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SUSTAINABLE DEVELOPMENT OF ECOTOURISM AS A DRIVER OF LOCAL DEVELOPMENT IN THE "KULUN-ATA" NATURE RESERVE, KYRGYZSTAN: PERCEPTIONS OF LOCAL COMMUNITIES

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Abstract: This article assesses the potential of sustainable ecotourism in the "Kulun-Ata" State Nature Reserve (Kyrgyzstan) as a catalyst for local development. The study aims to explore opportunities and constraints for implementing community-based ecotourism in a remote protected area. Methodologically, it combines household surveys, GIS mapping, functional zoning, and multi-criteria analysis. Results reveal strong community willingness to participate, despite institutional and infrastructural barriers. Based on the findings, a development model is proposed that integrates landscape mosaicism, local stakeholder involvement, and adaptive management principles. The research contributes to the understanding of ecotourism as a tool for promoting socio-economic resilience in peripheral mountainous regions. The study examines sustainable ecotourism as a lever for inclusive development in Kyrgyzstan's remote protected areas. Focusing on the Kulun-Ata State Nature Reserve, it identifies opportunities and constraints for community-based ecotourism. It situates the case within sustainable territorial development and community participation frameworks. The aim is to propose a spatially integrated, governance-ready model balancing conservation and local livelihoods. A mixed-methods design combines GIS-based suitability modelling, functional zoning, and field observations. Household surveys (N=197; Konduk and Oy-Tal, July 12–25, 2024) assess perceptions, capacities, and readiness. A 20-item Likert instrument spans ecological, socio-cultural, economic, and institutional-political dimensions. Multi-Criteria Decision Analysis and a Sustainability Barometer synthesize indicators to prioritize development options. Communities show high willingness to participate, with strongest scores in environmental awareness and socio-cultural identity. Institutional trust is weakest, and infrastructure remains inadequate. Spatial analysis reveals a heterogeneous landscape mosaic suitable for phased, low-impact route development outside core zones. Functional zoning delineates strict protection, buffer, regulated ecotourism use, and adjacent interaction belts. Priorities include capacity-building, micro-enterprise support, trained guiding, and minimal-footprint trail infrastructure. The framework aligns visitation with conservation thresholds while enhancing local income diversification and cultural stewardship. Findings position Kulun-Ata as a representative case for integrating secondary, hard-to-reach areas into national strategies. Policy implications stress phased implementation, cross-sector coordination, and monitoring using integrated sustainability indicators.

Keywords: ecotourism, local communities, spatial modeling, Kyrgyzstan, community-based tourism, environmental awareness, institutional barriers

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INTRODUCTION

Amid escalating global environmental challenges and socio-economic disparities in peripheral regions, ecotourism is gaining particular significance as a tool for integrating nature conservation with the sustainable development of local communities. As a form of tourism that emphasizes minimal impact on natural and cultural landscapes, ecotourism not only contributes to biodiversity conservation but also stimulates local economies by creating employment opportunities, diversifying income sources, and enhancing environmental awareness among the population (Weaver & Lawton, 2007).

The issue of ecotourism development is particularly relevant in Kyrgyzstan – a country with significant natural potential and a high concentration of specially protected natural areas. However, in most cases, these areas remain isolated from broader socio-economic processes, resulting in their perceived marginalization from the spatial and economic structure of regional development. A representative example is the "Kulun-Ata" State Nature Reserve – a unique natural cluster that encompasses diverse ecosystems and endemic species, located in a remote area of the Osh Region. Theoretically, this study is grounded in the concept of sustainable territorial development (Akbar et al., 2022), the theory of sustainable tourism

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(Butler, 1999), and the principles of community-based ecotourism, which emphasize active participation of local residents in the management of tourism activities (Scheyvens, 1999). These approaches allow ecotourism to be viewed not only as a form of recreation, but also as a platform for institutional and economic empowerment of marginalized regions.

Kyrgyzstan, as a country with a high level of natural diversity, has in recent years shown growing interest in developing a green economy and utilizing natural capital as a driver of sustainable growth. At the same time, the southern regions of the country continue to experience a high degree of socio-economic vulnerability, caused by limited access to infrastructure, labor migration, and insufficient employment diversification. Under such conditions, ecotourism may serve as a compensatory mechanism and a tool for integrating remote areas into the national economic space.

At the regional level, similar characteristics are observed in the Aksu-Zhabagly Biosphere Reserve in Kazakhstan and the Chatkal Biosphere Reserve in Uzbekistan (Akbar & Yang, 2022). These protected areas share geographical isolation, high levels of biodiversity, and at the same time, a limited degree of institutional integration into regional sustainable development strategies. Comparative analysis reveals that, in all these cases, the sustainability of ecotourism is determined by the interplay of natural value, local community involvement, and territorial accessibility. The "Kulun-Ata" Nature Reserve may thus be viewed as a representative case for analyzing the ecotourism potential of remote protected areas in Central Asia that lie outside major tourism routes and require new models of spatial integration.

Despite the growing number of publications on ecotourism, there remains a lack of well-developed spatial and economic mechanisms for realizing ecotourism potential in the context of Kyrgyzstan. This study is the first to propose a comprehensive model for the spatial integration of a protected area – the "Kulun-Ata" Nature Reserve – into a sustainable regional development framework. The scientific novelty of the research lies in the integration of approaches from conservation management, ecotourism planning, and local economic modeling. To date, the scientific literature has paid insufficient attention to the applied aspects of utilizing ecotourism as a strategic resource in the context of sparsely urbanized areas of Kyrgyzstan. There is a lack of comprehensive studies linking the spatial potential of protected areas with the socio-economic development of adjacent settlements. Meanwhile, the development of ecotourism activities in the "Kulun-Ata" Nature Reserve could serve as a catalyst for spatially balanced growth, contribute to improving the quality of life of local residents, and strengthen conservation management mechanisms through community-based conservation approaches.

