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SPATIAL ANALYSIS OF ECOTOURISM RESOURCE POTENTIAL IN THE MOUNTAINOUS REGIONS OF SURKHANDARYA, UZBEKISTAN

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Abstract: This study comprehensively assesses the ecotourism potential of Surkhandarya region, Uzbekistan, utilizing a multivariate criterion approach to evaluate its suitability for sustainable tourism development. Surkhandarya, characterized by approximately 70% mountainous terrain and nestled among the Hisor, Boysun, Bobotog, and Ko'hitang mountain ranges, is rich in natural, historical, and cultural assets. The region's diverse landscapes, which include hydrological features, geological formations, and biological diversity, present significant opportunities for ecotourism. However, despite the vast natural potential, the region faces challenges in infrastructure development and socio-economic engagement, hindering the full realization of its ecotourism prospects. This study applies the Ecotourism Potential Mapping and Assessment (ETPSMA) framework, which evaluates natural conditions, socio-economic factors, and infrastructural readiness, providing a clear picture of the region's current state and potential for ecotourism. The Boysun-Hisor zone emerged as having the highest potential, with rich natural resources and considerable community engagement, while the Bobotog zone showed limited potential due to infrastructural and socio-economic deficits. The Ko'hitang zone presented moderate potential, requiring targeted investments to enhance infrastructure and community participation. Recommendations for improvement include infrastructure enhancement, development of ecotourism routes, local community involvement, environmental education, and zoning for sustainable tourism practices. The study concludes that with strategic investments and policies, Surkhandarya could become a leading ecotourism destination, fostering both environmental conservation and socio-economic development. This research provides a solid foundation for the region's ecotourism strategy, aligning with global sustainable tourism principles.

Keywords: Surkhandarya, Hisor mountain range, sustainable development, tourism infrastructure, ecotourism potential, tourism planning, cultural heritage, biodiversity, regional development

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INTRODUCTION

The United Nations World Tourism Organization (UNWTO) underscores in its reports the imperative for sustainable tourism development, highlighting critical areas such as climate change mitigation, sustainable land management, biodiversity conservation, and the safeguarding of specially protected territories vital for ecotourism expansion (WTO, 2018). Further, the advancement of ecotourism necessitates the ecological sustainability of geosystems, the scientifically informed preservation of biodiversity and natural monuments, and the formulation of strategic frameworks aimed at the sector's sustainable evolution (WTO, 2024). Contemporary global practices reflect an increasing emphasis on research dedicated to the protection of natural monuments, conservation areas, and fragile geosystems, recognizing these as pillars for the long-term viability of ecotourism. Key priorities identified in academic discourse include the rational and efficient use of natural resources, the extension of ecotourism seasonality to reduce environmental pressure, the optimization of regional tourism infrastructures, and the rigorous application of sustainable development principles across all operational stages (Pešić et al., 2025; Ramos & Byrne, 2024). Furthermore, global scholarship actively engages in enhancing the theoretical and practical underpinnings of ecotourism and recreational service innovation, with particular focus on delineating future directions for ecotourism markets and integrating tourism sector models into

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broader national economic frameworks (Shi et al., 2023; Paul & Roy, 2023; Azmaiparashvili, 2021). Crucially, the determination of tourism's multiplier effects on related industries and its overall impact on national economies remains an ongoing challenge necessitating multidimensional analytical approaches (Shi & Chen, 2024).

The theoretical and methodological foundations of ecotourism have been extensively examined by numerous scholars, whose contributions have significantly shaped the contemporary understanding of the field, which include the seminal works by Krippendorf (1982) and Ceballos-Lascuráin (1980) who pioneered early conceptualizations of ecotourism, emphasizing its socio-ecological dimensions and sustainability imperatives. Subsequent studies by Ziffer (1989), Butler (1992), Lindberg (1993), Western (1993), Wall (1994), and Nelson (1994) deepened analyses of ecotourism development trends, economic viability, and environmental impacts. Scholars such as Thompson (1995), Honey (2008), and Shestakova et al., (2022) advanced critical perspectives on the commercialization of ecotourism and its integration into global tourism markets, while earlier insights introduced frameworks for biodiversity conservation within ecotourism strategies (Hasmira et al., 2025; Heshmati et al., 2022). Research from CIS countries - particularly by Drozdov (2005), Abylkassimova et al. (2024), Abdikarimova et al. (2025) - has provided valuable regional adaptations, focusing on the sustainable management of natural heritage sites and the socio-economic dynamics of ecotourism in post-Soviet landscapes. Within this global context, the mountainous and foothill regions of Surkhandarya province emerge as among Uzbekistan's most valuable ecotourism frontiers, distinguished by their rich assemblage of natural and cultural assets, diverse landscapes, and high levels of biological endemism.

The comprehensive assessment and strategic development of Surkhandarya's ecotourism potential hold substantial scientific and practical relevance. Not only would such efforts facilitate the enhancement of tourism infrastructure and the creation of alternative economic livelihoods for local populations, but they would also play a pivotal role in safeguarding natural ecosystems and promoting environmental stewardship. Moreover, strengthening the ecotourism sector is essential for elevating the international profile of the Surkhandarya region, aligning with broader national strategies aimed at sustainable tourism-driven economic diversification.

