organisations work together. Responsibilities need to be clearer where mandates overlap, and joint activities require regular funding and agreed procedures. Approval and monitoring processes should be better coordinated, while communities and businesses should be involved early enough for their knowledge to inform decisions. Institutions should also report back on concerns raised during consultation.

The form of support provided should reflect local capacity, with less-connected destinations receiving greater assistance in accessing national institutions and meeting common standards. The study shows how coordination problems are experienced across institutional boundaries, through bringing together the experiences of government agencies, local authorities, communities, NGOs and tourism businesses.

Its comparison of three destinations also demonstrates that the effectiveness of multi-level governance depends on local institutional conditions as well as national laws and policies. For Zimbabwe, stronger coordination would improve more than administrative efficiency. It would help ensure that conservation priorities, tourism development and local interests are considered together. Ecotourism governance will be more effective and legitimate when institutions communicate consistently, follow through on joint decisions, respond to local concerns and remain accessible to destinations with weaker institutional connections.

LIMITATIONS AND FUTURE RESEARCH

This study was designed to generate analytical insights rather than findings that can be statistically generalised to all ecotourism settings in Zimbabwe. It draws on 39 semi-structured interviews with purposively selected participants.

Although the interviews included several stakeholder groups, individual accounts cannot be assumed to represent every view within an organisation or stakeholder category. Victoria Falls, Hwange and Binga also provided useful contrasts, but they do not reflect the full range of conditions found across Zimbabwe's ecotourism destinations.

Future research could examine whether similar coordination challenges occur in other protected areas, borderland and community-based tourism settings. Longitudinal studies would help establish how relationships among institutions change as tourism and environmental governance reforms are implemented.

Social network analysis could provide a more systematic picture of which actors interact, how frequently they communicate and where influence is concentrated. Participatory research could also explore how communities experience consultation, representation, feedback and accountability over time.

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COMMUNITY INVOLVEMENT IN SUSTAINABLE TOURISM DEVELOPMENT BOOSTS RESIDENTS' WELL-BEING: INSIGHTS FROM WESTERN KENYA

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Abstract: Sustainable tourism affects host communities through interactions with tourists and other stakeholders, generating both benefits and costs for local residents. This study aims to examine how community involvement in community-based sustainable tourism development influences residents' overall well-being in Western Kenya, with particular attention to the mediating roles of support for tourism and community perceptions. The study addresses the limited empirical evidence on how these factors jointly shape residents' well-being in tourism contexts in developing regions. The study was guided by Social Exchange Theory and used a purposive sampling strategy. Quantitative data were collected using a structured questionnaire. A total of 400 questionnaires were administered, of which 310 complete responses were retained for analysis representing a 77.5% response rate. The data were analysed using a binary logistic regression model to assess the effects of community involvement, support for tourism, and community perceptions on overall well-being. The findings show that community involvement significantly improves residents' overall well-being, increasing it by 10.77%. Support for tourism and positive perceptions contributed an additional 1.5% and 0.5%, respectively. Interaction effects further revealed that community involvement combined with support increased well-being by 2.3%, while involvement combined with positive perceptions increased well-being by 6.8%. These findings provide empirical support for the application of Social Exchange Theory by demonstrating how participation, perceptions, and tourism support are associated with residents' well-being in the Western Kenyan context. These results suggest that active community participation, favourable perceptions, and stronger support for tourism are important drivers of improved well-being. The study, therefore, highlights the need for inclusive tourism policies and community-centred strategies that strengthen local participation and benefit-sharing mechanisms to enhance sustainable tourism development in Western Kenya.

Keywords: community participation, sustainability, tourism strategy, Social Exchange Theory, logistic regression, community-based model

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INTRODUCTION

Community involvement in sustainable tourism development planning has long been recognized as a pathway for empowering residents to participate in decision-making and implement strategies that advance desired socioeconomic outcomes (Riyanto et al., 2023). As a bottom-up approach, community involvement addresses issues directly shaping the tourism experience and fosters a development environment aligned with local social and cultural contexts (Park et al., 2017). Importantly, such involvement protects the community's environment and cultural heritage while simultaneously enhancing socioeconomic well-being. These benefits explain why community-based sustainable tourism has attracted growing scholarly and policy attention (Nuanmeesri, 2022; Mohammed & Osumanu, 2022).

Across developing contexts, community-based tourism has demonstrated potential for poverty alleviation, livelihood diversification and improvements in local welfare (Mohammed & Osumanu, 2022; Priatmoko et al., 2025).

Tourism generates markets for local goods and services and provides diverse occupational opportunities that improve community well-being (Dogra et al., 2022; Wani et al., 2024). Achieving sustainability, however, requires balancing tourism's economic, environmental, and sociocultural dimensions (Li et al., 2021; Wani et al., 2023).

When practiced sustainably, community-based tourism reduces problems while maximizing benefits for local communities (Dogra et al., 2022). For these reasons, developing nations have increasingly embraced it as a strategy for advancing socio-economic resilience (Wani et al., 2024).

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Despite its conceptual advancement, empirical evidence on the socioeconomic impacts of community-based sustainable tourism remains limited (Jugmohan & Giampiccoli, 2017; Wani et al., 2024). Rural communities, small islands, fishing villages, and indigenous groups could benefit substantially from such models (Wang et al., 2016; Watts et al., 2022). However, the success of these initiatives hinges on residents' active participation across decision-making, implementation, and evaluation processes (Wu et al., 2019; Rahman et al., 2024). Stakeholder-driven involvement not only fosters more effective, sustainable ecotourism but also enhances human well-being (Tseng et al., 2019). Indeed, community support is strongly shaped by residents' perceptions of tourism's economic, social, and environmental impacts (Dündar & Karacaer, 2024).

Tourism development can transform community values, lifestyles, and quality of life, often with both positive and negative outcomes (Rasoolimanesh et al., 2017; Sharpley, 2014; Mathew, 2022). Economically, it can create jobs, diversify income sources, and stimulate empowerment, but may also raise living costs and exacerbate property pressures (Dinis et al., 2019; Rasoolimanesh et al., 2015). Socially, tourism can enrich entertainment, recreation, and cultural identity (Mayaka et al., 2019; Su et al., 2017), while also causing congestion, crime, pollution, displacement, or cultural erosion (Alamineh et al., 2023; Látková & Vogt, 2012). On the cultural front, it can heighten global visibility and pride in local heritage (Gursoy et al., 2019), yet it must carefully balance preservation with tourism pressures (Ashworth & Page, 2011).

Both rural and urban contexts illustrate these dynamics. In rural areas, community-based tourism supports farming, services, and crafts while promoting cultural identity (Polukhina et al., 2021). Empirical studies confirm its potential for stable job creation, income growth, and poverty alleviation (Atun et al., 2019; Cheng & Zhang, 2020; Chen et al., 2022; Cunha et al., 2020) but also highlight risks such as income inequality and uneven spatial development (Zhang et al., 2023; Liu et al., 2022). In urban areas, tourism interacts with complex social and economic systems. While it can boost infrastructure, cultural tourism, and socio-economic well-being (Shin, 2010; Jaafar et al., 2020; Tan et al., 2023; Ma et al., 2020), excessive tourism threatens urban liveability, widening wage gaps, and limiting long-term benefits (Ananian et al., 2018; Ashworth & Page, 2011; Rasoolimanesh et al., 2017; Shi et al., 2020; Liu et al., 2023).

To explain these mixed outcomes, Social Exchange Theory (SET) offers a valuable lens. SET posits that individuals engage in exchanges to maximize benefits and minimize costs, making it well-suited to analyze residents' attitudes towards tourism. Community attachment,empowerment and a sense of belonging, increase residents' willingness to support and participate in tourism initiatives (Olya et al., 2018; Khalid et al., 2019; Strzelecka et al., 2017; Durrah et al., 2025). Similarly, residents' perceptions of economic growth, cultural enrichment, and social improvements positively influence support, whereas perceived costs reduce it (Chili, 2015; Pazhuhan et al., 2023; Megawati et al., 2025). Participation and inclusive governance further enhance legitimacy and sustainability (Choi & Murray, 2010; Dündar & Karacaer, 2024).

Against this backdrop, understanding the role of community involvement in shaping well-being through sustainable tourism becomes crucial. This study applies SET to explore how community attachment, perceived benefits, empowerment, participation, and environmental stewardship affect residents' support and overall well-being in Western Kenya. Applying SET to Western Kenya underscores the importance of community attachment, perceived benefits, empowerment, participation, and environmental stewardship in shaping residents' support for sustainable tourism. These factors collectively contribute to improved well-being, stronger engagement, and more effective, community-driven tourism development. The integration of SET not only contextualises local behaviour but also adds scientific value by linking psychosocial theories with empirical development outcomes. Therefore, this has paved the way for a probable research gap worth filling in this study.

We focused on community-based sustainable tourism practices among residents in Western Kenya, one of the regions where the country's development is being explored. Understanding the effects of community involvement in community-based sustainable tourism development on overall well-being can provide valuable insights into the interplays between local communities and sustainable tourism development from a specific geographical setting.

The aim of this study is to examine how community involvement in community-based sustainable tourism development influences residents' overall well-being in Western Kenya, with particular attention to the mediating roles of community perceptions and support for tourism development. More specifically, the study aims to contribute to the literature by addressing the following research questions:

i. To what extent does community involvement in community-based sustainable tourism development influence their overall well-being?

ii. Do perceptions mediate the relationship between involvement and well-being?

iii. What is the mediating effect of support for community-based sustainable tourism development on the nexus between community involvement and their overall well-being? By addressing these dynamics in a developing region context, this research responds to calls for more empirical evidence on the socioeconomic impacts of community-based sustainable tourism. It contributes to advancing both theory and practice.

MATERIALS AND METHODS

Study Area

The study was carried out in Western Kenya, covering Bungoma, Busia, Kakamega, Trans-Nzoia, and Vihiga counties, with a focus on Bungoma County due to its active tourism sector and diverse attractions. Bungoma (area ≈ 3,032.4 km²) hosts a range of cultural and natural sites (Mount Elgon National Park, Kitum Cave, Nabuyole Falls, Chetambe Fort, etc.) and a predominantly agricultural economy (County Government of Bungoma, 2023; Mamati & Omare, 2024; Downing et al., 2023; Kariithi, 2018). Local livelihoods combine farming with tourism-linked activities (guiding, hospitality, cultural performances, and handicrafts), making the county a suitable case for examining how community involvement in tourism relates to residents' well-being (Oduya, 2017). Figure 1 presents the study area in

Western Kenya, including the selected counties and the focal case of Bungoma County.Western Kenya, including the selected counties and the focal case of Bungoma County. Figure 2 shows selected original field photographs of tourism resources and community-related tourism activities linked to the study objectives.

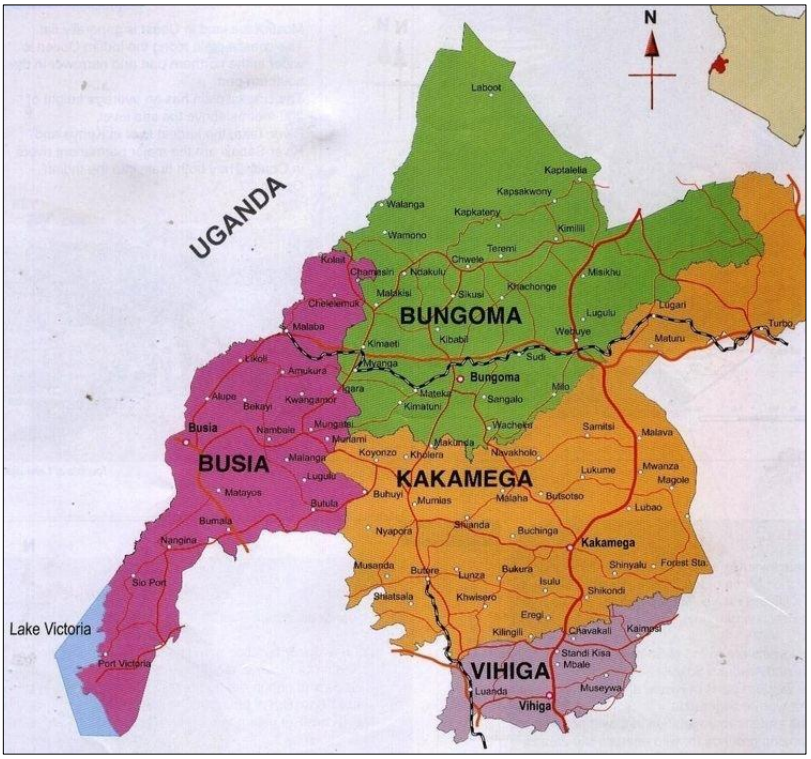


Figure 1. Geographical location of the study area in Western Kenya (Source: Retrieved from Alchetron)



Figure 2. Community-related tourism activity (Source: Photos by the author, taken during fieldwork, 2024)

Data Collection and Sampling

Data were collected using a structured questionnaire adapted from recent studies on community involvement, perceptions, tourism support, and well-being (e.g., Eslami et al., 2019; Gursoy et al., 2002; Riyanto et al., 2023). The questionnaire comprised four sections: (1) socio-demographic information (age, gender, education, monthly income (KES), residence, occupational engagement with tourism); (2) community involvement in tourism; (3) perceptions of sustainable tourism (positive and negative); and (4) overall well-being. Most attitudinal items used a 5-point Likert scale (1 = strongly disagree … 5 = strongly agree). Participants provided informed consent prior to completing the survey. A purposive, multi-stage approach targeted households and individuals engaged (directly or indirectly) in community-based tourism across the five counties, with Bungoma selected as a primary study site for its representativeness and accessibility. The sampling frame used 2019 Census household figures for the selected areas (N ≈ 358,796). Using Israel's (1992) formula for sample size estimation,

$$n = \frac{N}{\left(1 + N(e^2)\right)}$$

were n = sample size, N = target population size, e=level of precision (5%)

$$\text{Thus, } n = \frac{358{,}796}{\left(1+358{,}796(0.05^2)\right)} = 400$$

A total of 400 questionnaires were administered; 90 questionnaires were incomplete and therefore excluded, leaving 310 complete responses for analysis (final response rate = 310/400 = 77.5%).

