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THE IMPACT OF ECOTOURISM EFFICIENCY ON PROMOTING SUSTAINABLE TOURISM DEVELOPMENT IN THE NORTH CENTRAL REGION

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Abstract: This study aims to evaluate the impact of ecotourism efficiency on sustainable tourism development in the North Central region of Vietnam. It emphasizes the interconnected relationships among natural resource conservation, community awareness, and local economic growth as essential pillars for building effective sustainability strategies. The research applies the PLS-SEM method, which is particularly well-suited for analyzing higher-order structural models. The study is carried out in two distinct phases: a qualitative phase for validating measurement scales and designing surveys based on prior literature, followed by a quantitative phase to examine lower-order constructs (LOCs) and re-estimate the model using higher-order constructs (HOCs) treated as first-order latent variables. All relationships in the model are statistically significant, confirming the robustness of the proposed framework. Among the influencing variables, Ecotourism Performance (TP) exerts the strongest effect on Sustainable Tourism Development (SDT), followed by Ecotourism Quality. The indirect effect analysis further confirms that all mediating relationships are significant. Ecotourism Quality plays a partial complementary mediating role, indicating that improving ecotourism efficiency not only has a direct effect on sustainability but also enhances ecotourism quality, which in turn supports sustainable development. The findings confirm that ecotourism efficiency is a key driver of environmental protection, cultural preservation, and economic growth in the region. Moreover, ecotourism contributes to raising environmental awareness among both tourists and local communities. It plays a vital role in job creation and income generation, particularly for ethnic minority populations. Ecotourism also supports the preservation and promotion of indigenous culture and traditional values, which are essential for long-term tourism sustainability. Furthermore, the rising demand for ecotourism fosters investment in green infrastructure, such as eco-friendly transport and accommodations that utilize renewable energy. The study also acknowledges several limitations, including the narrow geographical scope and the lack of assessment regarding long-term impacts. Future research is encouraged to expand to other regions, explore the influence of national policies on ecotourism development, and investigate the role of technology and innovation in advancing sustainable tourism practices.

Keywords: ecotourism, sustainable tourism development, cultural preservation, ecotourism quality, local economic growth

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INTRODUCTION

Central Vietnam is a vital center for cultural and ecological tourism in Vietnam, renowned for its globally recognized cultural and natural heritage systems. In recent years, numerous regional tourism brands have established their presence on both domestic and international tourism maps. However, to achieve significant breakthroughs in tourism development, it is imperative to foster strong collaboration among provinces in the region. Such cooperation could create a chain of unique and appealing tourism products, offering visitors distinctive and captivating experiences. According to the Vietnam National Administration of Tourism, the provinces of Nghe An, Thanh Hoa, Ha Tinh, Quang Binh, Quang Tri, and Thua Thien Hue have established a shared coordination framework for strategic and product development. The region currently hosts 234 tourism and travel service providers. Through these collaborations, inter-regional tourism chains like the “Central Heritage Route” and the “Central Vietnam Ecological and Spiritual Cultural Route” have emerged, leveraging local advantages to attract tourists. Despite these developments, tourism in the region remains predominantly focused on sightseeing and leisure, with limited emphasis on sustainable or ecological tourism.

This oversight is significant, given the region's abundance of national parks, diverse natural landscapes, and renowned ecological destinations. Researching ways to enhance the effectiveness of ecotourism in Central Vietnam is essential for its sustainable development. The area boasts an extensive array of unique natural and cultural resources. Against the backdrop of increasing environmental and social awareness, ecotourism has become an undeniable trend. Developing ecotourism not only yields economic benefits but also contributes to environmental protection, ecosystem preservation, and restoration.

Improving ecotourism effectiveness offers both short-term benefits and long-term opportunities for regional development. By strengthening sustainable resource management and utilization, the ecotourism sector in this region can deliver high-quality travel experiences, attract more visitors, and contribute to the economic and social growth of

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Central Vietnam. Previous studies by Hoang et al. (2022) have not yet incorporated factors reflecting the effectiveness of implementing specific ecotourism models, such as sustainable management, community participation, or public–private partnerships, which may play a crucial role in enhancing tourist satisfaction and loyalty.

In addition, the lack of an in-depth investigation within a specific geographical area has limited the ability to identify distinct characteristics and localized impacts at individual ecotourism sites. Similarly, Hoang (2023) identified key elements of sustainable tourism development, including economic, social, and environmental factors, but did not delve into quality or ecological efficiency related to environmental conservation. Research by Wardana et al. (2021), Helmi & Naparin (2023), Khan et al. (2021) also highlighted factors influencing sustainable tourism development but lacked consistency in identifying the most critical factors and understanding their interactions. This inconsistency presents challenges in formulating a comprehensive and precise model for sustainable ecotourism.