Within Uzbekistan, tourism and ecotourism-related issues have been investigated by prominent scholars including Khamidov (2016), Ergasheva & Eralov (2024), and others. Specific studies addressing the scientific and theoretical underpinnings of ecotourism were conducted by Narmanov et al. (2023), Nigmatov (2019), Nigmatov & Tobirov (2021), Nilufar et al., (2021), Usmanov et al. (2020), Ravshanov & Xursanov (2024) and among others, who have sought to adapt global ecotourism models to Uzbekistan's environmental and cultural contexts. Nevertheless, despite these considerable efforts, critical knowledge gaps persist—particularly regarding the assessment and development of ecotourism in the mountainous and foothill regions, such as those found in Surkhandarya Province. These landscapes, characterized by their distinct geomorphological features, rich biodiversity, endemic species, and unique cultural attributes, represent highly valuable but underexplored ecotourism assets. Moreover, there remains a marked absence of geospatially driven studies that systematically evaluate ecotourism potential in these regions. Contemporary literature highlights that spatial analysis, using tools such as Geographic Information Systems (GIS) and remote sensing, is essential for identifying suitable ecotourism zones, assessing environmental sensitivity, mapping biodiversity hotspots, and modeling sustainable tourism infrastructure (Ardoin et al., 2015; Abtahee et al., 2023; Likun et al., 2025b; Pešić et al., 2025). Without the integration of geospatial methodologies, strategic planning for ecotourism remains fragmented and less resilient to environmental and socio-economic challenges (Paul & Roy, 2023; Barman et al., 2024).

Therefore, the ecotourism potential of Surkhandarya's mountainous and foothill territories warrants a comprehensive, multidisciplinary approach—one that combines ecological field studies, socio-economic analysis, and cutting-edge geospatial techniques to formulate sustainable development models (Abtahee et al., 2023; Shang et al., 2023; Thompson, 2022; Ahmad et al., 2022). This approach not only fills a significant gap in national research but also aligns Uzbekistan's ecotourism aspirations with global best practices in sustainable and responsible tourism planning. Therefore, this study assesses the ecotourism potential of the mountainous and foothill regions of Surkhandarya using field surveys, SWOT analysis, and complementary GIS analysis. It also aims to evaluate the area's natural and cultural resources, identify key heritage sites, analyse stakeholder interest, and determine critical strengths, weaknesses, opportunities, and threats. Based on these findings, the research proposes innovative strategies to promote ecologically, economically, and socially sustainable ecotourism development in the region. However, there are a number of limitations in the study as region remains in a formative stage, constrained by systemic data limitations, and methodological simplifications.

METHODS AND METHODOLOGY

Study Area

The Surkhandarya Region, Uzbekistan's southernmost province, is distinguished by its unique geographic and climatic attributes. Enclosed by the foothills of the Western Tien Shan mountains—including the Babatag, Surkhantau, and Hissar ranges—its basin-like topography contributes to a climate that is the hottest in the nation during summer and mild in winter. The Hissar Mountains act as a natural barrier, shielding the region from Arctic air masses. Despite its arid conditions, which can see temperatures soar above 45°C (Figure 1), Surkhandarya is endowed with substantial recreational and mineral wealth. The infamous "Afghan wind" poses a challenge to agriculture, desiccating vegetation rapidly and historically limiting the cultivation of orchards and vineyards. Nevertheless, through adaptive strategies inspired by global best practices, local agronomists have revived horticulture and viticulture, with the Denau district emerging as a regional hub. The region is also exploring ecotourism as a sustainable development pathway.