Ethical considerations

Respondents were informed about the study's purpose and provided consent. Survey participation was voluntary and anonymous; no identifying data beyond institutional contact details for the corresponding author were recorded. Where required, local permissions and approvals were sought.

Analytical Approach

The study applied descriptive and inferential statistics in analysing the collected data. Specifically, the demographic and socioeconomic attributes of households were analysed descriptively using percentages and frequencies, as well as means and standard deviations. Community involvement, tourism support, perceptions, and overall well-being were analysed and presented in figures. The qualitative data were analysed synthetically by summarizing familiar thematic texts.

Regarding the effect of community involvement on the overall well-being of the households, the four-item questions were summed into a score, out of which 1-stronly disagree and disagree scores were merged to imply a negative response "no" denoted by zero, and agree and strongly agree were merged into a positive answer "yes" denoted by 1. This also applied to supporting community perceptions of sustainable community-based tourism and encouraging households to support it. Since the outcome variable (household well-being) was binary, the study employed a binary logistic regression model to analyse the effect of involvement in community-based tourism, as well as the mediating effects of support for tourism and perceptions of the community. Binary responses on overall well-being were used to provide a detailed view of the influence of community-based tourism involvement. The binary logistic model was applied in this study because it is helpful for analysing binary variables and is flexible in handling a mixture of continuous and categorical variables (Agresti, 2010; Jari & Fraser, 2009). Following Agresti (2010), the binary logistic regression model was specified as follows:

$$Wi = In\left(\frac{P\pi i}{1 - P\pi i}\right) = \beta 0 + \beta 1 Com - invo1 + \beta 2 Com - invo * Sup2 + \beta 3 Com - invo * Perc3 + \beta c Xc + \mu i$$

Where Wi denotes well-being, $Com - invo$ denotes community involvement, $Com - invo * Sup$ denotes interaction between community involvement and support for community-based sustainable tourism, $Com - invo * Perc$ indicates interaction between community involvement and community perceptions of tourism, $P\pi i$ denotes the probability of positive well-being, and $1 \neg P\pi i$ is the probability of negative well-being, $\beta 0$ denotes the intercept, $\beta 1, \beta 2, \beta 3, \beta c$ denotes coefficient estimates of community involvement, interaction between community involvement and support, community involvement and perceptions and household covariates (marital status, education level, gender, age, residence and average monthly income). The error term is denoted by μi . The subscript i denotes households $i = 1, \ldots, 310$.

RESULTS AND DISCUSSION

Descriptive and Summary Statistics

Table 1 provides a detailed description of the study variables. The social-demographic variables indicate that more than half (50.2%) of the sampled respondents were female, while 49.8% were male. The majority (75.7%) of households resided in urban regions. The majority (96.1%) of household heads have a tertiary level of education, with an average monthly income of KES 14,371.84. More than half (84.1%) of the sampled household heads were unmarried, while the majority (71.9%) engaged in community-based tourism as an economic activity.

Results show that 60.3% of respondents are involved in community-based tourism, and 64.5% are involved in its development. This highlights strong local engagement in sustainable tourism practices. Lastly, the majority (61.3%) of

respondents have a positive perception of community-based tourism development. Altogether, we can state that not only do respondents support this, but the majority are looking for positive changes and are ready for the challenge.

Table 1. Socioeconomic Characteristics of Sampled Households
(Source: Author's own construction based on survey data, 2024) *Note: KES denotes Kenyan Shillings

Variable	Description	(n=310)	(%)	Min	Max	Mean	Std. Dev
Household head gender	Male =1	152	49.8%				
	Female =2	153	50.2%				
Tourism involvement status	No =0	87	28.1%				
	Yes =1	223	71.9%				
Household residence	Rural =0	75	24.3%				
	Urban =1	234	75.7%				
Household head's education level	No/primary education=0	7	2.3%				
	Secondary=1	5	1.6%				
	Tertiary =2	297	96.1%				
Average monthly income (KES)				0	10 0000	14 372	21 451
Household head marital status	Unmarried =0	260	84.1%				
	Married =1	49	15.9%				
Household head age in years	18-25 years=1	134	43.2%				
	26-35 years=2	105	33.9%				
	36-45 years=3	47	15.2%				
	46-55 years=4	22	7.1%				
	56+ years=5	2	0.7%				

Effect of Community Involvement on Overall Community Well-being: Binary Logistic Estimation

The effect of community involvement, along with other household characteristics, on residents' overall well-being was modelled using a binary logistic regression. Table 2 presents coefficient estimates, marginal effects, standard errors, and corresponding significance levels. The likelihood ratio value of -207.334 indicates that the binary logistic model and the selected independent variables accurately fit the collected data, suggesting that the probability of positive overall well-being, along with the explanatory variables, collectively contributes to a comprehensive understanding of overall well-being in the community. The pseudo-R-squared value of 0.4987, with a statistically significant ($P < 0.05$) greater LR Chi-square value of 3.880, indicated that the estimated logistic regression model has adequate explanatory power; hence, the model's information is appropriate. Table 2 shows that community involvement significantly predicts' well-being ($\beta = 0.431$, $p < 0.05$).

Table 2. Summary of Binary Logistic Regression Model: Effect of Community Involvement on Overall Well-being
(Source: Author's own construction using survey data and STATA software, 2024)

Variable	Coefficient	Marginal effect	Std. Err	Z	P-value>|Z|
Community involvement	0.431**	0.1077**	0.244	1.76	0.018
Tourism support	0.062**	0.015**	0.248	0.25	0.003
Positive perceptions	0.019***	0.005***	0.260	0.07	0.041
Negative perceptions	-0.094*	-0.023*	0.244	-0.38	0.027
Household head gender	0.098**	0.024**	0.257	0.40	0.000
Household head age	-0.042**	-0.017**	0.131	-0.32	0.055
Household head marital status	-0.034	-0.010	0.339	-0.22	0.902
Household average monthly income	1.83e-6	4.58e-07	5.7e-6	0.56	0.750
Household head's education level	-0.058	-0.014	0.382	-0.14	0.880
Constant	-0.218		0.861	-0.25	0.800
LR Chi2 (9)	3.88				
Prob > Chi^2	0.0000				
Pseudo R^2	0.4987				
Log Likelihood	-207.334				
No. of Observations	310				

Community involvement was a significant positive predictor of residents' overall well-being at the 5% significance level. Specifically, community involvement had a positive effect on well-being ($\beta = 0.431$; $P = 0.018 \leq 0.05$). The marginal effect indicates that an increase in the number of community members involved in tourism results in a 10.77% increase in residents' overall well-being, holding other factors constant. This is because community involvement in community-based tourism reflects the extent to which residents participate in tourism-related activities, thereby influencing their overall well-being (Riyanto et al., 2023). These results align with previous studies (Abukhalifeh & Wondirad, 2019; Lee & Jan, 2019; Riyanto et al., 2023). The findings also revealed that support and positive perceptions of community-based tourism are significant positive predictors of residents' overall well-being. These findings align with those observed in recent studies (Chang, 2021; Han et al., 2023; Riyanto et al., 2023).

Interestingly, the marginal effects indicate that increases in support for and positive perceptions of community-based tourism development are associated with 1.5% and 0.5% increases in residents' overall well-being, respectively. Indeed, when the residents are informed or are privy to the perceived positive effects of sustainable community-based tourism, their lives are affected emotionally, materially, safety-wise, and health-wise, which ultimately influences their overall well-being (Andereck & Nyaupane, 2011; Woo et al., 2015; Eslami et al., 2019; Han et al., 2023; Kim et al., 2013).

The results indicated that household head age and community negative perceptions were significant negative predictors of residents' overall well-being. Specifically, the marginal effects indicate that a 100% increase in household heads and negative perceptions results in a decline in residents' overall well-being of 1.7% and 2.3%, respectively.

These results align with the findings of Rasoolimanesh et al. (2017), who found that a negative perception of the socioeconomic impact of community-based tourism leads to reduced community involvement and support for tourism, ultimately affecting overall well-being. Furthermore, the findings confirm the views of Hunt & Stronza (2014) that residents who are not fully involved in community-based tourism tend to hold a more negative attitude towards it, thereby negatively influencing their overall well-being. On the other hand, household gender had a positive and significant effect on residents' overall well-being (β=0.098; P=0.000≤0.05), implying that an increase in male-headed households by 100% results in an increase in residents' overall well-being by 2.4% as indicated by the marginal effects.

Mediating Roles of Tourism Support and Community Perceptions: Binary Logistic Estimation

The study also examined the mediating role of support and community perceptions in the impacts of community-based tourism development. In particular, the need to have a deeper understanding of how community involvement in community-based sustainable tourism development has pushed many researchers to investigate the role played by the community's perceptions and support for sustainable tourism development in influencing their involvement and their overall well-being (Nawijn & Mitas, 2012; Koh et al., 2020; Riyanto et al., 2023). Specifically, studies have started examining the mediating effect of community perceptions and support for community-based sustainable tourism development (Gannon et al., 2021; Han et al., 2023; Riyanto et al., 2023; Tosun et al., 2021). The study started by classifying community perceptions into positive and negative perceptions, where previous studies have observed a significant positive link between positive perceived socioeconomic impacts of tourism and residents' overall well-being (Eslami et al., 2019; Han et al., 2023; Kim et al., 2013; Riyanto et al., 2023; Woo et al., 2022).

Table 3. Mediating Effect of Community Perceptions and Support for Tourism Development on Overall Well-being (Source: Author's analysis using survey data, 2024) (Note: ***p < 0.01; **p < 0.05; *p < 0.1)

Variable	Coefficient	Marginal effect	Std. Err	Z	P-value>|Z|
Community involvement	0.275**	0.069**	0.576	0.48	0.033
Tourism support	0.003**	0.001**	0.388	-0.01	0.000
Positive perceptions	0.154	0.039	0.426	0.36	0.718
Negative perceptions	-0.021	-0.005	0.394	-0.05	0.957
Community involvement*Support	0.092**	0.023**	0.508	0.18	0.046
Community involvement*Positive	0.271***	0.068***	0.545	0.50	0.020
Community involvement* Negative	-0.182	-0.045	0.486	-0.37	0.708
Household head gender	0.094	0.023	0.252	0.37	0.600
Household head age	-0.038*	-0.010*	0.133	-0.29	0.017
Household head marital status	-0.071	-0.018	0.342	-0.21	0.836
Household average monthly income	1.81e-6**	4.52e-7**	5.76e-6	0.31	0.053
Household head's education level	0.046	0.011	0.383	0.12	0.079
Constant	-0.134		0.943	-0.14	0.887
LR Chi2 (12)	4.32				
Prob > Chi^2	0.0105				
Pseudo R^2	0.2770				
Log Likelihood	-207.113				
No. of Observations	310				

On the other hand, inadequate planning and management of community-based tourism development led to negative perceptions, which ultimately impact the overall well-being of residents (Xu & Hu, 2021). How the community perceives the socioeconomic impacts of community-based tourism development influences their support, and this has a significant influence on their overall well-being (Eslami et al., 2019; Han et al., 2023; Jeon et al., 2016; Latip et al., 2018; Riyanto et al., 2023; Yu et al., 2018). Table 3 highlights the mediating roles of perceptions and tourism support in the relationship between involvement and well-being, with positive perceptions exerting the greatest influence.

Accordingly, the findings indicate a positive and significant mediating role of positive perceptions in the link between community involvement and residents' overall well-being ($\beta = 0.271$; $P \leq 0.05$). The marginal effects indicate that a 100% increase in the interaction between community involvement and positive perception results in a 6.8% increase in residents' overall well-being, holding all other factors constant. The findings align with the observations made by previous studies that sociocultural natural interactions with tourists are significantly associated with positive perceptions among residents, thereby promoting positive lifestyles, safety, and higher life satisfaction in non-material well-being domains (Carneiro et

al., 2018; Han et al., 2023; Hu et al., 2022; Xu & Hu, 2021). On the other hand, the results indicated a positive and significant interactive effect between community involvement and community-based tourism development on residents' overall well-being ($\beta = 0.092$; $P = 0.046 \leq 0.05$). The marginal effects indicate that a 100% increase in the interaction between community involvement and support for community-based tourism development results in a 2.3% increase in residents' overall well-being, holding all other factors constant. These findings corroborate previous studies showing that communities' perceptions of socioeconomic impacts influence their support and involvement in tourism (Dodds et al., 2018; Wani et al., 2024) but also provide new insights by quantifying effect sizes. Specifically, community involvement increased residents' well-being by 10.77% with additional effects from support (1.5%) and positive perceptions (0.5%).

Interaction effects between community involvement and support raised well-being by 2.3%, while involvement combined with positive perceptions increased it by 6.8%. These proportions are notably higher than those reported in earlier studies focusing on qualitative or non-context-specific analysis. The study extends Social Exchange Theory by empirically validating that perceived benefits (economic and social) significantly drive community members to exchange their support and involvement in tourism for improved well-being. This model-based, data-driven evidence from a rural Kenyan context offers a differentiated contribution to the literature and provides a replicable approach for other developing regions. For instance, the development of community-based tourism infrastructure increases social interaction and experiences as well as socioeconomic gains, thereby influencing overall well-being (Carrie et al., 2022; Jeelani et al., 2024; Wani et al., 2024).

CONCLUSION

Community involvement and residents' goodwill are paramount for the success and sustainability of any community-based tourism development. To evaluate residents' overall well-being resulting from community involvement, perceptions, and support for community-based sustainable tourism development precincts, this study drew on social exchange theory.

It incorporated various constructs related to residents' overall well-being, involvement, perceptions, and support for community-based tourism development. The study findings revealed a significant positive effect of community involvement on residents' overall well-being. The results further indicated a significant positive mediating effect of support and community perceptions of community-based tourism development. Most importantly, the study revealed that community perceptions of the socioeconomic impacts of community-based tourism development influence their involvement and support, which ultimately affect their overall well-being, as summarized in Table 4.