Therefore, it is crucial to conduct further research to evaluate and comprehensively analyze the factors influencing ecotourism in Central Vietnam. Developing appropriate models to understand the relationships between these factors and proposing specific measures to promote sustainable development in the ecotourism sector are necessary steps. Addressing these challenges through targeted research will be pivotal for advancing tourism in this region.

LITERATURE REVIEW

1. Ecotourism

The International Ecotourism Society TIES (2015) defines ecotourism as "responsible travel to natural areas that conserves the environment, sustains the well-being of local people, and involves interpretation and education." Ecotourism is regarded as an effective tool for protecting natural environments by generating income, promoting environmental ethics and conservation education, and fostering the active participation of local communities (Ross & Wall, 1999). Ecotourism is regarded as a responsible form of travel to untouched natural areas that seeks to deepen environmental and cultural understanding while minimizing disruption to local ecosystems.

It not only supports environmental conservation efforts but also provides meaningful economic benefits to indigenous and local communities (Giao et al., 2021). Conservation and development efforts are undertaken within the framework of sustainability, taking into account economic, social, and environmental factors (Angessa et al., 2022). Thus, the development of ecotourism extends beyond environmental protection and conservation to include economic aspects, income generation, education, and the integration of local communities (Wardana et al., 2021).

2. Ecotourism performance

Ecotourism performance is a critical aspect in evaluating and measuring the outcomes of ecotourism activities. It is assessed not only through economic indicators such as revenue and profitability but also by incorporating environmental, social, and cultural factors Wardana et al (2021). The performance of ecotourism reflects the degree of success in ecotourism initiatives, and enhancing this performance is not only a fundamental goal but also key to ensuring the long-term sustainability of ecotourism (Franzoni, 2015; Ghoochani et al., 2020).

Wardana et al. (2021) further outline four dimensions for evaluating ecotourism performance: environmental conservation, service quality, economic development, and infrastructure and control. These dimensions underscore the comprehensive approach required to achieve balanced and sustainable ecotourism outcomes.

3. Sustainable tourism

According to the United Nations World Tourism Organization (UNWTO, 2005), "Sustainable tourism is tourism that meets the current needs of tourists and destinations while ensuring and enhancing resources for the future. It involves managing all resources to fulfill economic, social, and aesthetic needs while preserving cultural and environmental integrity." Similarly, Helmi & Naparin (2023) define sustainable tourism as a form of tourism that balances the needs of travelers with the protection of natural resources, culture, and local community livelihoods.

The primary objective is to minimize the negative impacts of tourism while balancing environmental protection, cultural integrity, social equity, and economic benefits. Sustainable tourism aims to meet the needs of local communities and improve their quality of life in both the short and long term (Hashemkhani Zolfani et al., 2015).

Based on these concepts, this study defines sustainable tourism as a type of tourism in which both tourists and local communities share responsibilities. The goal is to ensure long-term economic, cultural-social, and environmental sustainability for local communities while providing the highest level of satisfaction to tourists (Huang et al., 2023).

In the current context, sustainability in tourism is assessed based on three main pillars. First, economic sustainability requires stable economic growth, enabling the tourism sector to generate income and employment for local residents, thus improving living standards and promoting development based on community assets.

Second, environmental sustainability demands that economic and tourism development be paired with preserving natural landscapes and maintaining the balance of ecosystems. Third, cultural-social sustainability ensures that development does not erode local identity, preserves the authenticity and simplicity of the local populace, and promotes the conservation and enhancement of valuable cultural traditions in each region (Hoang, 2023).

4. Hypotheses

4.1. Ecotourism performance

Ecotourism performance focuses on measuring the results of environmental protection and maintenance efforts,

while enhancing income, educational infrastructure, nature conservation, and the welfare of local communities, as well as preserving and developing the economy and infrastructure. Ecotourism often concentrates on the preservation and conservation of natural areas, creating unique experiences for tourists.

Destinations such as national parks, nature reserves, and primeval forests are not only attractive spots but also places where tourists can directly engage with nature and learn about biodiversity (Ghoochani et al., 2020).