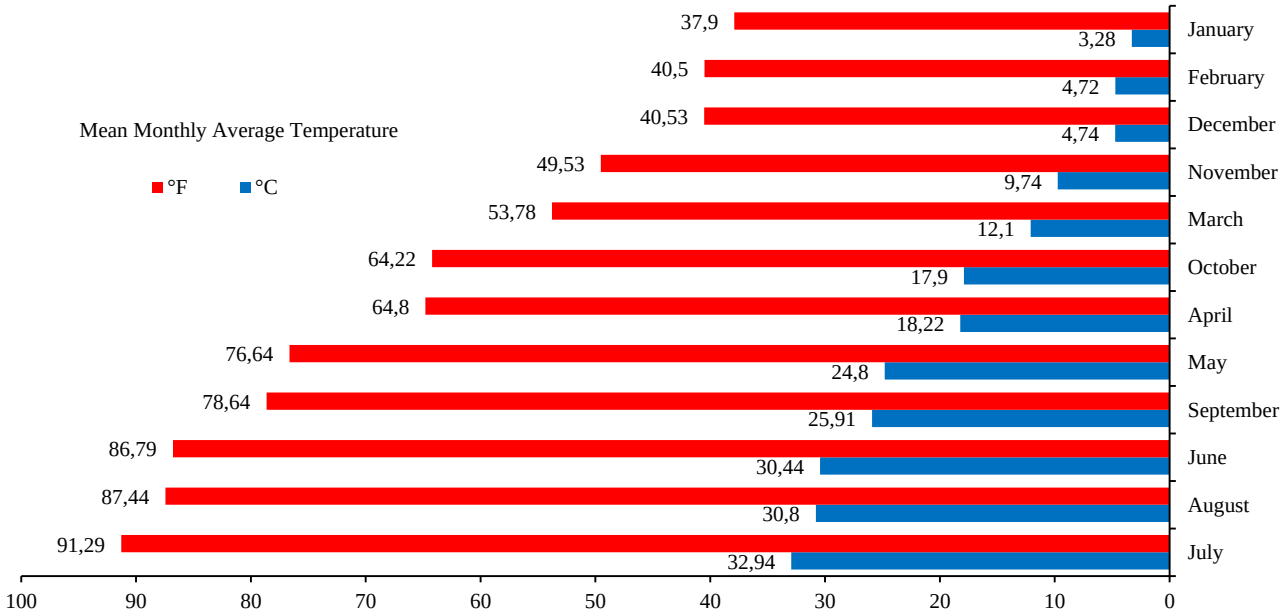

Figure1. Mean monthly temperature in Surkhandrya region, Uzbekistan (Weather and Climate, 2025)

Topographically, its rugged beauty offers niche opportunities for eco- and adventure tourism. Surkhandarya is rich in captivating natural formations—caves, trekking trails, and waterfalls—many formed by the dynamic Surkhandarya River system. Furthermore, the Baysuntau Range, part of the greater Hissar system, presents immense potential for extreme mountain tourism. It features some of the deepest caves in Central Asia, such as Dark Star and Yubileynaya, and pristine alpine landscapes. The Khaja Gurgur-Ata and Ketmanchapty massifs, rising up to 3,168 meters, offer breathtaking natural vistas and ecotourism promise, especially near settlements like Machay. The region represents a rare confluence of extreme climate, untapped natural beauty, and mineral wealth. Unlocking its full potential demands a nuanced approach—balancing ecological preservation, economic utilization, and community empowerment.

Data and Methods

The prospects for ecotourism development are fundamentally shaped by the region's Ecotourism Potential (ETP). ETP is predominantly defined by the inherent natural characteristics and resources of a territory, given that ecotourism, by its very essence, is centered around the sustainable appreciation of nature. However, the successful realization of this potential extends beyond environmental attributes alone. It is inextricably linked to the socio-economic context of the region and the existing level of tourism infrastructure development. Without an enabling socio-economic environment and a robust support system, even regions rich in natural wonders may struggle to foster a thriving eco tourism sector. Accordingly, the comprehensive evaluation of a region's ecotourism potential necessitates the analysis of three interrelated categories of indicators (Likun et al., 2025a; Ravshanov et al., 2024):

- **Natural Indicators:** These encompass the suitability of the region's natural conditions, the aesthetic and ecological appeal of its landscapes, and the richness and accessibility of ecotouristic resources.
- **Socio-Economic Indicators:** These involve assessing the extent of local employment generated by the tourism sector, the region's attractiveness for tourism-related investments, and its contribution to broader sustainable development objectives.
- **Ecotourism Infrastructure Indicators:** These pertain to the density and quality of accommodations (such as hotels, guesthouses, and eco-lodges), the adequacy and connectivity of transportation and communication networks, and the availability and professionalism of trained tourism personnel.

A critical and balanced appraisal across these domains is imperative to identify strengths, address deficiencies, and craft sustainable strategies that maximize ecological preservation while delivering tangible socio-economic benefits to local communities. Therefore, the study is an attempt to include those consideration while combining both quantitative measurements and qualitative judgments in a more ethically grounded and scientifically informed basis for decision-making. The scale of measurement for ecotourism potential zones were scaled on standardized five-point scale, from highly favourable to unfavourable zone based on the above three indicators by using the eq.1 (Baiburiyev, 2022; Wang, 2024):

$$ETP_{SMA} = \frac{NI\,(NI_1+NI_2+NI_3)+SEI\,(SEI_1+SEI_2+SEI_3)+IEI(SEI_1+SEI_2+SEI_3)}{3} \qquad \text{eq.1}$$

Where, $ETPS_{MA}$ is the ecotourism potential of mountainous areas, which is to be determined comprehensively by NI (natural indicators), SEI (socio-economic indicators), and SEI (ecotourism infrastructure indicators).

Further, the entire region of Surkhandarya was divided into three major groups depending to its natural landscape and field excursion. These regions were Boysun-Hisar, Bobotog, and Ko'hitang respectively. Table 1 exhibits assign scores for each indicator and their relative importance I those three defined regions for the above equation.

Table 1. Summary of indicators and ETP_{SMA} scores output from field survey

Sr. No.	Transboundary Ecotourism Zones (as an example).	Natural Indicators			Socio-economic Indicators			Ecotourism Infrastructure Indicators			Integral Average score			Overall score (EPMA)
		Favorable natural conditions	Ecotourism attractiveness of landscapes	Provision of ecotourism Resources	Employment of local Population in the Tourism sector	The investment Importance of regions	Contribution to sustainable development	Density of hotels and other tourist accommodationsi	Road and communication infrastructure	Provision of tourism personnel	**NI**	**SEI**	**IEI**	**ETP_{SMA}**
1	Boysun-Hisor	5	5	5	4	4	4	4	4	2	5	4	3.3	**4.1**
2	Bobotog ‘	3	3	2	1	2	2	1	2	1	3	1,6	1.3	**1.8**
3	Ko‘hitang	3	4	4	2	3	3	2	3	2	4	2.6	2,3	**2.8**