Additionally, the study synthesizes the research questions, key statistical findings, and recommended policy actions.

Table 4. Summary of Research Questions, Key Findings, and Policy Implications
(Source: Author's summary based on study findings, 2024)

Research Question	Findings	Policy Implications
To what extent does community involvement influence well-being?	Community involvement increases well-being by 10.77%.	Develop programs to boost local participation in tourism planning and implementation.
Do perceptions mediate the relationship between involvement and well-being?	Positive perceptions add 0.5%; when combined with involvement, they raise well-being by 6.8%.	Launch education campaigns to promote awareness of tourism's benefits.
What is the mediating effect of support on involvement and well-being?	Support alone adds 1.5%, and with involvement, increases well-being by 2.3%	Strengthen local support through inclusive policy frameworks and benefit-sharing mechanisms.

It can be inferred that involvement in community-based tourism improves residents' lives and demonstrates appreciation for their local heritage by fostering socioeconomic transformations (Kim et al., 2013; Riyanto et al., 2023; Wani et al., 2024). Therefore, the study presents a clear picture that enhanced involvement and support for community-based tourism development among residents can be an effective tool for poverty alleviation, thereby increasing social well-being among rural households. Based on the observed positive impact of community involvement, positive perception, and support for community-based tourism on residents' overall well-being, it can be posited that policies and programs should be conceptualized and implemented to enhance the development of community-based tourism.

However, more cautious policy strategies are required to promote increased community-based tourism development, in line with the ideal local government incentives. The aims of community-based tourism development should prioritize the preservation and protection of local heritage, the environment, the local economy, and everyday life, thereby enhancing residents' social well-being. At the top of these policy incentives should be a focus on aiding rural communities' social well-being by implementing community-based tourism development strategies in a more sustainable manner, including identifying the most effective ways to implement this while minimizing potential adverse effects.

Although this study yielded several insightful findings relevant to policymaking and academic discourse, a few limitations need to be addressed by forthcoming studies. To begin with, the study used a small sample from only one of the five counties in Kenya. A slightly larger sample size can improve the generalizability of this study's findings. Thus, future studies can focus on larger sample sizes. Secondly, future studies can examine how factors such as stakeholder perceptions and the local government's role influence community-based tourism development.

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DIGITAL PROCUREMENT, RESILIENCE AND INCLUSIVITY IN TOURISM MSME SUPPLY CHAINS: A COMPARATIVE CONCEPTUAL STUDY OF SOUTH AFRICA AND CAMEROON

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Abstract: The tourism industry significantly contributes to economic growth, employment and inclusive development in Sub-Saharan Africa (SSA), with micro, small and medium enterprises (MSMEs) forming the backbone of tourism value chains. Despite their importance, tourism supply chains in the region remain fragmented and vulnerable to external shocks such as economic instability, health crises, climate-related disruptions and infrastructural constraints. Digital procurement has emerged as a strategic mechanism for improving operational efficiency, strengthening supply chain resilience, and promoting inclusive participation among historically marginalised groups, particularly women- and youth-led enterprises. However, limited research has examined digital procurement and its implications for supply chain resilience and inclusivity among tourism MSMEs in SSA from a comparative perspective. This conceptual paper comparatively examines digital procurement in tourism MSME supply chains in South Africa and Cameroon, focusing on its implications for resilience and inclusivity. Drawing on the Technology–Organisation–Environment (TOE) framework as an analytical lens, the study compares the technological, organisational, and environmental conditions that shape digital procurement opportunities and constraints in the two countries. The comparison highlights South Africa's more established digital ecosystem and Cameroon's developing but uneven digital environment, while recognising that MSMEs in both contexts continue to experience disparities in digital access, capabilities and institutional support. The analysis suggests that digital procurement's contribution to supply chain resilience and inclusivity is context-dependent and influenced by technological readiness, organisational capabilities, and the wider institutional environment. The study contributes to tourism supply chain and digital transformation literature by providing a context-sensitive comparative understanding of digital procurement in two distinct SSA settings. The findings offer practical insights for policymakers, tourism practitioners, and development agencies seeking to strengthen resilient and inclusive tourism MSME supply chains.

Keywords: digital procurement, supply chain resilience, inclusivity, tourism MSMEs, South Africa, Cameroon

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INTRODUCTION

Tourism is globally recognised as one of the most rapidly expanding economic sectors, serving as a primary catalyst for socio-economic development in numerous Sub-Saharan African (SSA) nations. The sector significantly contributes to gross domestic product (GDP), employment generation, foreign exchange earnings, and poverty reduction.

Micro, small, and medium-sized enterprises (MSMEs) constitute the predominant force within tourism value chains (United Nations World Tourism Organisation [UNWTO] and United Nations Development Programme, 2017; World Tourism Organisation [UNWTO], 2018; 2023). In countries such as South Africa and Cameroon, tourism MSMEs are pivotal in providing accommodation, transportation, tour operations, food services, cultural experiences and ancillary services, thereby supporting local livelihoods and fostering economic diversification. Shaikha Al Nowais, Secretary-General Elect of the United Nations World Tourism Organisation (UNWTO) for the 2026–2029 term indicated that in 2024, the travel and tourism sector accounted for 10% of global GDP (Travel & Tourism News Middle East, 2025), while in Sub-Saharan Africa, the sector contributed 6.4% of regional GDP in 2025 (World Travel & Tourism Council, 2026).

Notwithstanding their crucial role, tourism supply chains in SSA confront substantial challenges. These include fragmented supplier networks, inadequate infrastructure, restricted access to financial resources, deficient organisational support and increasing susceptibility to systemic disruptions. Such disruptions encompass the COVID-19 pandemic, economic instability, climate-related events, and geopolitical uncertainties (Christie et al., 2014; Organisation for Economic Co-operation and Development [OECD], 2020; 2022).

These vulnerabilities underscore the imperative for tourism enterprises to cultivate resilient supply chain systems capable of anticipating, responding to, recovering from and adapting to disruptions.

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Digital transformation has emerged as a critical strategic imperative for optimising organisational operations and supply chain management across diverse sectors (Shonubi, 2025). Within this paradigm, digital procurement is widely acknowledged as the application of digital technologies to streamline purchasing processes, enhance transparency, and improve supplier relationship management (Srai & Lorentz, 2019; Bienhaus & Haddud, 2018). Bienhaus & Haddud (2018) further posit that digital procurement tools, encompassing e-procurement platforms, electronic tendering systems, cloud-based procurement applications, and integrated enterprise resource planning systems, possess the potential to bolster coordination among supply chain actors and augment decision-making through enhanced visibility and data analytics capabilities.

Within the tourism sector, Bienhaus & Haddud (2018); Meyer et al. (2021); Zhao et al. (2023) observe that digital procurement practices can contribute significantly to supply chain resilience. This is achieved by facilitating quicker supplier identification, reducing transaction costs, enhancing communication flows and enabling more agile responses during periods of disruption through improved visibility, information sharing, and data-driven decision-making capabilities.

Furthermore, the International Trade Centre (2022) highlights that digital procurement may foster inclusivity by lowering market entry barriers and expanding participation opportunities for women- and youth-led enterprises, which frequently encounter structural impediments in accessing information, networks and formal procurement processes. As Dr. Hazel Gooding, United Nations (UN) Women South Africa deputy representative, articulated during the Women's Month 2025 celebration in South Africa, "When women have equal access to digital markets, entire communities thrive" (UN Women Africa, 2025). The integration of inclusivity considerations into digital procurement systems aligns with broader sustainable development goals aimed at mitigating inequalities and fostering equitable economic participation.

While the adoption of digital procurement has been investigated within broader MSME and public procurement contexts, existing scholarship predominantly focuses on technological adoption determinants and operational efficiency outcomes (Dumeh, 2025; Kaunda, 2025; Kalaba & Nakamba, 2026). Limited attention has been directed towards how digital procurement might influence both supply chain resilience and inclusivity specifically within tourism MSMEs in SSA. Crucially, comparative studies examining how disparities in digital infrastructure, organisational capabilities, and institutional environments shape digital procurement across African contexts remain scarce. This lacuna restricts a comprehensive understanding of whether the opportunities and constraints associated with digital procurement are uniform across countries or are shaped by their specific contextual nuances. To address these identified research gaps, this conceptual paper undertakes a comparative examination of digital procurement among tourism MSMEs in South Africa and Cameroon, with particular emphasis on its implications for supply chain resilience and inclusivity. South Africa is widely regarded as one of the continent's more digitally advanced economies, underpinned by relatively sophisticated information and communication technology (ICT) infrastructure and established digital business ecosystems (International Trade Administration, 2024). In contrast, Cameroon's digital development remains uneven across the country (World Bank, 2019; 2022), reflecting persistent infrastructural and institutional challenges that continue to influence digital participation. These contrasting contexts offer a valuable opportunity to investigate how differences in technological, organisational, and environmental conditions influence digital procurement adoption and its potential contribution to resilient and inclusive tourism MSME supply chains. The following objectives guide the present paper:

1. To examine digital procurement practices, opportunities, and challenges among tourism MSMEs in South Africa and Cameroon.
2. To compare the technological, organisational, and environmental conditions shaping digital procurement adoption among tourism MSMEs in the two countries.
3. To critically examine the implications of these similarities and differences for tourism MSME supply chain resilience and inclusivity.

This study offers three principal contributions. Firstly, it extends existing research on tourism digitalisation by specifically focusing on digital procurement and its potential implications for resilience and inclusivity. Secondly, it employs the Technology–Organisation–Environment (TOE) framework as an analytical lens to investigate how technological, organisational, and environmental conditions shape digital procurement among tourism MSMEs. Thirdly, by comparing South Africa and Cameroon, the study elucidates how variations in digital development, institutional environments, and MSME conditions may influence digital procurement opportunities and outcomes. In doing so, the paper provides context-sensitive insights that can inform policy interventions and investment strategies aimed at fortifying resilient, inclusive, and sustainable tourism value chains across SSA. The subsequent section reviews the pertinent literature on tourism MSME supply chains, digital procurement, supply chain resilience, and inclusivity. It then discusses the TOE framework as the theoretical lens guiding the comparative analysis. The paper proceeds to examine the South African and Cameroonian contexts and comparatively analyses the technological, organisational, and environmental conditions shaping digital procurement in the two countries. The discussion then considers the implications of these similarities and differences for supply chain resilience and inclusivity. The paper concludes by highlighting theoretical and practical implications, limitations, and directions for future research.

LITERATURE REVIEW

Tourism MSME supply chains

MSMEs form the bedrock of tourism economies across SSA, constituting approximately 80% of tourism businesses (Chamboko-Mpotaringa et al., 2025). Nevertheless, tourism MSMEs operate within highly fragmented and interdependent supply chains, frequently under resource-constrained conditions characterised by limited access to finance, weak organisational capabilities, inadequate infrastructure and varying degrees of informality, particularly within developing and

SSA contexts (Zhang et al., 2009; Kimbu & Tichaawa, 2020; Muluh & Lekgau, 2023; Chamboko-Mpotaringa et al., 2025). Chhetri et al. (2026) further observe that tourism supply chains encompass an interconnected network of suppliers, service providers, and intermediaries that deliver tourism experiences, ranging from accommodation and transport to catering, guiding, and craft production. For MSMEs, participation in these networks can facilitate collaboration, resource access, and value creation; however, their limited financial and organisational resources can also heighten their susceptibility to supply disruptions and external shocks (Rastegar et al., 2023; Seow et al., 2024). Consequently, for MSMEs, these chains represent both sources of opportunity and vulnerability. Within the African context, tourism MSMEs confront distinct structural impediments that constrain their effective participation in formal tourism supply and value chains.

These include restricted access to finance, elevated borrowing costs, fragmented value chains, substantial market-entry barriers, and insufficient investment and business-readiness support (Adinolfi et al., 2018; South Africa National Department of Tourism, 2022; International Labour Organisation, 2022). These challenges are particularly pronounced among women- and youth-led enterprises, which frequently encounter additional financial, socio-cultural, institutional, and network-related barriers that impede their engagement in tourism entrepreneurship and formal value chains (Ribeiro et al., 2021; Tryphone & Mkenda, 2022; Mametja et al., 2023; Ofosu-Appiah et al., 2025). Digitalisation presents a potential avenue for addressing these fragmentation challenges. Evidence from South Africa indicates that digitally enabled and collaborative approaches can enhance coordination, connectivity, and visibility within tourism supply networks (Sifolo, 2025). However, the realisation of digitalisation's benefits is contingent upon the specific context in which tourism MSMEs operate.

Digital procurement in tourism MSMEs

Despite the increasing body of research on digital transformation within the tourism sector, digital procurement remains comparatively underexplored, particularly concerning tourism MSMEs and its implications for supply-chain resilience and inclusivity in SSA (Chamboko-Mpotaringa et al., 2025; Sifolo, 2025). Digital procurement is defined as the application of digital technologies and integrated electronic systems to support procurement activities, encompassing supplier identification, sourcing, purchasing, contract management, invoicing and payment (Bienhaus & Haddud, 2018; Srai & Lorentz, 2019). The evolution of procurement from traditional paper-based systems to interconnected digital systems has fundamentally altered how businesses manage supplier relationships, optimise costs, and enhance operational productivity (Shonubi, 2025). The transformative potential of digital procurement lies in its capacity to address inherent inefficiencies within tourism supply chains. Traditional and weakly digitalised tourism supply chain practices are often characterised by fragmented coordination, disconnected information flows, and limited visibility across supply networks (Sifolo, 2025). Digital procurement offers mechanisms to mitigate these limitations by integrating procurement activities, improving information exchange, and strengthening supplier coordination. Consequently, efficient procurement practices are essential as they can enable tourism MSMEs to reduce costs, enhance supplier coordination, improve service delivery, and strengthen long-term competitiveness and sustainability with their stakeholders (Kimbu & Tichaawa, 2020, p. 742; Sifolo, 2025). More recent evidence indicates that digitalised supply chains can support value co-creation, collaboration, and performance among South African tourism SMMEs (Sifolo et al., 2026, p. 1).