The aim of this study is to provide a comprehensive assessment of ecotourism opportunities in the context of local development within the "Kulun-Ata" Nature Reserve. The research examines the natural-geographical and institutional prerequisites, analyzes infrastructural constraints and risks, and proposes a model of ecotourism that ensures a balance between conservation priorities and the socio-economic needs of the region. The methodological framework is based on systemic and spatially-oriented approaches, incorporating GIS analysis, expert evaluations, and field observations.

LITERATURE REVIEW

The concept of ecotourism gained widespread recognition in the late 20th century as a response to the growing demand for tourism that integrates nature conservation with community-based resource management (Honey, 2008). In academic literature, ecotourism is regarded as a sustainable mechanism for balancing environmental, economic, and cultural objectives (Fennell, 2020). The development of ecotourism within protected areas is viewed in contemporary research as part of the sustainable territorial development paradigm, which combines environmental protection with the inclusion of local communities in the low-impact economy (Koshim et al., 2023; Morais et al., 2019; Blank & Li, 2021).

A central element in determining the success of ecotourism initiatives is the so-called "local effect" – the ability of ecotourism to generate added value within the local economy and to strengthen conservation outcomes through community participation (Stronza & Gordillo, 2008; Kiss, 2004). Within the framework of sustainable regional development, ecotourism is explored as a multifunctional process capable of driving the spatial integration of remote areas (Kaplan, 2015; Sergeyeva & Omirzakova, 2023). Several studies emphasize that the most successful cases of sustainable ecotourism occur when there is a genuine redistribution of benefits in favor of local communities involved in tourist services, interpretation of natural heritage, and infrastructure development (Purnomo et al., 2020; Akbar et al., 2020; Dey et al., 2021).

Ecotourism is often employed as a tool of exogenous resource management without adequately considering the interests of local communities, which can lead to social conflicts, unequal distribution of income, and environmental degradation in cases of unbalanced exploitation (Palmer, 2006; Ivancsóné Horváth et al., 2023; Gudkovskikh & Dirin, 2023). These challenges are particularly relevant in developing countries, where comprehensive tourism management and ecosystem impact monitoring are frequently lacking. In particular, researchers advocate for the integration of biodiversity conservation and ecosystem health indicators into the evaluation of tourism project effectiveness, alongside metrics related to employment, local income, and visitor satisfaction (Aliyeva et al., 2024). It has been noted that without such tools, it is difficult to assess the true contribution of ecotourism to sustainable development: for instance, an increase in tourist numbers and revenues does not necessarily guarantee improved environmental conditions or equitable benefit-sharing within communities.

According to a study conducted in Kazakhstan's national parks, only the combination of high visitor satisfaction, active local community participation, and the preservation of natural attractions indicates sustainable ecotourism development (Tiberghien et al., 2018; Aliyeva et al., 2020; Artemyev et al., 2025). Monitoring initiatives in the region are often limited to either ecological indicators (e.g., rare species counts, trail load) or economic indicators (e.g., tourism revenue, visitor numbers). Social effects – such as income distribution, women's and vulnerable groups' participation, and cultural heritage preservation – remain peripheral to evaluation frameworks. Some studies propose approaches for the development of integrated indicators. For instance, global literature suggests specific sustainability indices for rural tourism, and their adaptation for Central Asia could help fill this gap. Overall, the lack of cross-sectoral indicators

hampers the ability to determine whether ecotourism in the region is truly achieving its stated triple-win goals – for nature, people, and the economy. A final notable gap is the lack of attention to lesser-known, secondary, and hard-to-reach areas in ecotourism planning and research. Both academic publications and national strategies tend to focus primarily on a few flagship sites – popular national parks, nature reserves, and cultural-historical landmarks that already attract tourists. Meanwhile, vast areas with considerable ecotourism potential –such as remote mountain gorges, nature reserves, and borderland mountain villages – remain largely overlooked by researchers and policymakers.

Scholarly literature highlights that Central Asia contains unique ecosystems and communities that remain outside the scope of mass tourism and academic research, representing a missed opportunity for ecotourism development (Mukhambetov et al., 2014; Shadymanova et al., 2014; Alieva & Usmonova, 2021; Kurniawan & Khademi-Vidra, 2024; Apollo et al., 2021). It is recommended to expand the geographical scope of research and to include small and remote areas in development plans, drawing on local initiatives. Without such an approach, ecotourism risks developing in a one-sided manner, failing to engage vast parts of the region and falling short of its stated goal of inclusivity.

The literature review indicates that in order to fully unlock the ecotourism potential of post-Soviet Central Asia, it is essential to address the identified scientific and practical gaps. Strengthening local community participation through institutional reforms and education can ensure a more equitable distribution of benefits and greater support for conservation goals at the local level. The development and implementation of cross-sectoral indicators would enable objective measurement of the success of ecotourism initiatives across environmental, social, and economic dimensions, allowing for strategic adjustments when necessary. Finally, incorporating secondary and hard-to-reach areas into academic discourse and development planning could open new pathways for travelers and provide a stimulus for the revitalization of economically depressed regions. Central Asian countries are increasingly recognizing many of these challenges and have begun to take steps toward addressing them – ranging from regional cooperation in the tourism sector to the promotion of rural hospitality and ecological routes with the support of international organizations. Nevertheless, as the literature review demonstrates, these issues persist and continue to require the attention of both researchers and practitioners.