Ecotourism frequently encourages interaction with the local community and culture. Tourists are often encouraged to participate in cultural activities such as local festivals, learning traditional crafts, or engaging in environmental conservation projects. These experiences not only enhance the uniqueness of the travel journey but also create meaningful and memorable experiences for the tourists. Therefore, the performance of ecotourism is evaluated from various perspectives. In ecotourism research, performance includes service quality, conservation, economic development, infrastructure, and control factors (Helmi & Naparin, 2023; Viera Trevisan et al., 2022).

Furthermore, ecotourism creates job opportunities and income for local communities, boosts economic development, and improves the quality of life. Promoting awareness and education about the value of the environment and local culture not only enriches the tourist experience but also fosters consensus and support from the community. Ecotourism activities often generate value chains and business opportunities for local enterprises, contributing to economic diversification and reducing dependence on other income sources (Ghoochani et al., 2020; Wardana et al., 2018; Viera Trevisan et al., 2022). The effectiveness of ecotourism not only enhances the quality of the tourist experience but also contributes to environmental conservation, respects local culture, and fosters community economic development. This implies that ecotourism plays a crucial role in building a sustainable and positive tourism industry. Based on the results of studies proving the relationships from the research of (Hashemkhani Zolfani et al., 2015; Helmi & Naparin, 2023; Wardana et al., 2021), the author proposes the following hypotheses:

Hypothesis H1: Ecotourism performance has a positive influence on Tourism Quality.

Hypothesis H2: Ecotourism performance has a positive influence on Sustainable Tourism Development.

4.2 Tourism quality

The quality of the travel experience can significantly influence the preservation and protection of local environments. According to Khan et al. (2021), service quality encompasses elements such as control, conservation, economic development, infrastructure, and tourism service quality. When tourism is managed professionally and responsibly, it often leads to minimizing negative environmental impacts. Moreover, through environmentally responsible tourism activities, such as ecotourism, visitors have the opportunity to learn about the value of environmental protection and local communities. Additionally, the quality of the travel experience affects the economic and social development of the area. When visitors enjoy unique and memorable experiences, they are likely to spend on local services, products, and tourism activities, contributing to the economic development of the community and improving the quality of life for local residents (Khan et al., 2021). Furthermore, previous research, particularly by Helmi & Naparin (2023) and Wardana et al. (2021), also highlights this relationship. Based on this, the author proposes the following hypothesis:

Hypothesis H3: Ecotourism quality positively impacts Sustainable Tourism Development.

Building upon Hypotheses H2 and H3, the author proposes the following indirect effect hypothesis:

Hypothesis H4: Tourism quality mediates the influence of ecotourism performance on Sustainable Tourism Development.

Based on the above analysis, the conceptual framework of this study is proposed as shown in Figure 1.

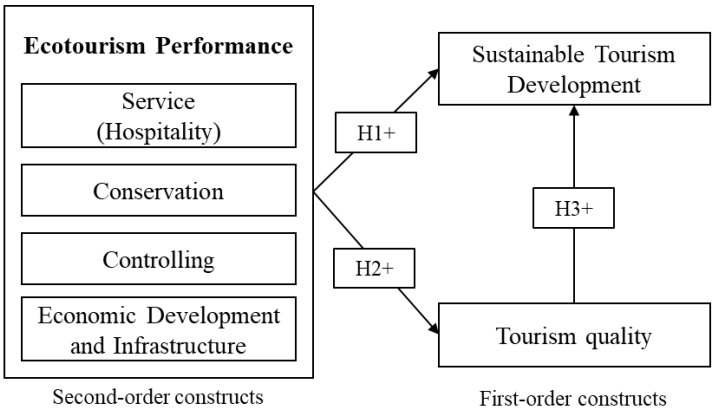

Figure 1. Conceptual framework (Note: CT: Controlling; CS: Conservation; EI: Economic Development and Infrastructure; SQ: Service (Hospitality) TP: Ecotourism Performance; TQ: Tourism Quality; STD: Sustainable Tourism Developmen)

RESEARCH METHOD

After synthesizing the literature review, consulting with experts, and referencing the theoretical framework, the majority of the proposed factors by the authors are found to be interrelated and collectively impact the development of sustainable tourism. Based on this foundation, the authors continue to build the research model based on the hypotheses outlined. In the proposed model, the factors are measured typically through PLS-SEM, with Ecotourism Performance

being treated as a second-order variable. Hair et al. (2010) argue that to perform exploratory factor analysis (EFA) effectively, the sample size should be approximately 5 to 10 times the number of observed variables.