Digital procurement tools, such as e-procurement platforms, electronic tendering systems, e-marketplaces, supplier relationship management systems, cloud-based procurement applications and enterprise resource planning (ERP) systems, provide tourism enterprises with opportunities to streamline purchasing processes and enhance transparency (Patrucco et al., 2021). Evidence from large-scale tourism operations illustrates these potential benefits.

For example, TUI Belgium's implementation of Nezasa's TripBuilder reduced the time to make a new tour bookable from about one business day to one hour, while increasing itineraries created and bookings (Nezasa, 2025). The COVID-19 pandemic accelerated digital transformation across the tourism industry, necessitating the adoption of digital solutions by many businesses to maintain operational continuity (Sigala, 2020). For MSMEs in SSA, however, the transition towards digital procurement presents a more intricate scenario. Adoption is influenced not only by the perceived benefits of digital technologies but also by organisational readiness, technological infrastructure, digital capabilities, financial resources and the broader institutional environment (Afolayan et al., 2015; Chamboko-Mpotaringa et al., 2025).

Evidence from South Africa demonstrates that an awareness of technological benefits does not invariably translate into adoption. Schoeman and Seymour (2022, p. 257), for instance, observed that managers possessed "a clear understanding of the benefits of AI adoption," despite persistent factors inhibiting actual adoption. Similarly, inadequate digital infrastructure, limited digital skills, financial constraints, and organisational resistance can impede digital transformation among MSMEs. The benefits of digital procurement are therefore unlikely to materialise automatically. Their realisation is contingent upon the technological, organisational, and environmental conditions within which MSMEs operate. The literature suggests that successful digital procurement adoption is predicated upon a supportive ecosystem characterised by enabling policy frameworks, robust digital infrastructure, capacity-building initiatives, affordable technological solutions, and strong public-private collaboration mechanisms (International Trade Administration, 2024; OECD, 2021; Shonubi, 2025; Tchoffo et al., 2026; UN Women Africa, 2025). Although research on digital transformation and technology adoption in tourism is expanding, limited attention has been specifically devoted to digital procurement and its implications for tourism MSMEs in SSA. Comparative research, in particular, is scarce. This results in an insufficient understanding of how differences in digital infrastructure, organisational capabilities, and institutional environments shape digital procurement opportunities and constraints across various African contexts. A comparative analysis of South Africa and Cameroon therefore offers an opportunity to examine how these contextual differences may influence digital procurement and its implications for supply chain resilience and inclusivity.

Supply chain resilience in tourism

Supply chain resilience has emerged as a critical area of academic inquiry, driven by the escalating exposure to disruptions impacting global and localised supply networks. Resilience is generally understood as a system's capacity to anticipate, prepare for, respond to, recover from and adapt to unforeseen disturbances while sustaining essential functions (Ivanov & Dolgui, 2020). As previously established, tourism supply chains exhibit high vulnerability to disruptions due to their reliance on multiple interdependent actors operating across diverse geographical locations. Events such as pandemics, natural disasters, political instability, cyberattacks and economic crises can profoundly affect tourism operations and service delivery (Prayag, 2020). The COVID-19 pandemic starkly illuminated these vulnerabilities, exposing the inherent fragility of tourism systems globally and underscoring the imperative for resilience-building strategies (Buluk, 2023). Furthermore, climate-related disruptions exert additional pressure on tourism supply chains in SSA. Flooding, storms, and extreme weather events can impede accessibility, compromise infrastructure, disrupt logistics, and affect interconnected suppliers (Achu et al., 2026). Such disruptions reinforce the necessity for tourism MSMEs to cultivate capabilities for anticipation, response, recovery and adaptation.

The extant literature on supply chain resilience identifies several dimensions that enable organisations to withstand and recover from disruptions. Within the tourism sector, where businesses are acutely susceptible to disruptions, supply chain resilience has become a strategic imperative. Resilience is manifested through four interconnected capabilities: anticipation, which empowers organisations to identify risks and implement preventative measures prior to the occurrence of disruptions (Ponomarov & Holcomb, 2009); response, which facilitates flexible and coordinated actions during disruptive events (Hohenstein et al., 2015); recovery, which dictates the speed and efficacy of restoring operations post-disruption (Ponomarov & Holcomb, 2009); and adaptation, which enables organisations to learn from disruptions and reconfigure systems to enhance future preparedness (Chowdhury & Quaddus, 2017; Chowdhury et al., 2019). Collectively, these capabilities foster business continuity, operational stability, and long-term competitiveness in uncertain environments.

Digital technologies are increasingly recognised as pivotal enablers of supply chain resilience. Technologies that facilitate real-time information sharing, enhanced visibility, predictive analytics, and collaborative decision-making contribute significantly to strengthening organisational resilience (Bienhaus & Haddud, 2018; Ivanov & Dolgui, 2020; Zhao et al., 2023).

For tourism MSMEs in SSA, resilience is particularly crucial given the structural challenges characterising many operating environments, including infrastructure deficits, limited financial reserves, and increasing exposure to external shocks (South African National Department of Tourism, 2021, Muluh & Lekgau, 2023). Existing resilience research has predominantly concentrated on manufacturing and large organisational contexts, resulting in a knowledge gap concerning MSME experiences within developing tourism economies (Ivanov & Dolgui, 2020). Addressing this lacuna is vital because resilient tourism supply chains are indispensable for sustainable destination competitiveness, employment preservation, and community well-being. Consequently, understanding the mechanisms through which digital procurement may bolster resilience capabilities can furnish valuable insights for both researchers and practitioners.

Inclusivity in tourism supply chains

The concept of inclusivity has emerged as a salient discourse within tourism supply-chain research. This emphasis aligns with broader sustainable development objectives, particularly concerning the equitable distribution of tourism benefits (Scheyvens & Biddulph, 2018). Within the context of supply chains, inclusivity is defined by the active participation and equitable representation of marginalised enterprises and communities in both procurement and value creation processes (Scheyvens & Biddulph, 2018). Kimbu & Tichaawa (2020) posit that, in SSA, inclusive tourism necessitates the substantive involvement of MSMEs and historically marginalised groups, including women, youth and community-based enterprises. Nevertheless, tourism MSMEs frequently encounter impediments to meaningful engagement in established value chains. Adinolfi et al. (2018) observe that SMMEs in developing contexts experience "marginalisation or exclusion" and encounter difficulties in integrating into industry value chains. These challenges can be particularly acute for women-led enterprises. Empirical evidence from Ghana and Nigeria, for instance, underscores gender-based constraints that affect women's access to credit, markets, and other opportunities (Ribeiro et al., 2021). Similarly, in South Africa, women-owned tourism micro-enterprises confront limitations pertaining to financial resources, human capital, ICT infrastructure and institutional support (Mametja et al., 2023). Such barriers may impede their capacity for full participation in increasingly digitalised tourism supply chains. For digital procurement mechanisms to genuinely foster inclusivity, they must mitigate rather than perpetuate existing inequalities. Digital platforms possess the potential to enhance supplier visibility, expand market access, and diminish geographical barriers for smaller enterprises. However, the realisation of these benefits is contingent upon access to requisite infrastructure, affordable connectivity, appropriate skills, and robust institutional support (UN Conference on Trade and Development [UNCTAD], 2021; International Trade Center, 2022). Consequently, inclusive digital procurement necessitates a dual focus on both technological accessibility and the development of capabilities essential for MSMEs to participate effectively. Understanding the South Africa-Cameroon comparison necessitates an examination of the distinctive historical, economic, and institutional contexts that shape tourism supply chains and digital procurement opportunities in each country. The comparison is therefore instrumental in scrutinising context as a significant determinant influencing digital procurement, supply-chain resilience and inclusivity.

THEORETICAL FRAMEWORK

The TOE framework, posited by Tornatzky & Fleischer (1990), offers a robust analytical lens for comprehending organisational technology adoption. This framework postulates that decisions pertaining to technology implementation are

shaped by three interconnected contexts: technological, organisational, and environmental factors. The technological context encapsulates the characteristics of technologies accessible to an organisation, encompassing perceived benefits, compatibility, complexity, and relative advantage, all of which exert an influence on technology adoption decisions (Baker, 2012). Within the domain of digital procurement, technological considerations such as system usability, interoperability, cybersecurity, and perceived usefulness represent pivotal determinants of successful procurement digitisation (Bienhaus & Haddud, 2018). The organisational context pertains to internal characteristics that bear upon technology adoption, including organisational scale, leadership endorsement, financial provisions, technological proficiencies, and employee competencies (Baker, 2012).

MSMEs within the tourism sector frequently encounter organisational impediments linked to restricted financial capital, insufficient digital proficiencies, and a dearth of technical expertise, which may impede their preparedness to embrace digital procurement systems (Achieng & Malatji, 2022). The environmental context encompasses external factors such as industry characteristics, competitive pressures, governmental regulations, infrastructure availability and support from external stakeholders (Baker, 2012). In the context of Sub-Saharan Africa, disparities in digital infrastructure development, policy landscapes, and institutional support mechanisms may significantly influence the uptake of digital procurement among tourism MSMEs (Achieng & Malatji, 2022). The TOE framework has been extensively employed to elucidate organisational technology adoption across diverse sectors. Its multidimensional perspective renders it particularly apposite for the current study, given that the adoption of digital procurement among tourism MSMEs is unlikely to be solely contingent on technology. Rather, it is also shaped by organisational capabilities and the broader institutional and business milieu. Consequently, in this study, the TOE framework is deployed as an analytical lens to facilitate a comparative analysis between South Africa and Cameroon. The technological dimension will consider variations in digital infrastructure, accessibility, and technological readiness; the organisational dimension will examine MSME resources, skills, and capabilities; and the environmental dimension will address regulatory conditions, institutional support, and the wider business environment. This approach furnishes a structured foundation for investigating the potential divergence in digital procurement opportunities and constraints between the two nations.

Supply chain resilience and inclusivity as analytical outcomes

The TOE framework offers a valuable analytical lens for investigating the contextual factors influencing the adoption of digital procurement; however, this study extends beyond mere adoption conditions to critically examine the potential ramifications of such implementation. Consequently, supply chain resilience and inclusivity are conceptualised as primary analytical outcomes, rather than distinct theoretical constructs. Supply chain resilience is defined as the intrinsic capacity of a supply chain to anticipate, respond to, recover from, and adapt to disruptive events (Chowdhury & Quaddus, 2017). Within this operational context, digital procurement possesses the potential to bolster resilience through enhanced information visibility, improved supplier coordination and more effective communication channels. This, in turn, may empower tourism MSMEs to navigate and mitigate supply chain disruptions with greater efficacy (Ivanov & Dolgui, 2021).

Inclusivity pertains to the degree to which diverse stakeholder groups, particularly those historically marginalised from economic participation, can access and derive benefits from opportunities within tourism value chains (Scheyvens & Biddulph, 2018). Digital procurement may foster more inclusive participation by facilitating improved access to procurement information, market opportunities, and supplier engagement for MSMEs, including those spearheaded by women and youth (International Trade Centre, 2022). Nevertheless, the equitable realisation of these opportunities may be impeded by disparities in digital access, requisite skills, available resources, and the robustness of institutional support. Therefore, the TOE framework serves to structure the comparative analysis between South Africa and Cameroon, while resilience and inclusivity constitute the two principal outcomes through which the implications of digital procurement are rigorously scrutinised. This methodological approach enables the study to ascertain how variations in technological, organisational and environmental conditions across the two nations may influence the opportunities and constraints associated with digital procurement, and their consequent implications for fostering more resilient and inclusive supply chains within tourism MSMEs.

METHODOLOGY

This conceptual study employed an integrative literature review to examine existing knowledge on tourism supply chains, MSMEs, digital procurement, resilience and inclusivity in SSA, with particular attention to South Africa and Cameroon. An integrative approach was considered appropriate because it allows theoretical and empirical literature from related fields to be brought together and critically synthesised to identify key concepts, relationships and gaps in existing knowledge (Snyder, 2019). The review aimed to integrate multidisciplinary knowledge rather than aggregate empirical effects. It drew together scholarship from tourism supply chain management, digital procurement, resilience and inclusive development. Particular attention was given to comparing South Africa and Cameroon to examine how differences in technological, organisational and environmental conditions may shape digital procurement opportunities and its implications for resilience and inclusivity. Relevant literature was identified through targeted searches of Web of Science, Scopus and Google Scholar, supplemented by citation chaining and hand-searching of key journals in tourism, hospitality and supply chain management. Search terms and combinations used embodied tourism and hospitality, supply chains, value chains, procurement, MSMEs/SMEs, digitalisation, resilience, and inclusivity, with specific attention to Sub-Saharan Africa, South Africa and Cameroon. Boolean operators such as AND and OR, together with truncation where appropriate, were used to combine key concepts and broaden or refine searches. The review focused primarily on literature published between 2015 and 2026 to capture contemporary developments in digitalisation, tourism supply chains and MSME participation. Earlier seminal studies were retained where they provided important theoretical or conceptual foundations.

Literature was selected purposively based on its theoretical contribution, conceptual relevance and contextual applicability to SSA. The search prioritised studies providing substantive insights into tourism or hospitality MSMEs and on issues related to supply chains, value chains, procurement, digitalisation, resilience, inclusivity, and associated challenges and opportunities. Consideration was given to evidence from SSA, with specific attention to South Africa and Cameroon. Literature from other developing-economy contexts was also considered where it provides concepts and theorist ha can be transferred.

The selected literature was analysed thematically and synthesised iteratively to identify, compare, and integrate recurring concepts, patterns and relationships across the literature with the aid of ChatGPT and Rayyan. This methodology was considered appropriate for the integrative nature of the review because it brought together evidence from diverse theoretical and empirical studies to support conceptual development. The analysis focused on recurring themes relevant to the study, including tourism MSME supply chain challenges, digital procurement practices, technological and organisational capabilities, environmental conditions, supply chain resilience, inclusivity, and emerging opportunities. The study examined similarities and differences between the South African and Cameroonian contexts and drew on evidence from the broader Sub-Saharan African literature and other developing economy contexts to provide additional contextual and theoretical insights.