Addressing these gaps will not only enrich the academic understanding of ecotourism but also contribute to the development of a more sustainable and inclusive tourism industry across Central Asia. Kyrgyzstan is characterized by a high density of protected natural areas; however, there remains a significant gap between nature conservation and the economic activities of local populations. Studies by Nizamiev et al. (2023); Kadyrova (2024) highlight the considerable potential for ecotourism in the country's mountainous regions, particularly in the southern provinces, while also emphasizing the presence of institutional and infrastructural barriers. Despite the growing number of studies, key issues remain underexplored, including territorial planning for ecotourism, spatial analysis of tourist flows, land-use scenarios, and the integration of ecotourism models into regional sustainable development strategies. Particularly understudied are small and remote protected areas, such as the "Kulun-Ata" Nature Reserve, which possess high biogeographic and sociocultural potential but remain outside the focus of tourism and research initiatives. This study aims to address these gaps by developing a comprehensive model for assessing the ecotourism potential of the reserve – one that considers not only natural resource parameters, but also spatial connectivity, sociocultural practices, and institutional conditions.

STUDY AREA

The "Kulun-Ata" State Nature Reserve was established by a Resolution of the Government of the Kyrgyz Republic on August 11, 2004. The primary objective of the reserve's creation is the preservation of biodiversity, including the rich gene pool of juniper-coniferous forests, as well as the conservation of local flora and fauna and the enhancement of biological resource protection. The reserve is located between the Fergana and Alai Mountain ranges, in the upper reaches of the Tar River, within the Karakulja District of Osh Region. Currently, the territory of the reserve comprises two designated areas: "Kulun-Ata" (21,435.5 ha) and Ton-Zoo (6,000.7 ha) (NABU Kyrgyzstan, 2025). According to the current forest management data, the total area of the reserve since its establishment in 2004 amounts to 27,434.2 hectares. The reserve is administratively divided into two forestry units (Borombaev, 2022). The study area is the "Kulun-Ata" State Nature Reserve, located in the southwestern part of the country, within the Karakulja District, along the southern slopes of the Fergana Range (Figure 1).

This area is characterized by high biological and landscape heterogeneity, encompassing rare and endemic species of flora and fauna. It also serves as a vital water source and ecological corridor for the southern region of Kyrgyzstan. The study area includes several rural "ayil" districts located within the buffer zone of the reserve, whose populations are primarily engaged in subsistence agriculture, pasture-based livestock herding, and seasonal labor migration. Despite its considerable natural and recreational potential, the reserve remains one of the least developed regions in the country in terms of tourism. It lacks adequate tourism infrastructure, and the interaction among the conservation administration, local communities, and potential investors is limited by institutional and resource constraints. The selection of this area is justified by its representativeness for remote and socioeconomically vulnerable protected zones in Central Asia, as well as by the presence of preconditions for the development of community-based ecotourism as a tool for sustainable and locally driven development.

MATERIALS AND METHODS

This study aims to assess the potential for sustainable ecotourism within the boundaries of the "Kulun-Ata" State Nature Reserve. The primary objectives include evaluating local residents' attitudes toward the development of ecotourism activities, identifying factors that facilitate or hinder community participation in this sector, and formulating recommendations for sustainable tourism planning. The methodological framework is based on the principles of community-based ecotourism and integrated sustainability, encompassing four key dimensions: ecological, socio-

cultural, economic, and institutional-political. The research employs a combination of empirical field analysis, spatial modeling, and perception assessment through structured questionnaires.

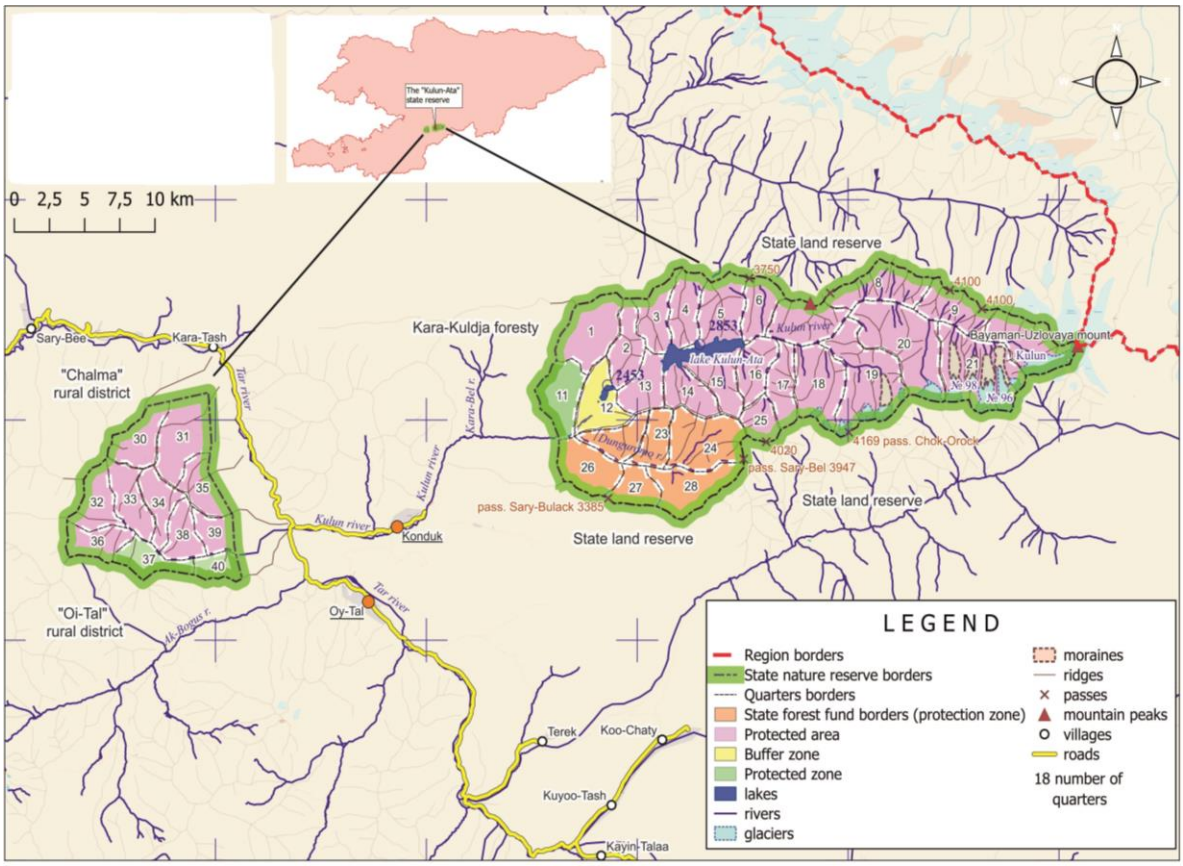

Figure 1. Geographical location of the "Kulun-Ata" Nature Reserve (Source: NABU Kyrgyzstan (2025), State Agency for Environmental Protection and Forestry, and own GIS processing)