RESULT AND DISCUSSION

Based on multivariate criterion, the present research presents a compressive assessments of tourism potential in Surkhandarya region, Uzbekistan and affirm that the region holds exceptional promise for the development of ecotourism. This potential is rooted in the region’s distinctive natural features and diverse landscapes of southern Uzbekistan, complemented by an abundance of natural and historical monuments and the rich cultural and ethnic heritage preserved by the peoples who have inhabited Surkhandarya across successive historical epochs. Yet, while ecotourism is lauded for its comparatively minimal environmental footprint and its lower infrastructural demands relative to mass tourism, it is not without significant challenges. Although Surkhandarya's natural endowments for ecotourism are virtually limitless, the realization of this potential necessitates substantial investment in planning, development, and maintenance. The establishment of essential ecotourism infrastructure is critical to enabling visitors to experience the region’s pristine natural environments responsibly and sustainably. Particular emphasis must be placed on developing well-organized ecotourism hubs in scenic areas such as Sairob, Khojaipok, Khojamaykhona, Darband, Sangardak, and Khonjiza, located within the Hisor, Boysun, and Bobotog mountain regions. The imperative to develop ecotourism in the Surkhandarya region is driven not solely by economic considerations—such as the creation of employment opportunities and the revitalization of remote areas—but also by an increasing societal demand. As public expectations regarding tourism, health, and the pursuit of meaningful and restorative leisure experiences grow more sophisticated, the impetus for advancing ecotourism initiatives correspondingly intensifies (Yiamjanya et al., 2024). In this context, the development of ecotourism emerges as both a response to market demand and a strategic vehicle for promoting balanced regional development.

The region demonstrates significant progress in the development of tourism infrastructure across the Surkhandarya region, aimed at enhancing visitor experiences and promoting sustainable regional growth. Recognizing the centrality of digital connectivity in modern tourism, authorities have installed Wi-Fi access points at 132 tourism facilities, enabling visitors to share their experiences instantly via social media. This initiative not only meets the digital expectations of tourists but also serves as an effective instrument for destination marketing through user-generated content, a strategy increasingly validated by contemporary tourism scholarship. To facilitate independent and group travel, 345 directional signs in Uzbek, Russian, and English have been erected at 101 major tourist sites, including 150 signs dedicated to cultural heritage monuments. As emphasized in tourism planning literature, clear and accessible wayfinding significantly enhances tourist mobility, satisfaction, and site engagement, contributing to more inclusive tourism experiences. The diversification of accommodation options further reflects an evolving responsiveness to varied tourist needs. Of the 215 operational lodging facilities, 58 are hotels, 19 are hostels, and 138 are family-run guesthouses, collectively offering 1,930 rooms and 4,228 beds. In addition, health tourism is supported by 91 sanatoriums and health clinics, providing over 3,300 beds for visitors seeking therapeutic services—an area of tourism increasingly recognized for its contribution to sustainable local economies. Transport infrastructure has similarly been expanded, with 90 tourist-class vehicles—comprising 45 buses, 35 minibuses, 2 electric cars, 3 jet skis, and 4 motorboats—made available to facilitate mobility within the region. The strengthening of internal transport networks is widely acknowledged in academic studies as a fundamental prerequisite for regional tourism competitiveness. Furthermore, the entrepreneurial environment within the tourism sector has grown rapidly. Over the past three years, the number of tourism enterprises has doubled. In 2023, 260 tourism companies operated in the region; by 2024, this number is projected to increase to 275. Currently, 58 tour operators and travel agencies are active, with six new businesses (two tour operators and four agencies) established in 2024 alone. This upward trend reflects the dynamic nature of the region’s tourism industry and aligns with international models of decentralized and community-based tourism development.

Further, the analyses of Surkhandarya’s natural and geographical assets also suggest that the classical model of ecotourism is particularly well-suited for the region’s mountainous and foothill territories. This model typically emphasizes activities conducted in or near protected areas, including wildlife and bird observation, educational lectures delivered by scientists, guided nature exploration, and engagement with traditional ecological knowledge systems. Such practices are widely recognized in ecotourism scholarship as central to fostering environmental awareness, conservation support, and

sustainable community involvement. The specific districts of Boysun, Sariosiyo, Oltinsoy, Uzun, and Sherobod—situated along the Hisor, Bobotog, and Ko'hitang mountain ranges—present especially favorable conditions for the development of ecotourism initiatives. These areas are distinguished by their rich biodiversity, dramatic landscapes, and relatively undisturbed ecosystems, which align with international ecotourism criteria emphasizing low-impact, conservation-oriented travel. Furthermore, academic studies affirm that mountain-based ecotourism not only contributes to preserving fragile natural environments but also serves as an instrument for rural socio-economic revitalization.