The literature was critically compared and integrated to identify relationships among the key concepts and to inform the development of the study's proposed conceptual framework and research propositions. The analysis followed a four-step interconnected process. Firstly, the literature was examined to identify and clarify the key constructs and their definitions. Second, emerging themes were compared across studies and contexts to identify similarities and differences. Then, relationships among the concepts were mapped and integrated to develop a preliminary conceptual framework that links the factors influencing digital procurement adoption with supply-chain resilience and inclusivity outcomes. The final stage involved integrating the identified themes into a comparative analysis of South Africa and Cameroon. The synthesis examined how technological, organisational and environmental conditions differ across the two contexts and how these differences may shape digital procurement adoption and its implications for tourism MSME supply-chain resilience and inclusivity.

RESULTS

The following section presents the results for the South African and Cameroonian contexts. South Africa provides a relatively established setting for tourism and digital business compared with many SSA economies. The country has an advanced ICT infrastructure and has established digital business systems, although access to these opportunities remains uneven across enterprises and locations (International Trade Administration, 2024). Tourism MSMEs operate within this relatively developed environment but differ considerably in their capacity to participate effectively in digital markets. Despite the availability of digital infrastructure, digital inequality remains relevant to South African MSMEs. Mbatha (2024: 65) finds that "a digital divide is hampering the adoption of technology by SMMEs", with technology costs, limited financial resources and inadequate technical knowledge among the barriers to adoption. Tourism-specific evidence similarly indicates that digital transformation among MSMEs is shaped by infrastructure, skills, financial capacity and organisational readiness (Chamboko-Mpotaringa et al., 2025). South Africa can therefore be understood as a context where the challenge is not simply the availability of digital technologies, but whether tourism MSMEs possess the resources and capabilities required to participate effectively in digitally mediated supply networks. This provides an important basis for comparison with Cameroon, where the digital and institutional environment is at a different stage of development.

Cameroon represents an emerging digital context where tourism contributes to economic development, but where digital infrastructure development remains uneven (Zoa, 2026). The country has made digitalisation an important development priority, but significant structural and institutional constraints remain. A World Bank assessment identified high broadband prices, limited institutional capacity, and weaknesses in digital policy and regulation as constraints on the development of Cameroon's digital economy (World Bank, 2022). While mobile technology adoption has increased substantially, challenges relating to internet penetration, affordability, digital skills, and institutional support persist (World Bank, 2022, p. 48; World Bank, 2019). There are nevertheless signs of institutional change. Cameroon enacted a Personal Data Protection Law in 2024, indicating progress towards strengthening the governance of its digital environment. However, the World Bank's (2022) assessment reports that several reforms relating to telecommunications, cybersecurity and cybercrime remained under review, while some planned institutional capacity-building programmes had yet to commence. Thus, Cameroon should not be characterised simply as digitally "underdeveloped". Rather, it represents an evolving digital ecosystem in which technological expansion is occurring alongside continuing institutional and regulatory development. Recent evidence shows growing adoption of digital financial services in Cameroon. World Bank Global Findex data indicate increasing use of mobile phones and computers for payments and transactions, though access remains uneven. Affordability persists as a barrier, with mobile data costs cited by non-smartphone owners as a reason for non-ownership (World Bank, 2025). These conditions matter for tourism MSMEs because digital procurement requires not only platform availability but also affordable connectivity, suitable devices, digital payment capabilities and an enabling institutional environment for trusted transactions. Examining Cameroon alongside South Africa provides valuable insights into how differing digital ecosystems shape procurement practices and resilience outcomes.

The comparison therefore reveals different conditions for digital procurement adoption. South Africa provides a relatively more established digital and institutional environment, although inequalities in access, affordability, and MSME capabilities remain. Cameroon represents a more rapidly evolving but uneven digital environment, where connectivity, affordability and institutional capacity remain significant considerations. These differences suggest that digital procurement cannot be understood as a uniform process across SSA. Its adoption and potential contribution to resilience and inclusivity are likely to depend on the technological, organisational and environmental conditions within which tourism MSMEs

operate. The contextual differences between South Africa and Cameroon can be summarised across the technological, organisational and environmental dimensions relevant to digital procurement adoption. Table 1 highlights these differences and their analytical significance for understanding the potential contribution of digital procurement to resilience and inclusivity among tourism MSMEs. The comparison suggests that digital procurement opportunities cannot be separated from the contexts in which tourism MSMEs operate. South Africa and Cameroon differ in their technological readiness, MSME capabilities and institutional environments. These differences provide the basis for the comparative analysis of how digital procurement may contribute to resilience and inclusivity in the two contexts.

Table 1. Comparative Context of Digital Procurement in Tourism MSMEs in South Africa and Cameroon

Dimension	South Africa	Cameroon	Analytical significance
Digital infrastructure	Relatively more developed digital infrastructure	Developing but uneven digital infrastructure	**Technological context:** influences digital readiness
Internet and mobile connectivity	Relatively higher levels of connectivity and digital access	Expanding but uneven access with affordability and connectivity constraints	**Technological context:** influences access to digital platforms
MSME digital capabilities	Relatively stronger digital ecosystem but uneven capabilities among MSMEs	Greater constraints in digital skills and enterprise capabilities	**Organisational context:** influences readiness and effective technology use
Institutional and regulatory environment	More established digital business and regulatory environment	Developing digital institutional and regulatory environment	**Environmental context:** shapes enabling conditions for adoption
Digital procurement readiness	Greater enabling conditions for digital procurement adoption although uneven across MSMEs	Emerging opportunities but constrained by infrastructure and enterprise readiness	**TOE interaction:** influences adoption opportunities and constraints
Women and youth participation	Participation opportunities exist but structural and digital inequalities remain	Participation opportunities exist but structural and digital barriers remain	**Inclusivity:** determines who can access and benefit from digital opportunities
Urban-rural digital divide	Digital disparities remain between locations and enterprises	Geographic disparities in connectivity and access remain significant	**Inclusivity and technology access:** may limit participation of rural MSMEs
Tourism MSME environment	Relatively established tourism and MSME ecosystem	Developing tourism MSME ecosystem with greater informality and capacity constraints	**Contextual difference:** affects how digital procurement practices may be transferred between settings
Potential resilience implications	Stronger digital foundations may support information sharing, coordination and response to disruptions	Potential benefits depend more strongly on improvements in connectivity and MSME capabilities	**Resilience:** digital procurement benefits are context-dependent

Comparison between South Africa and Cameroon shows how differences in technological, organisational and environmental conditions shape digital procurement opportunities among tourism MSMEs.

Rather than viewing one country as digitally advanced and the other as digitally disadvantaged, the comparison portrays different levels of readiness and different limitations within changing digital environments. The TOE framework provides a useful lens for interpreting these differences.

Technological conditions

South Africa has a relatively advanced digital infrastructure and higher levels of digital maturity, providing a stronger platform for adopting digital procurement technologies. Nevertheless, access and effective use remain uneven particularly among smaller and rural tourism enterprises. Recent research confirms that South African tourism SMMEs continue to experience challenges in effectively adopting digital technologies despite recognising their potential benefits (Chamboko-Mpotaringa et al., 2025). Sifolo (2025) similarly demonstrates that digital adoption remains a challenge within South African tourism supply networks, although digitally enabled interventions can improve connectivity, coordination and market visibility. Cameroon's digital environment is developing but remains more uneven. Broadband expansion, increasing internet traffic and growing digital services demonstrate ongoing digital transformation. However, affordability, connectivity and access remain vital limitations, especially outside major urban areas (World Bank, 2021; World Bank, 2022). These differences suggest that technology readiness acts as an important contextual condition: whereas South African tourism MSMEs may be better positioned to adopt more sophisticated digital procurement practices, many Cameroonian MSMEs may first require stronger foundations in affordable connectivity and accessible digital services.

Organisational and MSME conditions

The organisational dimension revealed that technological availability alone does not guarantee effective adoption. Tourism MSMEs necessitate financial resources (encompassing the acquisition of digital systems, equipment, subscriptions, and implementation costs), digital proficiencies, managerial capabilities, and organisational readiness to integrate digital tools into their procurement activities. In the South African context, while a comparatively robust digital ecosystem offers increased exposure to digital technologies, considerable disparities persist in the capabilities of tourism SMMEs to utilise them

effectively. This is attributable to variations among enterprises in terms of financial resources, digital skill levels, technical capabilities and organisational readiness (Chamboko-Mpotaringa et al., 2025). These organisational constraints are potentially more pronounced in Cameroon, where the broader digital ecosystem remains in a nascent stage of development. Furthermore, evidence from women-owned tourism enterprises indicates that the availability of institutional support does not necessarily translate into enterprise-level awareness and subsequent utilisation (Njinyah & Pendati, 2021). The comparative analysis therefore suggests that organisational readiness is pivotal in translating digital access into meaningful procurement participation (Ntimane, 2025). Consequently, digital procurement initiatives that overlook MSME capabilities may inadvertently exacerbate, rather than mitigate, disparities between digitally capable and less-prepared enterprises.

Environmental and institutional conditions

The environmental contexts of the two countries also diverge significantly. South Africa operates within a comparatively more developed digital business and regulatory framework, notwithstanding persistent challenges related to regulation and digital access (World Bank, 2018). Conversely, Cameroon is in the nascent stages of reinforcing the institutional foundations requisite for comprehensive digital transformation. Notably, broadband affordability, regulatory evolution, and institutional capacity remain pivotal considerations within Cameroon's digital transformation agenda (Hurpy, 2021). These contextual disparities hold considerable implications, as digital procurement is contingent upon an enabling environment that transcends the individual enterprise. The efficacy of MSME participation in digital supply networks is influenced by reliable infrastructure, supportive regulatory frameworks, affordable connectivity, accessible digital payment systems, and robust institutional support. Consequently, the advancement of procurement digitalisation may be more readily achievable in environments where these enabling conditions are firmly established. In nascent digital environments, such as Cameroon, augmented focus may be necessitated on fortifying both technological infrastructure and institutional capacity. This observation corroborates the TOE framework, which posits that the external environment can either facilitate or impede technology adoption, even when individual enterprises acknowledge its potential advantages.

Implications for supply chain resilience

A comparative analysis suggests that digital procurement can enhance the resilience of tourism supply chains; however, its efficacy is context dependent. Digital technologies offer potential benefits through improved information accessibility, enhanced supplier visibility, and more effective coordination, thereby enabling enterprises to respond robustly to disruptions. Empirical evidence from South Africa provides some substantiation for this potential. Sifolo (2025), for instance pointed out that digitally enabled interventions augmented tourism supply-network coordination and connectivity within Gauteng and KwaZulu-Natal. It is important to note, however, that her study focused on broader digitalisation rather than digital procurement specifically. In the context of Cameroon, the potential resilience benefits may be more contingent upon advancements in connectivity, affordability and the digital capabilities of enterprises (Harilal & Tichaawa, 2026).Consequently, digital procurement should be conceptualised as a resilience enabling mechanism rather than an inherent source of resilience. Its contribution to the anticipatory, responsive, recovery, and adaptive capacities of tourism MSMEs is thus mediated by the prevailing technological, organisational and environmental conditions.

Implications for inclusivity

Digital procurement presents a dualistic landscape of opportunities and risks for the advancement of inclusive tourism. While digital platforms offer the potential to enhance the visibility of smaller suppliers, streamline access to procurement opportunities and connect MSMEs with wider tourism markets, their benefits are not uniformly distributed. Disparities in access to connectivity, digital literacy, and financial resources pose significant barriers, precluding certain enterprises from leveraging these opportunities. Digital divides persist across Africa, particularly affecting impoverished and remote communities, with gender-based discrepancies in internet usage representing an additional concern (World Bank, 2023).

This analysis therefore underscores a critical tension: digital procurement, while capable of fostering inclusion, also bears the potential to perpetuate existing inequalities. In both South Africa and Cameroon, the pursuit of inclusive digital procurement necessitates interventions beyond mere technological implementation. It requires affordable access, targeted skills development, robust institutional support and concerted efforts to facilitate the participation of smaller, rural, women-led, and youth-led enterprises. The variations observed between the two nations further indicate that such interventions must be tailored to specific local contexts, rather than being applied uniformly across SSA. In conclusion, the comparative analysis reveals that South Africa and Cameroon operate within distinct digital and institutional environments within SSA. South Africa, characterised by a relatively mature ecosystem, nonetheless contends with persistent inequalities in access and MSME capabilities. Conversely, Cameroon exemplifies an emergent digital ecosystem where connectivity, affordability and institutional capacity remain more pronounced constraints. The central finding of this comparison is therefore that the capacity of digital procurement to enhance resilience and inclusivity is intrinsically contextual. While technological availability is a crucial factor, its ultimate outcomes are shaped by organisational preparedness and the broader institutional framework.

CONCLUSION

This conceptual study critically examines the role of digital procurement within the supply chains of tourism MSME supply chains in South Africa and Cameroon, with a specific focus on its implications for resilience and inclusivity. Employing the TOE framework as an analytical lens, the study posits that the potential advantages of digital procurement are contingent upon technological readiness, organisational capabilities, and the broader institutional

milieu. In South Africa, the operational context is characterised by a comparatively more developed digital ecosystem; however, persistent disparities in access, digital literacy and MSME capabilities remain evident.

Conversely, Cameroon presents an evolving digital landscape where issues of connectivity, affordability, and institutional capacity continue to exert significant influence over digital engagement. The comparative analysis indicates that digital procurement possesses the capacity to enhance supply chain resilience through improved visibility, coordination, and information exchange, whilst simultaneously fostering opportunities for broader MSME participation. Nevertheless, the realisation of these benefits is not inherent.