A As part of the empirical stage of the research, a comprehensive field expedition was conducted in July 2024 within the territory of the "Kulun-Ata" State Nature Reserve and adjacent rural settlements. The purpose of the fieldwork was to collect primary data on local residents' perceptions of ecotourism as a mechanism for sustainable local development, as well as to assess the presence and quality of institutional, environmental, and economic preconditions for its establishment.

A quantitative research method was employed for data collection and analysis. A structured questionnaire was developed to assess the prospects for sustainable ecotourism development in the reserve. The field survey was carried out from July 12 to July 25, 2024, involving respondents selected from the villages of Konduk and Oy-Tal. A stratified sampling method was applied, ensuring gender, age, and occupational representativeness. The main respondent categories included individuals directly or indirectly involved in subsistence and potential tourism-related activities: farmers, herders, households with experience hosting tourists, as well as local youth representatives. Total of 197 respondents participated in the study, including 102 residents from the village of Konduk and 95 residents from the village of Oy-Tal.

The sociological field survey conducted in Konduk (n = 102) and Oy-Tal (n = 95) revealed several significant differences in the demographic composition and educational level of the local populations, which are critical for analyzing the social dimension of sustainable ecotourism development. Figure 2 illustrates the demographic and educational composition of respondents in Konduk and Oy-Tal. The data reveal a predominance of women in both settlements, alongside a relatively balanced age structure with a slight dominance of older groups. Educational attainment shows that secondary education is prevalent, while higher education levels differ notably between the two villages. These patterns highlight the socio-demographic contrasts that may influence local engagement in ecotourism.

The collected data provide a deeper understanding of the social context within which ecotourism development is envisioned, allowing for the consideration of local community specificities when designing sustainable engagement strategies.

The questionnaire consisted of 20 statements evaluated using a five-point Likert scale (ranging from 1 – "strongly disagree" to 5 – "strongly agree"), grouped into four thematic dimensions: environmental awareness, socio-cultural identity, economic expectations, and institutional trust. In addition, open-ended questions and a comment section were included to complement the quantitative data with qualitative insights. All data collected were systematized and prepared for subsequent analysis using Multi-Criteria Decision Analysis (MCDA) and the Sustainability Barometer (Ko, 2005).

All participants provided informed voluntary consent to take part in the study, and full anonymity was guaranteed. The expedition was approved by local self-governing bodies and the administration of the nature reserve. To verify the results of spatial modelling, a combined strategy was applied. In the initial phase, expert assessments were conducted involving

local specialists – reserve administration staff, guides, and researchers familiar with the actual recreational pressure and landscape characteristics. These experts cross-validated the high-suitability zones identified by the GIS model with empirical field route data and observational records. In the second phase, cartographic overlay of the modelling results was conducted using known trails and areas of traditional land use (based on GPS tracking data and surveys).

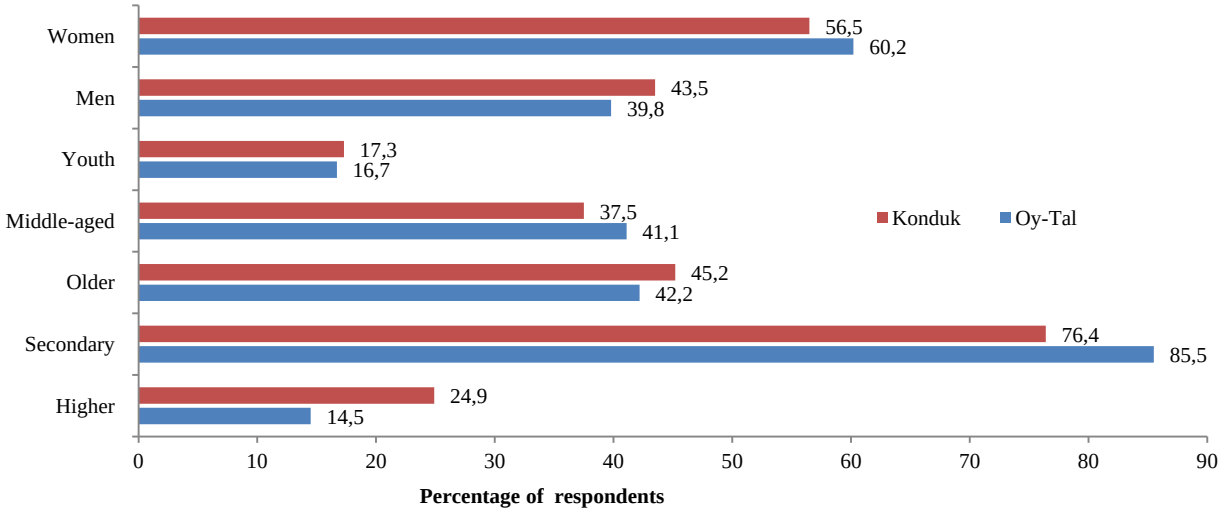

Figure 2. Socio-demographic characteristics of respondents in Konduk and Oy-Tal (Source: Own editing)

This allowed for validation of the accuracy in identifying key nodes of potential tourist activity. The methodological framework was adapted in accordance with guidelines for the application of geospatial technologies in nature-based tourism (Hennig, 2018) and best practices in the design of ecotourism routes using Multi-Criteria Decision-Making (MCDM) methods (Kolkos et al., 2024). The expeditionary work included route-based landscape and recreational observations within the buffer zone of the reserve. During transect walks, sites with potential tourist appeal were documented, alongside infrastructure conditions, evidence of traditional land use, and elements of cultural heritage. Spatial data collection involved the use of GPS loggers, photographic documentation, and route mapping, followed by vectorization in ArcGIS 10.8. The spatial analysis involved the construction of a suitability model for ecotourism using multi-criteria analysis methods within the ArcGIS 10.8 environment. The selected criteria included slope, distance to roads, water accessibility, degree of anthropogenic pressure, and the presence of protected objects.