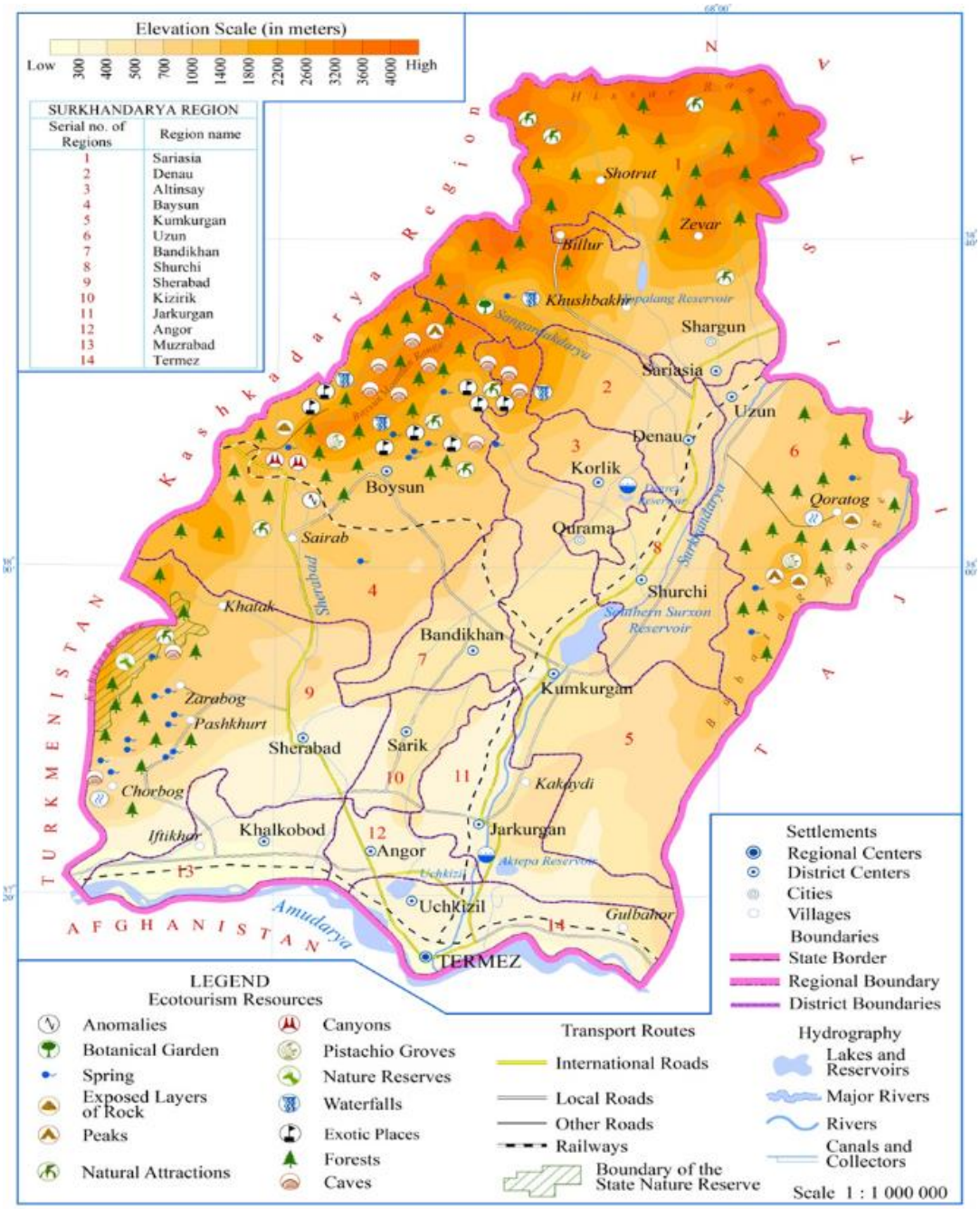

Figure 2. Ecotourism resource regions in Surkhandarya Transboundary region, Uzbekistan (Source: authors)

In Surkhandarya's region, ecotourism has the potential to stimulate local livelihoods, promote indigenous cultural heritage, and offer sustainable alternatives to extractive economic activities, which often threaten both ecological integrity and long-term community welfare. The results of the conducted analysis reveal that among the three designated regions—referred to as (a) Boysun-Hisor, (b) Bobotog, and (c) Ko'hitang Transboundary region—the ecotourism potential of three transboundary ecotourism zones has been systematically evaluated (Figure 2). This evaluation utilized ETP_{SMA} framework, incorporating scores derived from three principal categories: natural conditions, socio-economic factors, and infrastructural development indicators (Figure 3). By applying a multi-criteria assessment approach, the study systematically analyzed the natural resource base, the socio-economic readiness of local communities, and the quality and accessibility of tourism infrastructure across the regions. These composite indicators provided a holistic understanding of each area's viability for

sustainable ecotourism development. The comparative analysis of these three zones thus allowed for a structured ranking of their respective opportunities, strengths, and limitations regarding ecotourism expansion. The findings, summarized in the following section, offer critical insights into the prioritization of investments, policy interventions, and targeted capacity-building efforts necessary to unlock the ecotourism potential of each transboundary zone.