For regression analysis, according to Tabachnick & Fidell (2001), the minimum sample size should be calculated using the formula: 50 + 8 x m (where m is the number of independent variables), which, based on this formula, requires a sample size of 90 (50 + 8 x 5). However, to avoid complications and risks associated with distributing surveys via Google Forms and to ensure safety and reliability, the author has decided to select a sample size of 700. The collected surveys with valid data were processed and analyzed using SPSS 27.0 and SMART PLS 4 software.

This study conducts a quantitative model analysis using the PLS-SEM method. PLS-SEM is considered an appropriate choice for studies employing higher-order structural equation models. The study is conducted in two phases: qualitative and quantitative research. Phase 1: The qualitative study is conducted to identify and preliminarily test the measurement scales, serving as the foundation for constructing the questionnaire for the quantitative study. The author draws upon measurement scales from previous studies to build the questionnaire for the independent, mediating, and dependent variables. Phase 2: The quantitative study is carried out in two stages.

In the first stage, lower-order constructs (LOC) are examined in the structural model and are directly linked to other constructs without being mediated by higher-order constructs (HOC). In the second stage, the structural model is re-estimated, and second-order constructs become first-order constructs. Observed variables (LOC) are converted into latent variables, and explanatory constructs (HOC) become first-order latent variables.

RESULTS AND DISCUSSION

1. Respondent demographic profile

The characteristics of the study (Table 1) are reflected through the examination of demographic variables such as age, gender, education level, occupation, and income of the study participants. These details can provide a deeper understanding of the study population and the impact of demographic factors on the research. By analyzing the demographic variables of tourists participating in ecotourism in the North Central region, the study can identify trends and preferences among different age groups, occupations, income levels, and so on, regarding this type of tourism.

Table 1. Statistics demographic profile of respondents

		Frequency	Percentage
Gender	Male	338	47.08%
	Female	380	52.92%
Age	18 - 24 years old	161	22.42%
	25 - 30 years old	214	29.81%
	31 - 36 years old	291	40.53%
	Above 36 years old	52	7.24%
Occupation	Office worker	469	65.32%
	Civil servant/ public employee	153	21.31%
	Self-employed	96	13.37%
Income	Below 10 million VND	98	13.65%
	From 10 to 20 million VND	269	37.47%
	From 21 to 30 million VND	240	33.43%
	Above 30 million VND	111	15.46%

The sample consists of 718 respondents, with a balanced gender distribution of 338 males and 380 females. The age composition is diverse, with the majority aged 31–36 years (291 respondents), followed by 25–30 years (214 respondents), 18–24 years (161 respondents), and those above 36 years (52 respondents).

In terms of occupation, 469 respondents are office workers, 153 are civil servants or public employees, and 96 are self-employed. Income levels are varied, with 269 respondents earning between 10–20 million VND, 240 earning 21–30 million VND, 111 earning above 30 million VND, and 98 earning below 10 million VND. This diverse composition ensures the study captures a wide range of perspectives and experiences.

2. Model evaluation

2.1. Phase 1 model evaluation

According to Henseler et al. (2009), the outer loading factor coefficient should be greater than 0.7. Based on the results (Figure 2), it can be observed that all factor loading coefficients exceed the threshold of 0.7 (Henseler et al., 2009).

Therefore, all observed variables are significant in the model, and the LOC variables meet the conditions to proceed with the evaluation of other fit criteria. To draw the most accurate conclusions, the author evaluates the reliability based on three reliability indices: Cronbach's alpha, rho_A, and CR. The convergent validity of each factor was assessed through the CR index, which represents the composite reliability of each factor. The results in Table 2 show that all factors have CR values ranging from 0.916 to 0.947, exceeding the acceptable threshold of 0.7 (Hair et al., 2017).

For the Cronbach's Alpha reliability coefficient (Table 2), the factors range from 0.862 to 0.930, which aligns with the recommendation by Hair et al. (2010), with the value range of 0.7 < Cronbach's Alpha < 0.95. Finally, for the rho_A value, the factors range from 0.863 to 0.930, indicating high reliability of the observed variables in each factor (Sarstedt et al., 2019).