RESULTS

One of the fundamental tools for maintaining ecological balance and ensuring the sustainable use of resources in protected areas is functional zoning. This approach involves the spatial allocation of protection regimes and permissible activities based on natural, institutional, and socio-cultural factors. Functional zoning allows for the consideration of both ecosystem constraints and the opportunities for spatial integration of conservation objectives with those of sustainable tourism, scientific research, and environmental education. It serves as an essential foundation for the development of long-term management strategies for protected areas, particularly in border and mountainous regions such as the Karakulja District of Osh Region.

This study examines the functional zoning of the "Kulun-Ata" State Nature Reserve, which encompasses unique mountain-forest and river ecosystems. The spatial structure of zoning within the reserve is viewed as a key prerequisite for assessing the potential of sustainable ecotourism and for justifying directions in conservation and recreational planning.

Figure 3 presents the spatial-structural scheme of the functional zoning of the reserve, developed on the basis of data provided by the State Agency for Environmental Protection and Forestry under the Government of the Kyrgyz Republic. The territory of the reserve includes areas within the Karakulja District and is structured in accordance with international recommendations for the management of protected areas, as well as in alignment with regional environmental policies.

Functional zoning aims to optimize the allocation of territory based on ecological value, the sensitivity of natural complexes, and the admissibility of specific types of human activity. Within the framework of this zoning system, the territory of the reserve is classified into four main functional zones:

1. Strict Protection Zone (Core Area) – This zone encompasses the largest portion of the reserve and includes ecologically vulnerable landscapes characterized by primary biocenoses and habitats of rare and endemic species of flora and fauna. All forms of human intervention are strictly prohibited in this zone, including tourism, grazing, and the extraction of natural resources. The only permitted activity is scientific monitoring, conducted under the supervision of the reserve's administration. The core zone plays a critical role in maintaining ecological representativeness and serves as a reference area for assessing anthropogenic impacts on adjacent territories.

2. Buffer Zone (Ecological Stabilization Zone) – Surrounding the core area, this zone functions as a transitional ecological filter. Strictly regulated traditional land-use practices are permitted here, including seasonal livestock grazing, the collection of medicinal plants for scientific purposes, and activities aimed at increasing environmental awareness among the local population. The buffer zone also serves as a spatial reserve for organizing environmental education activities, scientific internships, and observational studies that do not exert direct pressure on the core ecosystem.

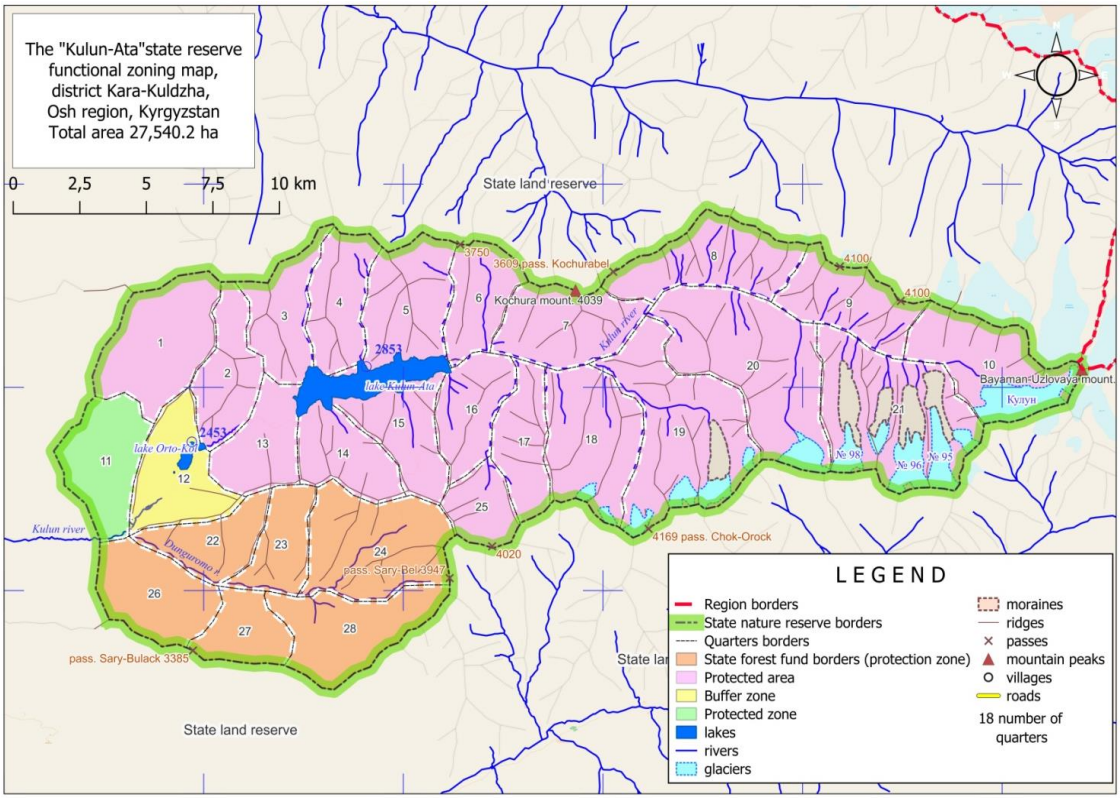

Figure 3. Functional zoning map of the "Kulun-Ata" Nature Reserve (Source: Own editing)

3. Regulated Ecotourism Use Zone – Located in the southern part of the reserve, adjacent to nearby settlements and access roads, this zone is characterized by a favorable combination of natural and landscape conditions, accessibility, and relative resilience to controlled tourist flows. This area is designated for the development of ecological infrastructure, including the establishment of marked trails, scenic viewpoints, informational displays, and temporary visitor facilities. The primary objective is to create a managed recreational environment that maintains ecological balance while offering an alternative source of income for local communities and preserving biodiversity.