Without sufficient digital skills, accessible and affordable connectivity, organisational preparedness, and robust institutional support, digitalisation risks exacerbating existing inequalities rather than mitigating them. Consequently, digital procurement strategies within SSA ought to be context-sensitive and complemented by targeted interventions aimed at supporting smaller, rural, women-led, and youth-led enterprises. Future empirical research could extend this comparative analysis by investigating the practical adoption of digital procurement among tourism MSMEs in South Africa and Cameroon and assessing its subsequent impact on resilience and inclusive participation.

This study contributes to the extant literature on tourism digitalisation and supply chains in three principal ways. Firstly, it demonstrates the utility of the TOE framework in elucidating contextual variations in digital procurement among tourism MSMEs, rather than focusing only on digital adoption. The comparative analysis reveals differential interactions among technological readiness, organisational capabilities and environmental conditions across distinct national contexts. Secondly, the study expands the discourse on digital procurement beyond conventional considerations of efficiency and cost reduction, by exploring its potential ramifications for supply chain resilience and inclusivity. The analysis posits that digital procurement may enhance coordination, visibility, and responsiveness, whilst concurrently fostering opportunities for broader MSME participation. Nevertheless, the realisation of these outcomes is contingent upon the specific conditions underpinning adoption. Thirdly, the comparative approach underscores the critical importance of context in the application of digital transformation concepts to SSA tourism. Findings and practices derived from digitally mature environments are not automatically transferable to nations characterised by divergent infrastructural, organisational, and institutional conditions. Consequently, this study offers a context-sensitive perspective on understanding digital procurement within African tourism supply chains. For policymakers and tourism practitioners, the findings suggest that digital procurement strategies ought to differentiate according to national and MSME readiness. In the South African context, a greater emphasis may be required on strengthening MSME digital capabilities, affordability, and the effective utilisation of extant digital infrastructure. Conversely, in Cameroon, priorities may encompass expanding affordable connectivity, fostering digital skills development, and fortifying the institutional environment that underpins digital business and MSME participation. Across both nations, digital procurement initiatives should integrate technological investment with MSME capacity building and inclusive participation. Particular attention should be directed towards smaller, rural, women-led, and youth-led enterprises, which may otherwise encounter difficulties in participating within increasingly digital tourism supply networks. Consequently, a context-sensitive approach is more likely to ensure that digital procurement contributes not only to operational efficiency but also to the development of more resilient and inclusive tourism supply chains.

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DEMOGRAPHIC DRIVERS OF PRO-ENVIRONMENTAL BEHAVIOUR IN AGRITOURISM: THE ROLES OF AGE, GENDER AND INCOME

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Abstract: Agritourism is increasingly positioned as a practical route to encourage more responsible environmental behaviour by bringing tourists into direct contact with farms, local landscapes, and everyday sustainability practices. Building on established measurement work on key pro-environmental constructs, this paper takes a narrower and more applied step by testing whether gender, age, and income meaningfully differentiate tourists' environmental awareness, concern, values, knowledge, attitudes, and pro-environmental behaviour in agritourism settings. A quantitative survey was administered to tourists participating in agritourism activities in Kashmir, India, India. Using purposive sampling, 700 tourists were approached and 560 usable responses were obtained (80% response rate). Gender differences were assessed using an independent-samples t-test, while age (below 30 years, 31–50 years, above 50 years) and income groups were examined using one-way ANOVA. The findings show a limited but informative role of demographics. Gender differences were significant only for environmental awareness, where female tourists reported higher awareness than male tourists. Age differences were significant for environmental attitude (stronger among tourists below 30 years) and for pro-environmental behaviour (highest among tourists aged 31–50 years). Income-based differences were significant for environmental knowledge, environmental attitude, and pro-environmental behaviour, with higher-income groups reporting consistently higher scores. Thus, the results provide segmentation-ready evidence that can help agritourism operators and destination planners tailor sustainability communication, experience design, and pricing or behavioural nudges to visitor groups with different constraints and response tendencies.

Keywords: agritourism, pro-environmental behaviour, demographics, gender, age, income, sustainable tourism

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INTRODUCTION

Tourism is no longer being measured based on the number of visitors that it brings, but also on the type of visitors that it is attracting to a disaster-prone destination (Alloh et al., 2024). Due to the increasing visibility of climate and biodiversity pressures in people's daily lives, destinations and tourism operators face increasing pressure to promote low-impact decisions, responsible consumption, and the well-being of local ecosystems (Badia et al., 2024). Similarly, Agritourism is one of the promising areas of this change, as tourists will stop merely sightseeing, but they will be involved in agriculturally based activities, have local food experiences, and experience the rural lifestyle (Ting & Cheng, 2017).

Since agritourism is based on the actual landscapes, labour, and utilisation of resources, it can render the environmental issues less abstract and more personal (Ohorodnyk & Finger, 2024). The experience of agritourism has suggested that agritourism participation can be linked to both the public sphere and the private sphere sustainable behaviours, suggesting that the experience may not only reinforce greener practices during the process of travel but may also extend to other areas (Brune et al., 2022). Simultaneously, agritourism is frequently framed as a rural sustainability and local wellbeing avenue, where environmental protection is connected to the local developmental goals (Ciolac et al., 2019).

An important factor as to why agritourism is important in sustainability is that it is able to turn the concept of environment into a slogan into a sight and touch experience for the tourists (Shi & Liao, 2025). As visitors see how the resources are saved, waste management, soil management and how food is produced in seasons, they are introduced to sustainability as a collection of daily choices and not a far-fetched policy argument (Wu et al., 2024; Zhang et al., 2024).

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Research on farm tourism and other tourism in a rural setting demonstrates that these experiences have the potential to bridge personal values and environmentally responsible decision-making, which supports the idea that sustainability is partially related to what individuals value and how they understand their contribution to visiting (Hassan et al., 2024). In a broader sense, tourism studies have long held that internal factors (including knowledge, attitudes, and values) are significantly connected to intentions and behaviour, albeit the level of connection depends on the situation and the kind of behaviour under investigation (Gao et al., 2016). That is, the psychological pathway is substantive, but it does not work in empty space.

This is where the role of demographic differences comes in as a practical factor. Tourism managers seldom enjoy the privilege of creating a single sustainability message or a single green experience that will be equally effective on all. Age, gender, and income usually determine the affordability of the tourists, their priorities, responsibility interpretations, and their readiness to abandon routine behaviours (Pinho & Gomes, 2024). Within the hotel and destination contexts, it has been observed that there are systematic circular attitude differences as well as environmental behaviours across socio-demographic lines, some of the results indicated that women expressed greater circular behaviours compared to men and willing to pay higher to access greener establishments may also differ depending on their socio-demographic background (Rodríguez et al., 2020). On the same note, gender work in tourist settings has demonstrated that the connections among individual elements and pro-environmental behaviour may vary between men and women so that they indicate that what drives green behaviour may not be the same among men and women (López-Bonilla et al., 2020). The issue of income is also significant as it may serve as an enabler (possibility to afford greener alternatives) and be a barrier (price sensitivity and competing needs). Indicatively, studies on green product purchasing behaviours of tourists show that there is a noteworthy variation in the environmentally friendly purchasing behaviour across income classes (Pekerşen & Canoz, 2022). More recent findings on the relevance of socio-demographics (such as age, gender, and income) in explaining or moderating sustainable travel decisions and associated behavioural patterns are also reported in India (Naik et al., 2025). Combined, the literature direction is clearly pointed that demographic segments may vary, but the trend of variations may be situation-specific and has to be verified in the context under investigation.

It is in this context that the current paper takes a very narrow and pragmatic approach. The most important constructs in the pro-environmental behaviour chain such as Environmental Awareness, Environment Concern, Environment Value, Environmental Knowledge, Environmental Attitude and Pro-environmental Behaviour have already been discussed in previous research work in terms of their concept divisions as well as the relationship of one with another (Ansari et al., 2021; Bilynets & Knezevic Cvelbar, 2022; Fatoki, 2019; Foroughi et al., 2022; Li et al., 2022).

There have been least studies that might have studied the role of demographic variables. Thus, this study focuses on whether there are any significant differences in the mean scores of these constructs across significant demographic groups in an agritourism setting. The study would create practical demographic segmentation knowledge to agritourism operators and destination planners by isolating the variation in demographic in this manner.

These understandings can be used to make the communication of sustainability more accurate, experience design, and pricing or behavioural nudges so that the practitioners can better reach out to groups with the highest response rates and also account for the limits and incentives that could be driving less responsive groups.

The rest of the paper will be structured in the following way. Section 2 demonstrates the theoretical framework and hypotheses of the study. Section 3 describes the research design, sampling method, construct measurement and the analytical methods. In section 4, the findings of the empirical research are reported. In Section 5, the results will be discussed, the most important limitations identified, and the way future research should be carried out.

Theoretical Framework

Agritourism provides a setting where tourists encounter the natural environment and food production systems in a direct, experience-based way (Alloh et al., 2024; Karthik & Gajanand, 2017). Unlike conventional tourism, where sustainability may remain a background message, agritourism makes environmental issues visible through land-based activities, local food consumption, and interaction with rural communities (Jamaliah et al., 2021).

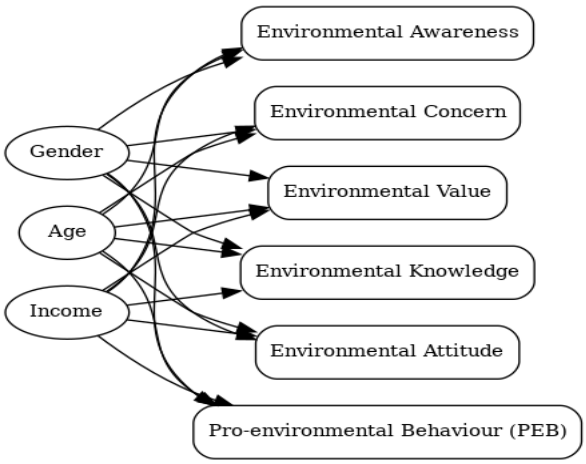


Figure 1. Research Framework

This matters because pro-environmental behaviour in tourism is shaped not only by what people believe in principle, but also by what the setting makes salient and easy to practise (Brune et al., 2022). The present model (Figure 1) is intentionally framed as a segmentation model, not a causal behavioural model. The model assumes that gender, age, and income function as distal determinants that can create meaningful differences in tourists' environmental orientations and actions. This is consistent with the broader literature, which recognises that demographic characteristics often shape socialisation, resources, and constraints, and therefore influence environmental attitudes and behaviours (Stern, 2000). In tourism settings, socio-demographic profiling has been used to explain why some tourists exhibit stronger environmentally responsible or circular practices than others, suggesting that demographic segmentation is useful for sustainability planning (Rodríguez et al., 2020).

Hypotheses development

Gender-based differences in pro-environmental factors and behaviour

A large body of literature suggests that gender can shape pro-environmental attitudes and behaviour, although the direction and strength of this effect vary across settings. Early work by Zelezny et al. (2000) showed that women often report stronger environmental concern and a greater tendency towards environmentally responsible behaviour than men. More recent evidence also supports this pattern. For example, Li et al. (2022), in a study from China, found that women showed higher environmental concern and engaged in several greener everyday practices than men. Within tourism and hospitality, Han et al. (2009) reported that the relationships between green attitudes, hotel image, and behavioural intentions were generally stronger among female guests in a green hotel context. Similarly, Moise et al. (2021) found that gender moderated the effects of hotel green practices on guest responses, suggesting that women may respond more positively to environmentally responsible hospitality initiatives in some contexts. At the same time, the evidence is not fully consistent. MacDonald & Hara (1994) found only weak gender differences in environmental concern, with males showing slightly higher concern in their sample of college students. In another study, Mostafa (2007) reported significant gender differences in green purchase behaviour among Egyptian consumers, showing that such variation is highly context-dependent rather than universal. Patel et al. (2017), using evidence from India, also reported that men displayed higher pro-environmental behaviour than women in their sample. Taken together, these findings suggest that gender may influence pro-environmental factors and behaviour, but the pattern is shaped by cultural context, type of behaviour, and research setting. In view of these mixed findings, the following hypothesis is proposed:

H1: Male and female tourists do not differ significantly with respect to pro-environmental factors (environmental awareness, environmental concern, environmental value, environmental knowledge, environmental attitude) and pro-environmental behaviour.

Age-based differences in pro-environmental behaviour

Age is widely used as a demographic variable in sustainability research because different life stages are often associated with different values, routines, responsibilities, and consumption habits (Farmaki et al., 2026; Sadeque et al., 2026). However, the relationship between age and pro-environmental behaviour is far from straightforward. Some studies suggest that younger consumers may be more receptive to green appeals, especially where environmental behaviour is linked with identity, innovation, and social influence (Khairy et al., 2026). Lee (2008), for instance, showed that young consumers can be an important segment for green marketing. In hospitality research, Han et al. (2009) found that age had a moderating role in the relationship between green attitudes and behavioural intentions in a hotel setting. These findings indicate that younger groups may be especially responsive to green communication in some market environments. Other studies point in a different direction. Wang et al. (2021), using cross-national evidence from 31 countries, found a positive relationship between age and pro-environmental behaviour, with older people more likely to participate in environmentally responsible actions. Sun et al. (2019) also found that age affects green consumption behaviour, although its effect operates within a broader system of demographic and environmental influences. In tourism specifically, Wang et al. (2020) reported that age significantly influenced green purchase attitudes towards green hotel selection in China. By contrast, Akehurst et al. (2012) argued that psychographic factors are often more important than socio-demographic variables in explaining green purchase behaviour, which suggests that age alone may not be a reliable predictor in every context. Patel et al. (2017) likewise found that middle-aged consumers scored higher on pro-environmental behaviour than both younger and older groups, reinforcing the idea that age effects are present but not uniform. Given this mixed yet meaningful evidence, the following hypothesis is proposed:

H2: Tourists across different age categories differ significantly in mean pro-environmental behaviour.