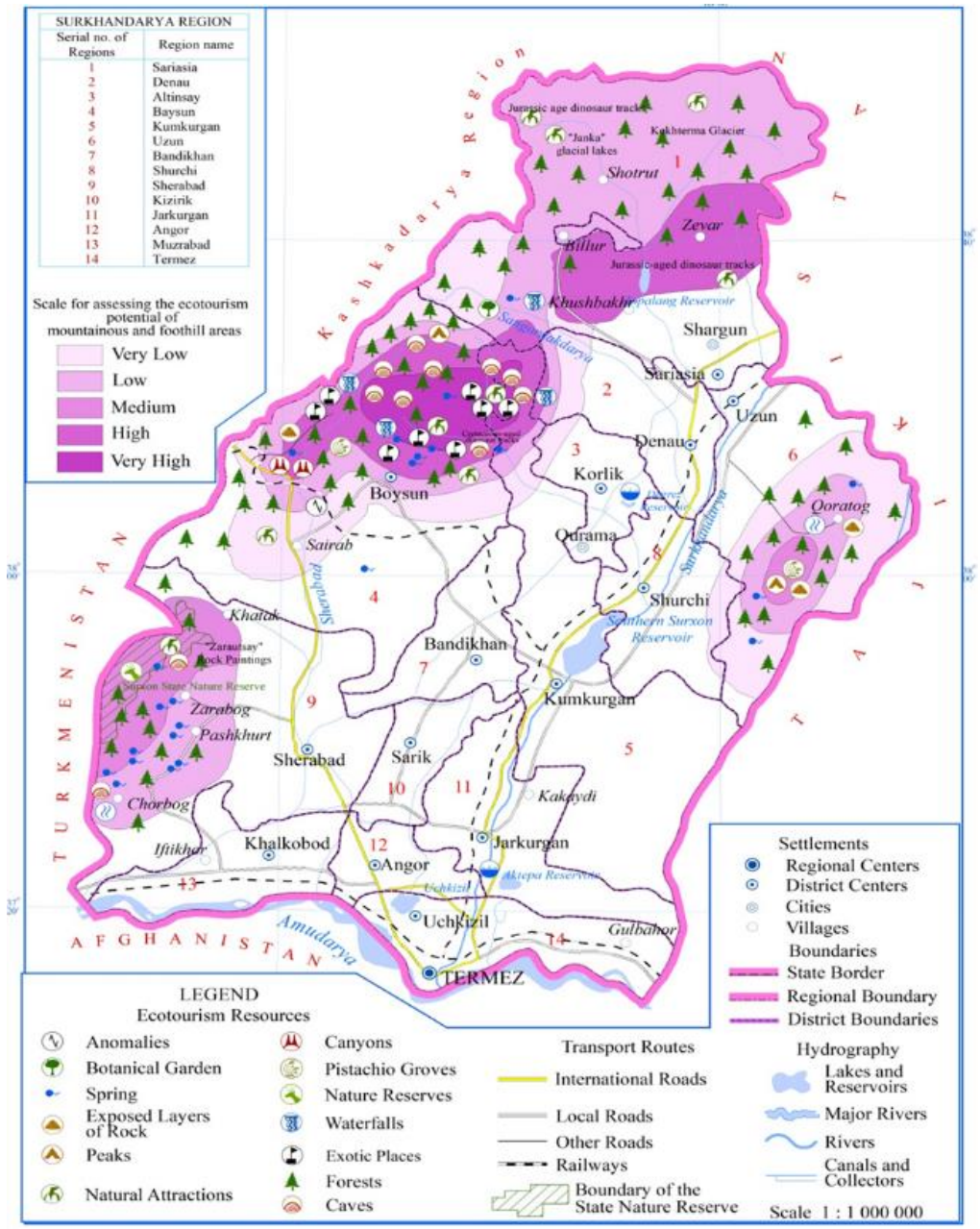

Figure 3. Ecotourism potential zoning (a) Boysun-Hisor, (b) Bobotog, and (c) Ko'hitang area in the mountainous and foothill region of Surkhandarya, Uzbekistan (Created by authors based on output from eq.1 and Table 1)

Firstly, the Boysun-Hisor transboundary ecotourism zone emerges as a region of exceptional promise for sustainable ecotourism development. Based on ETP_{SMA} model, the zone achieves an impressive score of 4.1, placing it within the "very high potential" category. Its natural indicators, scoring the maximum of 5 points, highlight the presence of diverse landscapes, abundant biodiversity, and rich ecotourism resources—factors that Ceballos-Lascuráin (1996) identifies as fundamental to authentic nature-based tourism experiences. From a socio-economic perspective, the zone earns 4 points, reflecting considerable community engagement in tourism activities and strong investment potential. This aligns with Honey's (2008) argument that local involvement is crucial to ensuring that ecotourism promotes sustainable development rather than reinforcing socio-economic disparities. Infrastructure indicators, however, reveal a critical shortfall. Although hotels, accommodations, and transportation networks are relatively well-established, the shortage of skilled tourism personnel, scoring only 3 points, presents a significant limitation. The absence of adequately trained human capital can undermine even the most naturally endowed tourism regions. Therefore, while Boysun-Hisor possesses substantial natural and infrastructural advantages, its success in ecotourism development critically depends on strategic investments in human resource training and

capacity building. Without focused efforts to enhance professional competencies in sustainable tourism, the region risks failing to fully realize its remarkable potential, a concern consistently echoed in the broader ecotourism literature.