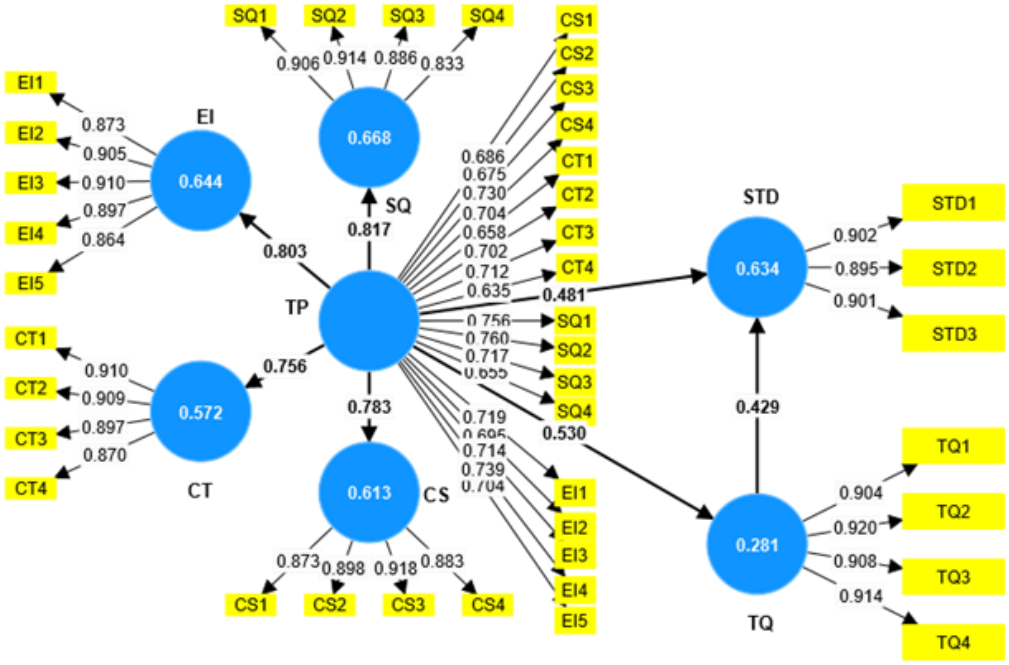

Figure 2. Results of the PLS-SEM Measurement Model for the LOC Variables Phase
(Note: CT: Controlling; CS: Conservation; EI: Economic Development and Infrastructure; SQ: Service (Hospitality)
TP: Ecotourism Performance; TQ: Tourism Quality; STD: Sustainable Tourism Development)

Discriminant validity testing of lower-order

The results in Table 3 show that the HTMT values are all < 0.85, meeting the criteria established by Henseler et al. (2015) to proceed with the subsequent tests.

Table 2. Evaluation of the Reliability of the LOC
(Note: CT: Controlling; CS: Conservation; EI: Economic Development and Infrastructure; SQ: Service (Hospitality)
TP: Ecotourism Performance; TQ: Tourism Quality; STD: Sustainable Tourism Development)

	Cronbach's Alpha	rho_A	CR	AVE
CS	0.909	0.910	0.936	0.786
CT	0.899	0.902	0.930	0.768
EI	0.930	0.930	0.947	0.782
SQ	0.897	0.900	0.928	0.764
STD	0.862	0.863	0.916	0.784
TQ	0.924	0.927	0.946	0.813

Table 3. Results Discriminant Validity Testing of Lower-Order
Note: CT: Controlling; CS: Conservation; EI: Economic Development and Infrastructure; SQ: Service (Hospitality)
TP: Ecotourism Performance; TQ: Tourism Quality; STD: Sustainable Tourism Development)

	CS	CT	EI	SQ	STD	TQ
CS						
CT	0.326					
EI	0.716	0.383				
SQ	0.458	0.642	0.445			
STD	0.564	0.647	0.560	0.587		
TQ	0.413	0.311	0.381	0.480	0.681	

2.2. Phase 2 model evaluation

In phase two, the first-order latent variables (LOC) will be standardized through the weighted average method using the latent variable index (Sarstedt et al., 2019). This process allows the second-order constructs to be standardized into first-order constructs. Based on the results in Figure 3 regarding the factor loadings, it can be observed that the values of the factors range from 0.758 to 0.920, all exceeding the threshold of > 0.7. According to Henseler et al. (2015), the outer loading factor coefficient should be > 0.7, indicating that all observed variables are significant in the model.

The results in the table show that the Cronbach's Alpha reliability coefficient ranges from 0.767 to 0.924. According to Hair et al. (2019), Cronbach's Alpha should exceed 0.7, indicating that the results meet the required standards. As for the rho_A and CR coefficients, they are both above 0.7, so it can be concluded that the reliability of the factors meets high standards based on the testing of three different reliability indices, ensuring an objective evaluation of their reliability.