4. Adjacent Areas and State Land Reserve Zones – While not formally part of the reserve, these areas hold strategic importance in terms of landscape and ecological connectivity. They form an external interaction belt between the protected area and the region's agro-pastoral system. These zones are critical for implementing protective ecosystem corridors, promoting sustainable pasture management, and fostering local initiatives in agro-ecotourism.

Functional zoning not only enables the optimization of conservation policies at the level of the individual reserve but also serves as a tool for integrating the protected area into the broader regional socio-economic fabric. The application of this zoning framework is a necessary condition for the development of a spatial strategy for ecotourism, minimizing conflicts between conservation and livelihood activities, and facilitating coordination among the reserve administration, local communities, and potential investors in sustainable tourism.

Based on the analysis of functional zoning, topographical characteristics, and the natural and cultural resources of the "Kulun-Ata" State Nature Reserve, the feasibility of developing tourism routes aligned with the principles of sustainable land use has been substantiated. The spatial structure of the reserve – which includes strictly protected areas, buffer zones, and areas designated for regulated tourism, creates favorable conditions for formalising and regulating visitor access without compromising ecosystem stability. The proposed routes are designed to integrate natural and cultural attractions, including: Mountain passes and scenic viewpoints providing visual dominance (panoramic segments along the ridge in the eastern part of the reserve); Springs and river valleys featuring unique flora (the valleys of the "Kulun-Ata" and Tar Rivers); Forest and subalpine ecosystems rich in biodiversity; Sacred sites and seasonal herding camps that reflect elements of intangible cultural heritage (notably within the Oy-Tal and the Karakulja mountain range) (Figure 4).

Figure 4 illustrates the spatial distribution of designated tourist routes within the "Kulun-Ata" State Nature Reserve, located in the Kara-Kuldzha district of Osh region, Kyrgyzstan. The mapped trails, marked in red, traverse key ecological and scenic landmarks of the reserve, including alpine lakes (Kulun-Ata, Orto-Köl), mountain passes (Sary-Bulak, Chok-Orock, Sary-Bel, Oyruma), glacier areas, and panoramic peaks such as Bayaman-Uzlovaya (4,773 m) and Kochura Mountain.

The tourist trails were planned to balance landscape diversity, ecological sensitivity, and visitor accessibility, avoiding the core protected zone. Most of the routes are concentrated in the buffer and forested transition zones to ensure minimal environmental disturbance. Green triangle symbols indicate designated tourist campsites, strategically located for overnight stays and resting points along multi-day routes. The trails vary in length and difficulty – from short radial hikes to high-altitude circuits crossing several passes. The most visited routes include those leading to Kulun-Ata Lake and to the glacier belt in the eastern section of the reserve. All proposed routes should adhere to the principles of low-impact tourism,

including the use of existing trails, avoidance of permanent infrastructure construction, installation of minimal navigational signage, and mandatory accompaniment by trained guides. The sociological field survey conducted in the settlements of Konduk and Oy-Tal (N = 197) revealed a representative distribution of key demographic and socio-economic groups.