Secondly, the Bobotog transboundary ecotourism zone, in contrast to other regions assessed, demonstrates notably limited potential for ecotourism development. According ETP_{SMA} model, the area achieves a low score of 1.8, demonstrate serious deficiencies across natural, socio-economic, and infrastructure indicators. Natural indicators register only 2.6 points, reflecting an insufficient diversity of landscapes and a scarcity of ecotourism-attractive resources. The absence of compelling natural assets significantly diminishes the viability of ecotourism initiatives, which rely heavily on authentic and high-quality environmental attractions. Socio-economic indicators are similarly discouraging. With a score of merely 1 point, the local population is minimally involved in the tourism sector, and the investment climate remains largely underdeveloped. It is argued that without active local participation and investment readiness, sustainable tourism models often fail to take root. Infrastructure assessments also reveal serious shortcomings, with roads, communication networks, accommodation facilities, and skilled tourism personnel scoring between 1 and 2 points, indicating a critical lack of basic tourism services. Therefore, Bobotog clearly faces major developmental barriers. Consequently, while the region possesses certain latent possibilities, realizing its ecotourism potential would require extensive resource allocation, long-term planning, and focused interventions. Early strategies must prioritize infrastructure development and community engagement, complemented by thorough scientific research to map and enhance latent ecotourism assets for marginalized ecotourism destinations (Rahman & Haque, 2024).

Thirdly, the Ko'hitang transboundary ecotourism zone demonstrates moderate potential for ecotourism development, achieving an Ecotourism Potential Mapping and Assessment (EPMA) score of 2.8, categorizing it within the "medium" potential range. Natural indicators stand relatively strong at 3.6 points, signifying the presence of appealing landscapes and a reasonably rich natural resource base that could support ecotourism initiatives. As emphasized by Honey (2008), such environmental richness forms the bedrock for authentic ecotourism experiences that prioritize conservation and local benefit. Socio-economic indicators, however, are less robust, ranging between 2 and 3 points. While the local community exhibits some involvement in tourism and limited investment activities, this engagement is notably weaker than that seen in zones like Boysun-Hisor. The infrastructure indicators reveal similar constraints, ie. road networks, accommodations, and tourism-related services are evaluated at only 2–3 points, reflecting the infrastructural gaps typical of many emerging ecotourism destinations. A further critical limitation lies in the insufficient availability of skilled tourism personnel, which could undermine the delivery of high-quality ecotourism experiences. Consequently, although the Ko'hitang zone possesses a sound natural foundation, its advancement as a competitive ecotourism destination depends on strategic investments in physical infrastructure, comprehensive capacity-building initiatives, and greater community engagement to foster sustainable practices, in line with the principles set forth by the World Tourism Organization (WTO, 2024).

SWOT Analysis

The evaluation of the ecotourism potential in the Surkhandarya region was undertaken through a comprehensive SWOT analysis (refer to Table 2), offering an assessment of its strengths, weaknesses, opportunities, and threats. This analytical framework serves as a critical tool for identifying key factors influencing the region's ecotourism development, providing both a strategic overview and a foundation for informed decision-making in line with sustainable tourism principles.

Table 2. Results from SWOT analysis (based on field survey and interview method)

Strength	**Weakness**
The Surkhandarya region boasts vast natural landscapes, including areas rich in biodiversity like Bokira, and features UNESCO-protected sites. The Surkhon Reserve, with its unique ecological significance, further enhances the region's ecotourism potential. The area's distinct culture and local customs add to its allure, complemented by a strong legislative framework supporting tourism development. The region is poised to achieve sustainable development, with growing interest in ecotourism and well-equipped guesthouses in ecotourism zones. Additionally, the region offers lower service prices compared to other tourism types and provides access to naturally clean food products, making it an attractive destination for eco-conscious travellers.	The region faces several challenges that hinder the growth of ecotourism, including underdeveloped road infrastructure and a shortage of qualified personnel in the field. There is also a lack of marketing and branding for ecotourism, alongside insufficient investment and financing in the sector. Most infrastructure is concentrated in cities and large population centers, with the existing ecotourism facilities not meeting international standards. Additionally, the organization of activities at tourist attractions, including protected areas, is inadequate, and there is a general lack of proficiency among stakeholders and staff, particularly in foreign languages, further impeding the development of the sector.
Opportunity	**Threat**
Ecotourism in Uzbekistan is gaining increasing popularity both domestically and globally, driven by a rising interest in education and sustainable travel. Government initiatives aimed at preserving ecological balance and promoting ecotourism are further fostering growth. These efforts create new job opportunities, particularly in the mountain and foothill regions, while developing a national tourism product centred around ecotourism. The sector's expansion is expected to boost both domestic and international tourist flows, while also fostering ecological awareness among local populations and preserving the natural, historical, and cultural heritage of specific regions. Additionally, improved relations with neighbouring countries and the removal of border barriers will enhance cross-border tourism, further supported by events like the Boysun Bahori International Festival, which attracts numerous visitors.	The development of ecotourism in Surkhandarya is hindered by several significant challenges, including the low purchasing power of the population and the absence of a clear ecotourism development strategy. The lack of a well-defined concept of ecotourism among the public, coupled with a low level of ecological education, further complicates efforts to promote sustainable tourism. Additionally, global climate change and the deteriorating environmental situation pose risks to the region's natural resources, while natural disasters such as floods, snowstorms, and rainy periods add to the unpredictability, making it difficult to ensure consistent growth in the sector.

Incorporating insights from existing literature on ecotourism, this approach highlights the intricate balance between environmental conservation and tourism growth, emphasizing the need for a holistic understanding of the region's unique ecological assets and socio-economic dynamics. The findings contribute to a broader discourse on sustainable development in ecotourism, particularly in the context of Central Asia's evolving tourism landscape.