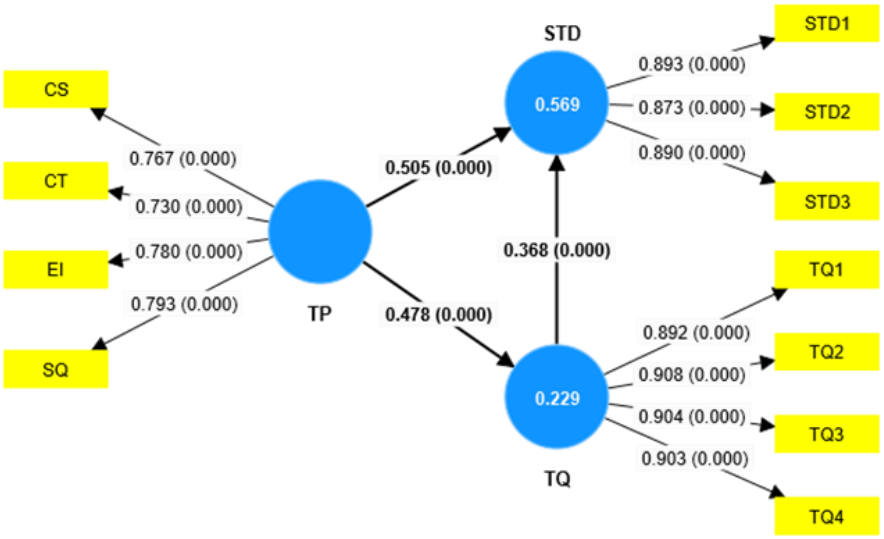

Figure 3. Results of the PLS-SEM Measurement Model for the HOC Variables Phase
(Note: TP: Ecotourism Performance; TQ: Tourism Quality; STD: Sustainable Tourism Development)

Additionally, considering convergent validity, the AVE values for the factors range from 0.589 to 0.813, which is greater than 0.5 (Hair et al., 2017), indicating that the model achieves high convergent validity.

The results in the Table 4 also show that the highest HTMT value is 0.837, which is less than 0.85, and all other HTMT coefficients are below 0.85, meeting the criteria set by Henseler et al. (2015). This demonstrates that the factors have high discriminant validity in the measurement model.

Table 4. Reliability, Discriminant Validity, and Convergent Validity Testing of the Model
(Note: TP: Ecotourism Performance; TQ: Tourism Quality; STD: Sustainable Tourism Development)

	Cronbach's Alpha	rho_A	CR	AVE	STD	TP	TQ
STD	0.862	0.863	0.916	0.784			
TP	0.767	0.768	0.852	0.589	0.837		
TQ	0.924	0.927	0.946	0.813	0.681	0.562	

Model fit testing

According to Hair et al. (2017), the VIF index is used to assess the potential occurrence of multicollinearity among the variables in the measurement model. A VIF value < 10 is acceptable, but to ensure higher reliability, a VIF value < 5 is considered good (Hair et al., 2014). Comparing the results in Table 5 for the variables in the model, it can be seen that the VIF values range from 1.000 to 1.297, all less than 4 (<4), meeting the condition of being < 5, ensuring that multicollinearity is not an issue in the model. According to Hair et al. (2019) the f^2 coefficient reflects the impact of the factors in the structural model after being standardized. Based on the results in Table 5, it shows that the values are all greater than 0.02 and even exceed 0.35, indicating that the variables have a significant effect on the dependent variable in the model. This also demonstrates that the relationships being studied are reasonable.

Table 5. Results of R^2, f^2, and Multicollinearity Tests
(Note: TP: Ecotourism Performance; TQ: Tourism Quality; STD: Sustainable Tourism Development)

	f^2	VIF	STD	TQ
TP → STD	0.457	1.297		
TP → TQ	0.297	1.000		
TQ → STD	0.242	1.297		
R^2			0.569	0.229

Additionally, the R-squared (R^2) coefficient is used to measure the explanatory power of the model for the dependent variable. This means that the variables explain 56.9% of the variance in the Sustainable Tourism Development (STD) variable, with the remaining 22.9% attributed to other variables outside the model.

2.3. Hypothesis Testing

Direct Hypothesis Testing

Based on the 95% confidence level, the P-value results for the relationships between the factors in the PLS-SEM model are all < 0.05, indicating that all relationships are statistically significant (Table 6). This suggests that the influence of the factors on each other is meaningful and relevant within the model. According to the impact coefficients, it can be concluded that Tourism Efficiency (TP) has the strongest effect on Sustainable Tourism Development (SDT) with a value of 0.505.