Income-based differences in pro-environmental behaviour

The role of income in pro-environmental behaviour remains one of the most debated issues in this literature. One line of research suggests that higher income can support greener behaviour because it reduces the financial burden associated with eco-friendly products, green premiums, or sustainable service choices (Buckley et al., 2025; Wang & Zhang, 2020). Khare (2015) found that income influenced environmentally friendly behaviour among Indian consumers, while Wang et al. (2020) reported that income significantly affected both green purchase attitudes and behavioural intention towards green hotel selection in China. These studies support the argument that financial capacity may make it easier for consumers to translate environmental concern into action, particularly when sustainable choices involve higher cost or perceived sacrifice (Pang & Jiang, 2026). Yet another line of evidence suggests that income is neither simple nor consistently positive as a predictor of green behaviour. Akehurst et al. (2012) concluded that psychographic variables were more relevant than socio-

demographic ones in explaining ecologically conscious consumer behaviour. Sun et al. (2019) similarly found that while several demographic factors matter, overall consumption levels did not have a significant impact on green consumption in their multilevel model. More recent evidence further complicates the picture. Berthold et al. (2023) found that higher income was associated with lower willingness to engage in certain pro-environmental behaviours, while subjective financial scarcity also reduced willingness to act sustainably. This suggests that both objective resources and subjective financial experience can shape environmental behaviour in different ways (Voss et al., 2026). Therefore, the effect of income appears to be context-sensitive and dependent on the type of behaviour being measured. In light of these mixed findings, the following hypothesis is proposed:

H3: Tourists across different income categories differ significantly in mean pro-environmental behaviour.

METHODOLOGY

This paper investigates how key demographic variables shape tourists' pro-environmental behaviour in agritourism settings in Kashmir, India. In line with the study's central purpose, the analysis focuses on whether age, gender, and income significantly differentiate tourists' pro-environmental behaviour, rather than re-examining the already well-established causal links among environmental values, beliefs, attitudes, norms, perceived behavioural control, and behavior (Forleo & Bredice, 2025; Majid et al., 2025). This focus is practically important because agritourism operators and destination planners need clear segmentation-based evidence to design sustainability messages, visitor experiences, and behavioural interventions for different categories of tourists. To address this objective, the study adopted a quantitative survey design and gathered systematic evidence from tourists who had participated in agritourism activities in the region. The target sample comprised 700 domestic and international tourists, and purposive sampling was used to ensure that all respondents had direct experience of agritourism in Kashmir. Before the main survey, the questionnaire was piloted with 80 respondents to assess clarity, relevance, and logical flow in line with the studies (Malik et al., 2025; Mehraj et al., 2025; Mehraj & Qureshi, 2022a; Qureshi & Mehraj, 2022; Tanzeela et al., 2024). Based on the pilot feedback, minor revisions were made to improve the final instrument. The structured questionnaire consisted of two main sections. The first section captured the demographic profile of respondents, including age, gender, nationality, education, occupation, and income. The second section measured the major pro-environmental constructs using established scales drawn from earlier studies.



Figure 2. Methodological Flow Diagram (Source: Prepared by the authors)

Specifically, pro-environmental values were adapted from Stern et al. (1999), pro-environmental beliefs from Dunlap et al. (2000), pro-environmental attitude from Kaiser et al. (1999), social norms from Cialdini et al. (1990), environmental conscientiousness from Hirsh (2010), perceived behavioural control from Ajzen (1991), and pro-environmental behaviour

from Kaiser (1998). All items were rated on a five-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree. Of the 700 questionnaires distributed, 560 valid responses were received, giving a response rate of 80 per cent. In line with the study's segmentation objective, respondents were grouped by age into below 30 years (26 per cent), 31-50 years (50 per cent), and above 50 years (24 per cent). Gender was evenly distributed between male (50 per cent) and female (50 per cent) respondents. Monthly income was classified into five brackets: below ₹20,000 (15 per cent), ₹20,000-₹50,000 (30 per cent), ₹50,001-₹100,000 (25 per cent), ₹100,000-₹200,000 (20 per cent), and above ₹200,000 (10 per cent). For the statistical analysis, an independent-samples t-test was used to examine gender-based differences, while one-way ANOVA was applied to test differences across age and income groups. Thus, the study seeks to identify which categories of tourists display higher or lower levels of pro-environmental behaviour in agritourism settings and to generate practical insights for more targeted and effective sustainability strategies as showin in Figure 2.

RESULTS

Analysis for Gender

To examine whether Environmental Awareness, Environmental Concern, Environmental Value, Environmental Knowledge, Environmental Attitude, and Pro-environmental Behavior differ based on gender, an independent sample t-test was conducted. The results, presented in Table 1, indicate that Environmental Awareness is the only construct where a statistically significant difference was observed between male and female respondents ($t = -2.43$, $p = 0.015$). Females ($M = 3.75$, $SD = 1.07$) reported higher environmental awareness compared to males ($M = 3.52$, $SD = 1.15$), suggesting that women tend to be more environmentally conscious in agritourism settings. The Levene's test for equality of variances ($F = 5.75$, $p = 0.017$) indicates that variance was not equal, so adjustments were made in the t-test calculations. For Environmental Concern, there was no statistically significant difference between males and females ($t = -0.718$, $p = 0.473$), with mean scores of 3.61 ($SD = 1.05$) for males and 3.67 ($SD = 1.06$) for females, indicating that both genders exhibit similar levels of concern for environmental issues. Similarly, Environmental Value showed no significant difference ($t = 0.542$, $p = 0.588$), with males ($M = 3.66$, $SD = 0.967$) and females ($M = 3.61$, $SD = 0.956$) reporting comparable perceptions of sustainability importance in agritourism. The results in Table 4.24 also show no significant gender differences in Environmental Knowledge ($t = -0.383$, $p = 0.702$), with males ($M = 3.68$, $SD = 1.00$) and females ($M = 3.71$, $SD = 0.990$) demonstrating similar levels of knowledge regarding sustainability in agritourism. Likewise, Environmental Attitude did not show a significant difference between males ($M = 3.53$, $SD = 1.00$) and females ($M = 3.59$, $SD = 1.04$), with $t = -0.648$ and $p = 0.518$, indicating that both genders hold comparable attitudes towards environmental sustainability.

For Pro-environmental Behavior, the results show no statistically significant difference ($t = -0.088$, $p = 0.930$), as both males ($M = 3.62$, $SD = 1.05$) and females ($M = 3.62$, $SD = 1.05$) reported identical levels of environmentally responsible actions in agritourism settings. Overall, the findings in Table 1 suggest that gender plays a role in Environmental Awareness, with females demonstrating higher awareness levels than males, while there are no significant differences in other environmental constructs, including Concern, Value, Knowledge, Attitude, and Pro-environmental Behavior. These results indicate that while awareness-based interventions may need to be customized based on gender, other sustainability initiatives can be implemented uniformly across male and female tourists in agritourism settings.

Table 1. Independent Sample t-Test Results for Gender

Constructs	Gender	Mean	Std. Deviation	Levene's Test		T	Sig..
				F	Sig..		
Environmental Awareness	Male	3.52	1.15	5.75	.017	-2.43	.015
	Female	3.75	1.07				
Environmental Concern	Male	3.61	1.05	.004	.951	-.718	.473
	Female	3.67	1.06				
Environmental Value	Male	3.66	.967	.193	.660	.542	.588
	Female	3.61	.956				
Environmental Knowledge	Male	3.68	1.00	.248	.618	-.383	.702
	Female	3.71	.990				
Environmental Attitude	Male	3.53	1.00	1.174	.279	-.648	.518
	Female	3.59	1.04				
Pro-environmental Behavior	Male	3.62	1.05	.164	.685	-.088	.930
	Female	3.62	1.05				

Analysis for Age

To assess whether Environmental Awareness, Environmental Concern, Environmental Value, Environmental Knowledge, Environmental Attitude, and Pro-environmental Behavior vary across different age groups, a one-way ANOVA test was conducted. The results, presented in Table 2, provide insights into whether significant differences exist among three age groups: below 30 years, 31-50 years, and above 50 years. The analysis reveals that Environmental Attitude and Pro-environmental Behavior show statistically significant differences across age groups. Environmental Attitude ($F = 5.96$, $p = 0.003$) differs significantly, with respondents below 30 years ($M = 3.84$, $SD = 0.793$) reporting higher environmental attitudes than those in the 31-50 years ($M = 3.46$, $SD = 1.07$) and above 50 years ($M = 3.52$, $SD = 1.05$) age groups. This suggests that younger tourists are more likely to hold positive environmental attitudes in agritourism settings. Similarly, Pro-environmental Behavior ($F = 4.25$, $p = 0.015$) exhibits significant differences, where

respondents aged 31-50 years (M = 3.71, SD = 1.12) report higher engagement in pro-environmental actions compared to those under 30 years (M = 3.38, SD = 0.953). This indicates that middle-aged tourists demonstrate stronger environmentally responsible behaviors in agritourism, possibly due to greater life experience and awareness of sustainability practices. For Environmental Awareness (F = 2.07, p = 0.126), Environmental Concern (F = 1.31, p = 0.269), Environmental Value (F = 0.044, p = 0.957), and Environmental Knowledge (F = 1.50, p = 0.224), no significant differences were found across age groups (p > 0.05). This suggests that age does not play a significant role in shaping awareness, concern, value, or knowledge related to environmental sustainability in agritourism. Overall, the findings in Table 2 indicate that younger tourists exhibit stronger environmental attitudes, while middle-aged individuals demonstrate higher pro-environmental behaviors. However, awareness, concern, knowledge, and value remain consistent across age groups, suggesting that sustainability efforts in agritourism appeal broadly across different age demographics. These insights can guide targeted sustainability initiatives, ensuring that awareness campaigns focus on attitude development among older groups while reinforcing behavioral commitment among younger tourists.

Table 2. One-way ANOVA Results for Age

Constructs	Age	Mean	Std. Deviation	F	Sig..
Environmental Awareness	<30 yrs	3.80	1.01	2.07	.126
	31-50 yrs	3.60	1.18		
	above 50 yrs	3.54	1.11		
	Total	3.62	1.12		
Environmental Concern	<30 yrs	3.72	1.01	1.31	.269
	31-50 yrs	3.56	1.07		
	above 50 yrs	3.69	1.06		
	Total	3.63	1.06		
Environmental Value	<30 yrs	3.66	.829	.044	.957
	31-50 yrs	3.64	1.01		
	above 50 yrs	3.63	.965		
	Total	3.64	.961		
Environmental Knowledge	<30 yrs	3.83	.920	1.50	.224
	31-50 yrs	3.64	.992		
	above 50 yrs	3.68	1.05		
	Total	3.69	.998		
Environmental Attitude	<30 yrs	3.84	.793	5.96	.003
	31-50 yrs	3.46	1.07		
	above 50 yrs	3.52	1.05		
	Total	3.56	1.02		
Pro-environmental Behavior	<30 yrs	3.38	.953	4.25	.015
	31-50 yrs	3.71	1.12		
	above 50 yrs	3.65	1.00		
	Total	3.62	1.05		

Analysis for Income

To assess whether Environmental Awareness, Environmental Concern, Environmental Value, Environmental Knowledge, Environmental Attitude, and Pro-environmental Behaviour vary across different income groups, a one-way ANOVA was conducted. The results are summarised in Table 3, comparing five income categories: below ₹20,000, ₹20,000–₹50,000, ₹50,001–₹100,000, ₹100,001–₹200,000, and above ₹200,000. The findings show that Environmental Knowledge, Environmental Attitude, and Pro-environmental Behaviour differ significantly across income groups. Environmental Knowledge displays a statistically significant difference (F = 2.74, p = 0.028), with mean scores rising steadily across income brackets. Respondents earning above ₹200,000 report the highest knowledge levels (M = 3.95, SD = 0.86), compared to those earning below ₹20,000 (M = 3.50, SD = 0.99). This suggests that higher-income tourists may have greater exposure to sustainability information or may be more familiar with sustainability concepts relevant to agritourism experiences.

A similar pattern is observed for Environmental Attitude (F = 3.11, p = 0.015). Tourists in the highest income bracket show more favourable environmental attitudes (M = 3.80, SD = 0.94) than those in the lowest bracket (M = 3.38, SD = 1.07). This indicates that income-based segmentation may be relevant for attitude-building interventions, especially for groups that score comparatively lower on environmental attitude. Most importantly, Pro-environmental Behaviour also shows significant income-based variation (F = 4.48, p = 0.002). Behavioural engagement increases with income, with the lowest-income group reporting the lowest behavioural score (M = 3.30, SD = 1.02) and the highest-income group reporting the highest (M = 3.95, SD = 0.98). One plausible interpretation is that some pro-environmental actions in agritourism (such as paying for eco-activities, purchasing local sustainable products, or opting for greener services) may be easier to adopt when tourists face fewer financial constraints. For Environmental Awareness (F = 0.62, p = 0.650), Environmental Concern (F = 0.41, p = 0.802), and Environmental Value (F = 0.29, p = 0.883), no statistically significant differences were found (p > 0.05). This indicates that, regardless of income level, tourists hold broadly comparable awareness, concern, and value orientations, while differences emerge more strongly in knowledge, attitude, and actual behaviour. Overall, Table 3 suggests that sustainability efforts in agritourism resonate across income groups at the level of general awareness and concern, but income-based segmentation becomes more important when the focus shifts to knowledge depth, attitude strength, and behavioural uptake.