Based on the above research findings, the following strategic recommendations and proposals have been formulated:

1) Infrastructure Development – There is an imperative need to enhance tourist infrastructure in harmony with natural resources. This encompasses improving road networks, expanding accommodations such as hotels, hostels, and guesthouses, establishing information centers, ensuring reliable internet connectivity, and introducing eco-friendly transportation options to reduce the carbon footprint.

2) Defining Tourist Routes – It is essential to design captivating travel routes through the mountainous and foothill regions, offering activities such as hiking and horseback riding. These routes should be complemented by professional tour guides and clear signage, with eco-routes specifically crafted to acquaint tourists with natural landmarks in alignment with ecotourism principles.

3) Enhancing Local Community Participation – The active inclusion of local communities in ecotourism development is paramount. Supporting the growth of local services, such as the sale of artisanal products, traditional cuisine, and handcrafted goods, will stimulate the local economy while contributing to sustainable development by integrating cultural authenticity into the tourism experience.

4) Developing Environmental Education Programs – To foster environmental stewardship, it is crucial to implement ecological education programs targeting both ecotourists and local populations. These initiatives will raise awareness of environmental conservation and encourage the responsible use of natural resources, ensuring the long-term viability of the region's ecosystems.

5) Zoning the Region – In order to optimize ecotourism potential, it is necessary to zone Surkhandarya's mountainous and foothill areas according to their suitability for sustainable tourism development. This zoning should incorporate protected areas, recreational zones, and designated areas for tourism infrastructure, all designed to safeguard ecological integrity and ensure sustainable growth.

6) International Cooperation and Promotion – To elevate Surkhandarya's ecotourism profile on the global stage, it is vital to host international tourism forums, attract foreign investments, and engage in cross-border collaborations. These efforts will enhance the region's visibility, fostering increased tourist arrivals and positioning Surkhandarya as a prime ecotourism destination.

CONCLUSION

The mountainous and foothill regions of Surkhandarya exhibit substantial ecotourism potential, offering diverse opportunities for sustainable development in alignment with global ecotourism principles. With approximately 70% of its area characterized by mountainous terrain, Surkhandarya is bordered by the Hisor, Boysun, Bobotog, and Ko'hitang mountain ranges, creating a natural fortress that holds significant ecological, geological, and hydrological assets.

Key ecotourism attractions in these regions include hydrological features such as springs, rivers, and waterfalls; geological wonders like caves, rock formations, and canyons; and rich biological diversity, including ancient plane trees and pristine forests—each contributing to the region's high ecotourism potential.

The evaluation of Surkhandarya's ecotourism prospects was conducted using three primary indicators: ecological, social, and economic factors. While the region's natural assets were found to be of exceptional value, social and economic indicators were found lacking. Specifically, the region suffers from insufficient development in tourism infrastructure and environmental management, which impedes its full ecotourism potential.

Despite this, the findings highlight the region's diverse and significant opportunities for growth, provided that the necessary infrastructure and environmental protection measures are implemented.

Grounded on established literature in the field of sustainable tourism development, it is evident that infrastructure development, local community involvement, and environmental education are critical to overcoming these challenges. To that end, the study offers several practical recommendations, including the improvement of road infrastructure, the creation of eco-routes, the promotion of local community participation, and the development of eco-friendly services. Furthermore, it emphasizes the importance of aligning tourism development with the preservation of the region's ecological and cultural heritage, as well as the need for targeted government policies and investments.

The insights derived from this study offer a solid scientific foundation for shaping a comprehensive strategy for the sustainable development of ecotourism in Surkhandarya. By leveraging its natural and cultural wealth in a responsible manner, the region has the potential to become a model for ecotourism development in Central Asia, contributing both to the preservation of its unique environment and the socio-economic empowerment of its local communities.

Limitation of the study

The present research on ecotourism in Uzbekistan has offered practical and innovative contributions to the field particularly in the context of the Surkhandarya region. However, several limitations persist in the study which includes:

1) The limited access to reliable and comprehensive data on ecotourism indicators specifically to Surkhandarya region. The absence of a unified or specialized regional database has significantly hindered the depth and accuracy of empirical analysis. More accurate and reliable data would contribute to further refinement the current ecological, socio-

cultural, or infrastructural dynamics of the region. Therefore, this may affect the precision of policy recommendations derived from the research.

2) Furthermore, most existing research has been constrained by narrow geographical sampling, often excluding comparative analysis with other regions in Uzbekistan or similar ecotourism sites in Central Asia. This limits the potential to develop robust, transferable models that capture broader trends.

3) Methodologically, many studies have not yet incorporated advanced modeling techniques, such as artificial neural networks or trend-based predictive frameworks, which could enhance the capacity to simulate and forecast ecotourism growth under varying environmental and socio-economic conditions in future.

In view of the above, therefore, it is recommended that the future research shall include detail local surveys, more advance satellite data, and community-based records. Also, there is need to include comparative and cross-regional approaches to contextualize Surkhandarya's ecotourism within national and regional frameworks. Further, the adaptation of advanced econometric and machine learning models would certainly contribute in better understanding of complex interactions between tourism, local development, and sustainability.

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