Table 6. Results of Direct Impact Testing
(Note: TP: Ecotourism Performance; TQ: Tourism Quality; STD: Sustainable Tourism Development)

	Coefficients	SE	T values	P values	Note
H1: TP → STD	0.505	0.028	17.897	0.000	Accepted H1
H2: TP → TQ	0.478	0.041	11.654	0.000	Accepted H2
H3: TQ → STD	0.368	0.033	11.206	0.000	Accepted H3

Mediating Role Testing

From the results of evaluating specific indirect effects and total indirect effects, it can be observed that all mediating relationships are accepted and show a direct (positive) effect, meaning hypothesis H4 is accepted (Table 7). According to Hair et al. (2021); Baron & Kenny (1986), if both indirect and direct effects are significant and in the same direction, it can be concluded that Tourism Quality plays a partial mediating role in an additive form.

Table 7. Results of Specific and Total Indirect Effects Testing
(Note: TP: Ecotourism Performance; TQ: Tourism Quality; STD: Sustainable Tourism Development)

	Coefficients	SE	T values	P values	Note
Specific Indirect Effects					
TP → TQ→ STD	0.176	0.024	7.370	0.000	Accepted H4
Total Indirect Effects					
TP → STD	0.176	0.024	7.370	0.000	Accepted H4

DISCUSSION

The PLS-SEM analysis results show that Hypothesis H1, which states that the effectiveness of ecotourism has a positive impact on sustainable tourism development, is accepted with statistical significance. The standardized regression coefficient for the relationship between ecotourism effectiveness and sustainable tourism development is 0.505, P-value = 0.000 ($p < 0.05$). This finding is quite similar to related studies globally, especially the study by Wardana et al. (2021), though the impact level in this study is lower than that indicated in the research. Ecotourism effectiveness positively influences sustainable tourism development by protecting the environment, promoting the local economy, and preserving culture. Ecotourism minimizes negative impacts on the environment and raises awareness about nature conservation. It creates job opportunities and income for local communities while encouraging the consumption of local products and services, boosting the local economy. Moreover, ecotourism helps preserve and promote traditional cultures, fostering cultural exchanges between tourists and communities. Thus, ecotourism not only enhances the quality of the experience but also contributes to the sustainable development of tourism and the local community. Additionally, infrastructure and facilities must be designed in a way that minimizes negative impacts on nature. Maintaining a protected and clean environment is a key factor for tourists. Furthermore, the study results also reveal that the relationship between the effectiveness of ecotourism and tourism quality is statistically significant, with a standardized impact coefficient of 0.478. This shows that the effectiveness of ecotourism significantly contributes to enhancing the quality of tourism, with a strong and clear impact. This coefficient indicates a positive relationship, meaning that as ecotourism effectiveness increases, tourism quality improves accordingly. Studies have demonstrated the relationship between ecotourism effectiveness and tourism quality using various research methods. A notable example is the study by Martinez (2022), where ecotourism businesses were required to provide environmentally friendly and reliable services. Additionally, Kiper's (2013) research highlighted that ecotourism not only brings economic benefits to local communities but also helps preserve the natural environment, creating high-quality and sustainable tourism experiences. This study also affirms that tourists involved in ecotourism tend to rate tourism quality and the uniqueness of the experience higher than those in traditional tourism forms. This is consistent with the findings of Breiby et al. (2020), Khan et al. (2021), and Wardana et al. (2021).

Lastly, Hypothesis H3, stating that the quality of ecotourism positively impacts sustainable tourism development, is also accepted with a standardized impact coefficient of 0.368 and a P-value < 0.05. One of the main reasons is that ecotourism focuses on environmental protection, respecting local cultures, and promoting community economies. This finding aligns with Breiby et al. (2020) and also shows that the factors contributing to sustainable tourism quality are significant. Specifically, there are four key aspects of this experience: interaction with the natural environment, communication with the cultural environment, understanding and perspectives, and participation in activities characteristic of the destination. These factors not only add value to the tourism experience but also contribute to building a sustainable tourism system and ensuring the quality of the tourist experience. The result also confirms and validates the relationship from the studies of Ghoochani et al. (2020), Khan et al. (2021), and Wardana et al. (2021). Additionally, the research results indicate a partial mediating role of tourism quality in the relationships above. The mediating role of tourism quality between ecotourism effectiveness and sustainable tourism development is to create a tourism environment where activities are not only focused on environmental protection but also ensure meaningful experiences for tourists and contribute to the development of local communities. Tourism quality establishes a foundation for positive interactions between tourists and the local environment, encouraging respect and the protection of natural and cultural resources. This not only enhances the effectiveness of ecotourism activities but also creates sustainable development opportunities for tourism by generating income for local communities, raising awareness and commitment from tourists about environmental conservation, and fostering the inclusion and development of local cultures. Therefore, tourism quality plays a crucial role in building a sustainable tourism industry, promoting economic and social development without harming the environment and local culture.