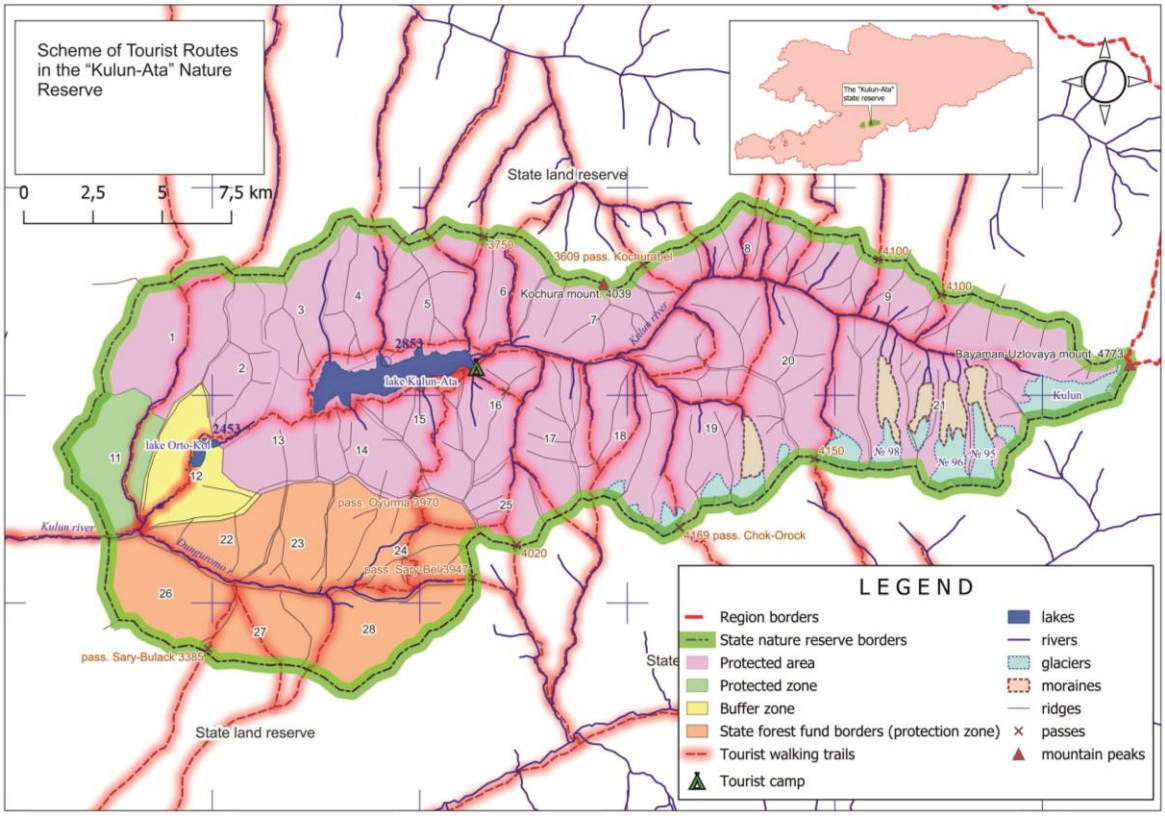

Figure 4. Scheme of Tourist Routes in the "Kulun-Ata" Nature Reserve (Source: Own editing)

Women constituted the majority of respondents (56.5% in Konduk and 60.2% in Oy-Tal), which may indicate the feminization of local economic practices and the predominance of female social capital in the context of migratory imbalance caused by the outmigration of working-age men. The age structure of respondents – dominated by middle-aged and older generations – reflects a dual dynamic: on the one hand, the presence of a valuable repository of traditional ecological knowledge; on the other, a shortage of human resources for developing tourism services that require digital and entrepreneurial competencies. Analysis of educational attainment among respondents revealed a predominance of basic (secondary) education, with over 75% of participants falling into this category. This indicates the presence of a minimum cognitive and socio-cultural capacity to engage in interpretive and environmental education programs.

However, the relatively low rate of higher education – particularly in the village of Oy-Tal (14.5%) – highlights the need for tailored capacity-building programs in sustainable land use, ecotourism management, and small-scale entrepreneurship, specifically adapted to rural contexts and gender dynamics. The survey results, organized across four key dimensions of sustainability (ecological, socio-cultural, economic, and institutional-political), enable a comparative interpretation of ecotourism perceptions in the two target locations – Konduk and Oy-Tal. Responses were standardized using a five-point Likert scale, ensuring comparability and consistency in interpretation (Figure 5).

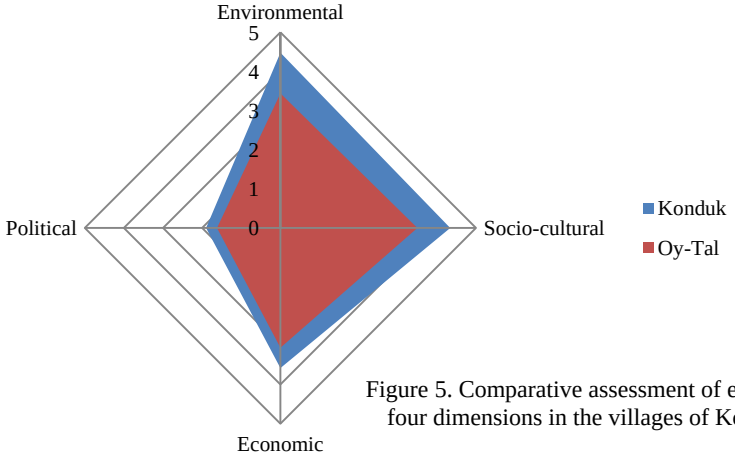

Figure 5. Comparative assessment of ecotourism sustainability perceptions across four dimensions in the villages of Konduk and Oy-Tal (Source: Own editing)

The highest sustainability scores were observed in the domain of environmental awareness: the average score in Konduk was 4.48, compared to 3.44 in Oy-Tal. These differences suggest a deeper understanding among Konduk residents of the ecological significance of natural complexes and, likely, a stronger connection to the reserve's territory. This supports the interpretation of Konduk as a potential hub for eco-interpretation activities. Conversely, in Oy-Tal, it is advisable to strengthen environmental education initiatives aimed at fostering ecological consciousness.

Socio-cultural sustainability also showed high levels in both samples (4.34 in Konduk and 3.50 in Oy-Tal), indicating the presence of local cultural practices, traditions of hospitality, and a strong sense of identity. However, the higher score in Konduk may be attributed to better preservation of intangible heritage, more effective intergenerational knowledge transmission, and more active forms of community self-governance. In contrast, Oy-Tal demonstrates signs of partial erosion of socio-cultural capital, likely linked to youth outmigration and the weakening of extended family structures.

Economic sustainability scores demonstrated moderate levels: 3.58 in Konduk and 3.06 in Oy-Tal. The gap between the two villages may indicate the presence of micro-entrepreneurial activities in Konduk linked to tourism – such as private households offering accommodation or local products, whereas in Oy-Tal such forms of employment have yet to become institutionalized. Low income diversification, seasonality, and limited access to markets remain constraining factors in both locations. These findings highlight the need to develop support programs for rural eco-businesses, including microcredit schemes, training, and marketing assistance. The most vulnerable dimension in both samples was institutional trust, with particularly low scores: 1.90 in Konduk and 1.62 in Oy-Tal. These values reflect limited community participation in the management of conservation and tourism activities, weak legal and regulatory frameworks, and a general lack of awareness regarding participation mechanisms. Coupled with the exogenous nature of most development initiatives, this leads to widespread distrust and, in some cases, resistance to change. Overcoming this barrier requires the institutionalisation of co-management approaches, the inclusion of local communities in advisory councils and decision-making processes, and the establishment of effective cross-sectoral coordination mechanisms.