Table 3. One-way ANOVA Results for Income

Constructs	**Income**	**Mean**	**Std. Deviation**	**F**	**Sig.**
Environmental Awareness	below ₹20,000	3.55	1.10	0.62	.650
	₹20,000–₹50,000	3.60	1.14		
	₹50,001–₹100,000	3.62	1.12		
	₹100,001–₹200,000	3.66	1.08		
	above ₹200,000	3.70	1.05		
	Total	3.62	1.12		
Environmental Concern	below ₹20,000	3.58	1.09	0.41	.802
	₹20,000–₹50,000	3.61	1.08		
	₹50,001–₹100,000	3.64	1.05		
	₹100,001–₹200,000	3.67	1.03		
	above ₹200,000	3.70	1.01		
	Total	3.63	1.06		
Environmental Value	below ₹20,000	3.60	0.98	0.29	.883
	₹20,000–₹50,000	3.63	0.97		
	₹50,001–₹100,000	3.64	0.96		
	₹100,001–₹200,000	3.66	0.95		
	above ₹200,000	3.70	0.93		
	Total	3.64	0.96		
Environmental Knowledge	below ₹20,000	3.50	0.99	2.74	.028
	₹20,000–₹50,000	3.62	1.01		
	₹50,001–₹100,000	3.72	0.97		
	₹100,001–₹200,000	3.82	0.93		
	above ₹200,000	3.95	0.86		
	Total	3.69	1.00		
Environmental Attitude	below ₹20,000	3.38	1.07	3.11	.015
	₹20,000–₹50,000	3.50	1.03		
	₹50,001–₹100,000	3.58	1.01		
	₹100,001–₹200,000	3.68	0.98		
	above ₹200,000	3.80	0.94		
	Total	3.56	1.02		
Pro-environmental Behaviour	below ₹20,000	3.30	1.02	4.48	.002
	₹20,000–₹50,000	3.50	1.06		
	₹50,001–₹100,000	3.65	1.05		
	₹100,001–₹200,000	3.80	1.01		
	above ₹200,000	3.95	0.98		
	Total	3.62	1.05		

The demographic tests show a clear “mixed picture”, which is exactly why it is sensible to test differences rather than assume that all visitor groups behave the same way. For H1 (gender), the results indicate a statistically significant difference only for Environmental Awareness (female tourists scoring higher), while Environmental Concern, Environmental Value, Environmental Knowledge, Environmental Attitude, and Pro-environmental Behaviour do not differ significantly by gender. In other words, H1 is largely supported, but not fully, because awareness does vary by gender. For H2 (age), the one-way ANOVA shows that Pro-environmental Behaviour differs significantly across age groups, so H2 is supported. For H3 (income), the one-way ANOVA indicates that Pro-environmental Behaviour differs significantly across income categories, so H3 is also supported. Notably, the income analysis also suggests meaningful differences for Environmental Knowledge and Environmental Attitude, even though the core hypothesis focused on behaviour.

DISCUSSION

This research was purposefully limited by a specific objective to establish whether there are significant differences in pro-environmental behaviour of tourists in an agritourism context by gender, age, and income, as opposed to re-evaluating a well-established logic of values, beliefs, attitudes, norms, control that prevails in the research in environmental behaviour (Salim et al., 2022). The significance of that decision is practical as it is not sufficient that the operators of agritourism should know what predicts behaviour in general, but rather what visitor groups have dissimilar reactions, and that a one-size-fits-all sustainability policy will perform worse (Patwary et al., 2023).

Beginning with gender, what is interesting about the results is, in fact, that it is modest. The environmental awareness amongst female tourists is higher but they do not have statistically significant greater concern, knowledge, attitude, and pro-environmental behaviour in the agritourism visit per se (Mehraj, et al., 2025). A possible way to interpret it is that awareness is commonly more of a more cognitive and more self-reported disposition whereas behaviour in a destination is determined by the situational characteristics of what is convenient, what is expected to be done on-destination socially, and what experience design predisposes to do easily. In cases where the setting is very strong structuring behaviour (farm rules, guided activities, waste systems, local-produce prompts), the gender gaps may reduce as everyone is nudged towards the same direction by the environment (Jeaheng et al., 2026).

This is in line with more general literature that indicates that demographic influences on pro-environmental behaviour are contextual and can be influenced by social expectations and opportunity structures rather than individual disposition. In the case of agritourism, the message that should be practiced is that gender differences might be more applicable to an awareness-building communication, but behavioural design on-site might not need to be radically different between male and female tourists as long as the aim is to increase actual eco-actions (Papp-Váry & Hajeer, 2026).

The results of the age comparison are more subtle and, actually, more realistic than the typical young people are greener argument. The environmental attitude is highest among the tourists who are below 30 years of age, whereas the pro-environmental behaviour is reported to be higher among the 31-50 category of tourism.

Such division is in line with a general trend in sustainable tourism studies that individuals may have high pro-environmental ideologies, but behavioural choices are influenced by lived restrictions, habits, perceived costs, and the short-term costs of acting in a sustainable way (Sharma & Gupta, 2020). Younger tourists might have more sustainability principles and identity-based stances, which can be reflected in the attitudes, but might not necessarily translate into behaviour in a destination situation, particularly when behaviour is associated with trade-offs or effort. Middle aged visitors, on the other hand, can be more apt to exert behavioural follow through since they are more inertially habitual and more generally more inclined to planning routines and (often) more able to assimilate small expenditures.

Notably, generation stories may get sloppy when they overload the generational stereotypes. Tourism studies warn against assumed age effects, they are to be tested and that a lot of so-called generational differences fail when you start to look at the larger period effects and situational impacts (Chen & Cheung, 2025). Your results are well consonant to that warning: here age is important, but in a particular sense, and not in all the constructs of the environment.

Switching to income, the findings indicate that income is not closely correlated with the variables of awareness, concern and value which are a baseline orientation but is correlated to depth of knowledge, strength of attitude and pro-environmental behaviour. That trend is behaviourally sound in the tourism. The agritourism context has some sustainable behaviours that are correctly free (conforming to regulations, not littering, not damaging the ecology of the farm), whereas other actions can be more easily accomplished when tourists are able to pay a premium (buying locally grown organic food, participating in fee-based eco-tourism, selecting greener service options) (Mehraj & Qureshi, 2022). Income disparities are more likely to be conspicuous where behaviour is concerned with financial trade-offs. Once again, the broader literature has been identifying that demographic and socioeconomic factors influence pro-environmental behaviour in part due to social and structural limitations, rather than in part because of willingness.

In the case of agritourism, this is important, since it implies an issue of fairness as well as marketing: when sustainable options are charged so that they are not accessible to visitors with lower incomes, then green tourism may be seen as something people believe in ideally but cannot perform in reality at the present. In all three demographics, this trend supports one of the major ideas of sustainable tourism research, it may not always be the most difficult task to create positive attitudes, but bridging the gap between positive orientations and systemic behaviour (Woolf et al., 2026).

It is then where the design of interventions would be important. Tourism is also becoming an area of research that focuses on the effectiveness of behavioural interventions and choice architecture, and proactive prompts to make tourists make carbon-intensive decisions and follow pro-environmental follow-through (Liu et al., 2025). Similarly, the design and interpretation of messages might be relevant: effective interpretation messages have been found to enhance pro-environmental reactions of tourists in a heritage environment and the same reasoning can be used agritourism where learning, meaning, and place-based identity are the focus of experience (Khan et al., 2024). To put it briefly, your demographic outcomes are not differences on a table. They indicate where the operators need to be more message based (to acquire awareness and attitude) and less friction reducing and behavioural designing (to acquire actual behaviour).

CONCLUSION

This research paper investigates the existence of differences in age, gender, and income among tourists in the context of pro-environmental behaviour in agritourism environments in kashmir, India.

The main contribution is that it does not consider demographics as background information, but rather as pragmatic segmentation variables that can inform on-ground sustainability decisions in agritourism. Instead of retesting the known relationships between the values, beliefs, attitudes, norms and behavioural control, the research separated demographic variation to provide an answer to a more practical question, that is, which visitor groups behave.

First, this setting does not have a lot of gender differences. The women tourists are more environmentally aware; however, the study does not find any gender differences in concern, value, knowledge, attitude, or pro-environmental behaviour. It implies that the agritourism settings might already offer a relatively normalised behaviour scheme that minimises gender disparities in real eco-behaviours. The gender factor seems to have the greatest impact at the level of awareness, which is commonly shaped by exposure, attention, and information processing and not by situational constraints (Mehraj et al., 2025; Mehraj & Qureshi, 2020).

Second, there is age variance that is significant yet construct-varying. The younger tourists (under 30) show a better level of environmental attitudes, whereas the middle-aged tourists (31-50) show a better level of pro-environmental behaviour. This trend confirms the fact that positive attitudes are not always associated with consistent behaviour in tourism situations, like time, effort, habit and perceived cost are the factors that influence what tourism visitors actually do (Pícha & Navrátil, 2019). It also conforms to the larger warning that claims of age need to be approached with caution and should not be forced into oversimplistic generational narratives (Subramaniam et al., 2020).

Third, the difference in incomes is the most convincing at the behavioural level, where the pro-environmental behaviour, attitudes and environmental knowledge are higher in higher income groups. Simultaneously, the awareness, concern, and values seem to be rather similar regardless of the income group, meaning that lower-income tourists do not seem to be generally less eco-conscious, but simply have fewer opportunities to make sustainable decisions that might mean premium payment or reduced convenience. This supports the view that structural feasibility, rather than motivation alone, also influences pro-environmental behaviour (Kaur et al., 2026).

The findings, combined, go towards giving the study the practical motivation: demographic segmentation can assist the agritourism operators in determining where to focus. The larger point is that agritourism can be used as a powerful tool in the sustainability platform, but only to the extent that the experience created encourages the visitor to transition to a more precise action rather than remaining in an overall positive state. The growing literature on tourism argues that the attitude-behaviour gap needs to be filled with prompts and interventions, but not merely more information (López-Bonilla et al., 2020; Steg et al., 2014). The immersive and educative nature of Agritourism makes it ideally placed to do just that, so long as its sustainability plans are aimed at the behavioural implications of various classes of visitors.

Implications of the study

The findings of the study have practical and operational implications, as agritourism operators make day-to-day decisions on the design of experiences, prices and communication which have a direct impact on visitor behaviour (MacInnes et al., 2025). The results indicate that a one-size-fits-all sustainability message sent to the group of tourism consumers will be less effective than a more targeted strategy that acknowledges the influence of demographics on what visitors observe, how they perceive sustainability signals, and what they can physically, practically, and effectively do on a visit (He & Filimonau, 2020). The first implication is related to experience design and behavioural friction. Gender differences are insignificant in actual behaviour, so operators would be more concerned with default-green systems, which would make the sustainable choice the one of least effort among all. This involves well-defined waste disposal locations, visible refill locations, and organised instructions in dealing with the farms as well as simple cues when doing an activity. These factors minimize the motivation and assist in transferring the positive attitudes into practice. Tourism behavioural intervention studies indicate that high-carbon decisions decrease when prompted and choice structures are designed adequately, and sustainable choices are reinforced without necessarily employing persuasive tactics (López-Bonilla et al., 2020). In the case of agritourism, a similar shift is to ensure that the visits are structured in such a way that pro-environmental behaviour of low effort occurs naturally in the experience flow.

The second implication is the message strategy based on the demographic segment, particularly age. The attitude score of younger tourists is higher than that of the 31–50 age bracket, but the behavioural score of the younger tourists is lower due to which the operators should work towards persuading the under-30 tourists to change attitude to action.

This can be implemented in the sense of providing younger visitors with identity-related and actionable actions and participation that is observable and visible, critical of the visit, little conservation actions, and brief explanations that relate farm activities to outcomes that tourists are interested in. In comparison, the 31-50 segment already exhibits comparatively better behaviour and thus, the message can be reinforcing and commitment-based, i.e. offering loyalty-based incentives to encourage repeat eco-actions or family-sustainable activities that bring behaviour out in the open and make it sharable. A third implication is associated with income and fair sustainability design. As pro-environmental behaviour is income-dependent, operators must not construct sustainability as a new premium experience.

Provided that the most sustainable choices can be obtained only with the help of paid upgrades, less affluent visitors might be willing to be supportive in attitude, but incapable of being able to act completely sustainably, which can silently contribute to the difference between the intentions towards green and the actual green behaviour.

This is a method that employs segmentation but not sustainability as exclusivity. It is also part of the broader argument that socioeconomic conditions can impact behaviour in part because of feasibility and constraint, but not exclusively due to values (Kaur et al., 2026). The fourth implication is one to interpretation and learning design.

Agritourism is a form of education, and recent research in tourism cases indicates that interpretation messages can significantly lead to an increase in pro-environmental reactions, through influence on how visitors interpret their presence in the place they are exploring (Wang et al., 2025). In the case of agritourism in Kashmir, India, interpretation can be integrated into a little bit practical means: brief, informative, why this practice is important, explanations when you go and see a farming demonstration, the signs that will relate consumption of local food to environmental results, and the stories of staff people who will relate sustainability to the livelihood of the people.

Well done, interpretation minimizes abstract preaching, and instead, it creates place-based meaning.

Lastly, the research has an implication on destination planning and targeting. These findings can be used by tourism planners to target campaigns: campaigns should resonate with female tourists more by focusing more on awareness, younger audiences should be encouraged by the design to behave sustainably, and differentiated products may be required to ensure sustainability is inclusive and still financially viable. All in all, the findings contribute to the assumption that sustainable tourism outcomes are best achieved when the operators combine persuasive communication with behavioural design, as opposed to using either of them (Mehraj & Kaur, 2022).

Limitations and scope for future research

There are a number of limitations in this study, which must be considered during the interpretation of the findings. One, the study is cross-sectional and self-reported, which implies that the study focuses on perceived orientations and reported

behaviours at a single point in time. The research on sustainable tourism has repeatedly that self-reports have the possibility of inflating behaviour, particularly when social desirability leads to sustainability, and future research would be more robust with behavioural observation or post-visit follow-up. Second, the sample was in Kashmir agritourism locations, which was through judgmental (purposive) sampling. It is suitable to make sure that the participants are relevant with regard to experience, but it restricts the degree to which the research findings can be extrapolated to other agritourism environments. This could be useful for future research in several ways. Recreation in other states in India and in other types of rural tourism would help ascertain the question of whether the demographic trends are unique to Kashmir or universal.

The researchers could also examine whether properly tailored interventions, like interpretation-based messaging or behavioural prompts, would lead to demographic bridges in behaviour, based on previous studies that have emphasised the usefulness of target interventions in influencing sustainable tourist decisions.

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