Managerial implications

First, it is important to implement and adhere to policies that protect natural resources, alongside organizing educational programs to raise awareness about environmental protection. Second, improving service quality through staff training and the development of eco-friendly tourism products will enhance the visitor experience. Third, supporting the local economy, particularly in ecotourism areas that are preserving the region's biospheres, can be achieved by collaborating with local businesses and creating job opportunities through tourism activities, thus contributing to local livelihoods and economic development. Finally, investing in sustainable infrastructure and establishing a strict management and control system will ensure that tourism activities comply with environmental protection regulations and standards.

These strategies will help improve the quality of ecotourism, ensuring sustainable development and bringing long-term benefits to both the community and the environment. Regarding the quality of ecotourism, first, training staff to provide professional and friendly services, as well as developing creative tourism products and services, will create unique and memorable experiences for visitors. Protecting and conserving the environment is a top priority, with specific measures such as limiting plastic use, managing waste effectively, and investing in sustainable infrastructure such as wastewater treatment systems and renewable energy. Establishing clear quality standards and conducting continuous evaluations and improvements will ensure that all activities meet the highest requirements. Lastly, organizing educational programs and using effective communication to raise awareness about the importance of protecting the environment and local culture will attract environmentally-conscious tourists. These strategies not only improve the tourism experience but also contribute to preserving natural resources and ensuring sustainable development for the local community.

To promote sustainable tourism development in the North Central region, famous tourist destinations such as Sam Son, Cua Lo, Nhat Le, Lang Co, Phong Nha – Ke Bang, Paradise Cave, Son Doong, Dong Loc Junction, the Imperial City of Hue, Thien Mu Pagoda, Ho Chi Minh's birthplace, and General Vo Nguyen Giap's tomb should be emphasized. These places are unique not only for their natural beauty but also for their historical and cultural values. It is necessary to focus on strengthening the connections and cooperation among localities in the region. First, a common tourism development plan for the entire region should be developed, focusing on leveraging the natural, cultural, and human strengths of each province. This can be achieved through organizing regular task force groups to share information, assess market conditions, and develop unique and diverse tourism products. Second, promoting and marketing tourism through joint campaigns will attract attention from major tourist distribution centers across the country.

This requires close cooperation between provinces to create a strong and attractive image of the North Central region in the tourism market. Finally, investments should be made in improving tourism infrastructure and services, while training tourism personnel to enhance service quality and the visitor experience. This will help create a sustainable and appealing tourism environment, while also increasing income and job opportunities for the local community.

Limitations and future research directions

This study, while providing valuable insights into the impact of ecotourism on sustainable tourism development in North Central Vietnam, has some limitations. The scope of the research focuses only on a few prominent tourist destinations, lacking comprehensive data from external factors such as national policies. Moreover, the long-term effects of ecotourism have not been fully assessed. Future research could expand the scope to other regions, evaluate long-term impacts, and delve deeper into policies related to the protection of natural resources. Additionally, integrating technology and innovation into ecotourism will be an important direction to promote sustainable development in the industry.

CONCLUSION

The study shows that the effectiveness of ecotourism has a significant positive impact on sustainable tourism development. This is consistent with global studies, although the level of impact is lower. The effectiveness of ecotourism benefits sustainable tourism by protecting the environment, boosting the economy in the North Central region, and preserving cultural heritage. The study also highlights the positive influence of ecotourism effectiveness on tourism quality, showing that as the effectiveness of ecotourism increases, tourism quality improves. Ecotourism quality also has a positive impact on sustainable tourism development, emphasizing the importance of environmental protection, cultural respect, and community economic promotion. The partial mediating role of ecotourism quality further highlights its importance in promoting sustainable tourism by enhancing the tourist experience and supporting local communities.

The research on the impact of ecotourism effectiveness in promoting sustainable tourism development in the North Central region reveals many positive results. Ecotourism not only raises awareness among the community and tourists about the value and necessity of environmental protection but also stimulates local economic development through job creation and income, especially for ethnic minority communities. Moreover, ecotourism supports the preservation and promotion of local cultural and traditional values, helping to maintain and promote indigenous culture.

The demand for ecotourism development encourages investment in sustainable infrastructure and services, ranging from environmentally friendly transportation to accommodations using renewable energy.

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