Comparative analysis indicates that the village of Konduk exhibits a more sustainable profile across all dimensions, particularly in the ecological and socio-cultural aspects. In contrast, Oy-Tal is characterized by a higher degree of institutional vulnerability, which requires targeted attention from project teams, local governance bodies, and non-governmental organizations. The observed differences underscore the importance of localized ecotourism development strategies that are tailored to the socio-cultural and institutional specificities of individual communities. Based on the integrated analysis, the key barriers and opportunities within the "Kulun-Ata" State Nature Reserve were identified (Table 1).

Table 1. Key Barriers and Opportunities for Ecotourism Development in the "Kulun-Ata" State Nature Reserve

Category	Barriers	Opportunities	Significance Rating (on a scale from 1 to 5)
Environmental	Risk of ecosystem degradation due to unregulated tourism	High natural and landscape heterogeneity	5
Socio-cultural	Lack of experience among the local population	Strong traditions of hospitality, local identity	4
Economic	Absence of initial investment, seasonal income patterns	Potential for micro-business development and agrotourism	2
Institutional	Weak regulatory framework, limited administrative capacity	Engagement of NGOs, potential international support	3

DISCUSSION

The results of this study support the thesis that ecotourism, as an integrative form of natural resource use and local community development, can serve as an effective instrument for sustainable development in marginal territories of Central Asia. The specific case of the "Kulun-Ata" State Nature Reserve illustrates several patterns and challenges previously identified in global and regional literature, while also contributing new empirical data derived from a remote rural context characterized by high conservation value and limited economic opportunities.

The high levels of environmental and socio-cultural awareness demonstrated by respondents reinforce findings from earlier studies emphasizing that local communities possess significant latent potential for participation in ecotourism. This is particularly important, as the success of community-based tourism largely depends on the willingness and readiness of local populations to engage and their recognition of the cultural and ecological value of their territory.

For the sustainable implementation of ecotourism in the reserve, it is not sufficient to merely inform the local population. Their role must be institutionally embedded in management processes, benefit-sharing mechanisms, and decision-making structures. The results of the spatial analysis confirm the high suitability of several areas within the reserve for the development of ecotourism routes with minimal ecological impact. This aligns with the findings of Fennell & de Grosbois (2023), who emphasize that landscape heterogeneity, natural diversity, and buffering capacity are key criteria for the establishment of "green corridors" in ecotourism. However, the lack of tourism infrastructure, identified through on-site route assessments, indicates the structural unpreparedness of the region to accommodate even a limited number of visitors. In such contexts, it is essential to pursue a phased, low-impact infrastructure development strategy (eco-trails, guesthouses, trained local guides) in order to avoid rapid environmental degradation and visitor dissatisfaction.

The institutional barriers identified – such as weak coordination, limited resources, and underdeveloped legal frameworks – are common across many rural protected areas in the post-Soviet space. Nevertheless, this study reveals an important positive dynamic: the presence of engaged local leaders, non-governmental organizations, and grassroots

initiatives. These actors represent a potential institutional "growth point" that can be activated with appropriate multi-level support – at the local, national, and donor levels. It is important to emphasize that the absence of comprehensive sustainability indicators – both ecological and social – complicates the regular assessment of ecotourism impacts. In this regard, the sustainability barometer framework proposed in the study may be adapted for broader application at the level of local administrations and protected area (PA) management. The findings reinforce the relevance of expanding the scope of ecotourism beyond flagship destinations and integrating "secondary" or underrepresented areas into national and regional strategies. Despite its remoteness, the "Kulun-Ata" Nature Reserve demonstrates significant potential to serve as a nodal center for local sustainable development, particularly given the persistent social vulnerability of southern Kyrgyzstan.

Therefore, ecotourism in the reserve should not be viewed as an isolated initiative but rather as part of a broader strategy for territorial resource redistribution, institutional renewal, and infrastructure decentralization. Without a systemic approach and support from both bottom-up and top-down levels, such initiatives risk remaining fragmented and short-lived.

CONCLUSION

This study provided a comprehensive assessment of the potential for sustainable ecotourism within the "Kulun-Ata" State Nature Reserve of the Kyrgyz Republic. The analysis, based on a combination of spatial modeling, questionnaire surveys, expert interviews, and field observations, identified several key findings of both theoretical and practical relevance.

The high ecotourism potential of the area is supported by its biogeographic diversity, cultural heritage, and favorable landscape-geographic conditions. The spatial suitability model revealed zones that meet the criteria for sustainable tourism with minimal anthropogenic pressure. The local population demonstrates a strong level of support for ecotourism initiatives, particularly regarding environmental and socio-cultural dimensions. However, moderate levels of institutional distrust and limited readiness for entrepreneurial engagement without external support persist. This highlights the need for mechanisms of accompaniment, capacity building, and coordination.

Institutional barriers remain a significant challenge for initiating ecotourism activities, including a lack of cross-sectoral coordination, regulatory ambiguity in buffer zone management, and limited involvement of local structures in decision-making. Nevertheless, the presence of interested stakeholders – such as non-governmental organizations and community-based groups – offers the potential to serve as intermediaries in transforming the governance model.

A lack of infrastructure remains a systemic constraint, necessitating the adoption of an adaptive, phased approach to development – beginning with short-distance routes, the establishment of guesthouses, and the training of local guides. It is essential to avoid large-scale, unregulated projects that could disrupt the fragile ecological balance of the area.

The use of Multi-Criteria Decision Analysis (MCDA) and the Sustainability Barometer enabled an objective assessment of current conditions and helped establish development priorities. This approach can be adapted as a tool for territorial planning and monitoring of ecotourism initiatives in other regions of Kyrgyzstan and Central Asia.

Ecotourism in the "Kulun-Ata" Nature Reserve holds potential to become a strategic vector for local sustainable development, provided there is institutional support, spatial integration, and active participation of the local population. The findings of this study contribute to the advancement of sustainable tourism concepts in peripheral areas and may inform the development of regional green economy programs and territorial planning strategies in post-Soviet countries.

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