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Tourism Capacity and Green Infrastructure: Evidence from the Eastern part of Lake Alakol

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Abstract
With the growing tourist load and increased anthropogenic pressure on coastal areas, the need to develop sustainable management models for tourist destinations based on the integration of natural and infrastructural solutions is becoming urgent. The aim of this study is to develop a scientifically grounded approach to assessing the capacity of green infrastructure and to propose mechanisms for managing tourist flows to reduce anthropogenic pressure and improve the quality of the destination's tourism environment. The research methods include spatial analysis using geoinformation tools, and the calculation of recreational capacity based on normative, spatial, and temporal approaches, using the methodology for assessing the capacity of territories. The initial data are represented by spatial characteristics of the territory, standards of recreational load, infrastructure parameters (pedestrian and bicycle zones), and time indicators of attendance. The results of the study show that, based on normative spatial modeling, with an area of 40,000 m2 and a standard of 50 m2 per visitor, the simultaneous recreational capacity is 200 people. Considering the turnover rate, the daily throughput reaches 1,200 visits, and during the peak tourist period (60 days), 72,000 visits. The obtained values indicate the possibility of effectively redistributing tourist flows and reducing the burden on coastal ecosystems through the introduction of the AEEB model. The findings indicate the potential to regulate tourist flows and reduce anthropogenic pressure on coastal ecosystems.

KEYWORDS
Tourism Capacity, Tourism Business, Green Infrastructure, Recreational Capacity, Management, Spatial Planning, Regional Economy

1 | INTRODUCTION

The Alakol resort area, located in the Abay and Zhetysu regions of Kazakhstan, represents one of the country's most significant recreational destinations. This study focuses on the eastern part of Lake Alakol within the Abay region (hereinafter referred to as "the destination"), which is included among the 21 officially designated resort areas. The destination is characterized by a predominance of ecosystem services associated with aquatic environments and is considered to possess therapeutic properties. According to data from the Bureau of National Statistics of the Republic of Kazakhstan (2025), the destination ranks among the top six domestic destinations by visitor numbers, indicating its growing importance within the national tourism system.

Historically, the destination has played a notable role in regional trade and cultural exchange. During the Soviet period, it developed into a center for health and wellness tourism, laying the foundation for its current tourism specialization. Following Kazakhstan's independence in 1991, the destination has experienced steady growth in visitor numbers, attracting both domestic and international tourists. However, the continued expansion of tourism requires a transition toward more sustainable development models, including effective natural resource management, infrastructure modernization, and cross-border cooperation (Kapassova et al., 2025).

At the national policy level, the importance of improving tourism competitiveness has been emphasized in the State of the Nation Address by President Kassym-Jomart Tokayev (2025), where particular attention was given to the condition of tourism infrastructure and the need for systemic improvements. In 2025, the situation in the Alakol resort area further highlighted existing management challenges. Numerous public complaints concerning inadequate sanitary conditions, unregulated trade activities, insufficient infrastructure, and communication issues revealed significant systemic shortcomings in the organization and maintenance of the destination.

In response, government authorities-initiated inspections and introduced measures to improve sanitary and epidemiological conditions, strengthen waste management systems, and enhance infrastructure and communication services (Nigmatullina, 2025). These developments demonstrate that sustainable tourism development requires not only an increase in tourist flows but also the assurance of quality, safety, and resilience of the tourism environment through effective governance mechanisms.

Despite recent progress, the destination's development has largely focused on expanding accommodation facilities and transport accessibility, while the role of green infrastructure remains insufficiently addressed. This imbalance poses risks to environmental sustainability, particularly under conditions of the seasonal concentration of tourist flows along the lake's shoreline. The lack of systematic monitoring of recreational pressure, fragmented infrastructure planning, and limited coordination among stakeholders further exacerbates the destination's vulnerability during peak periods.

Given the above, there is a need to reconsider existing approaches to tourism management by integrating the principles of sustainable development, environmental management, and risk-based planning into territorial governance. In particular, the assessment of carrying capacity and the role of green infrastructure as a regulating mechanism for tourist flows remains insufficiently explored in the context of emerging destinations such as Alakol. The aim of this study is to develop a scientifically grounded approach to assessing the capacity of green infrastructure and to propose mechanisms for managing tourist flows in order to reduce anthropogenic pressure and improve the quality of the tourism environment in the destination.

This study makes three main contributions. First, it advances the understanding of sustainable tourism development by conceptualizing green infrastructure as an integral component of tourism destination systems. Second, it proposes an integrative model that combines the principles of sustainable tourism, nature-based solutions, and culturally sensitive development within the framework of the "Alakol Ethno-Eco Bagshasy" (hereinafter – AEEB) concept. Third, the proposed model offers practical implications for planning and managing sustainable development in emerging tourist destinations.

2 | LITERATURE REVIEW

In recent years, sustainable tourism has been increasingly conceptualized as a multidimensional framework integrating environmental protection, spatial planning, community well-being, and economic development. Within this paradigm, tourism destinations are understood as complex socio-ecological systems in which natural environments, infrastructure, governance mechanisms, and human activities interact dynamically. As a result, the concept of destination resilience has gained prominence, emphasizing the capacity of territories to manage tourist flows, reduce environmental pressure, and maintain the quality and safety of the tourism environment amid growing demand.

For the purposes of this study, the literature review is structured around three interrelated thematic areas: sustainable tourism and destination resilience; green infrastructure, nature-based solutions, and wellbeing; and empirical studies on Lake Alakol. This structure enables a systematic connection between broader theoretical discussions and the destination's specific territorial context.

The literature consistently indicates that sustainable tourism development involves balancing economic growth with environmental protection, cultural preservation, and social inclusion. In this context, tourism destinations are increasingly viewed not merely as sites of consumption, but as integrated systems in which infrastructure, ecosystems, and local communities are closely interconnected. Particular attention has been given to the management of tourist flows and their spatial concentration. In coastal and lake destinations, recreational activities are often concentrated along limited shoreline areas, which may lead to uneven spatial pressure. Under such conditions, insufficient infrastructure planning, limited environmental monitoring, and fragmented governance structures can increase destinations' vulnerability during peak periods.

Recent studies also highlight the importance of integrating hard infrastructure, such as transport networks, accommodation, and service facilities, with environmental infrastructure, including green spaces, ecological corridors, and nature-based systems. This integration is widely regarded as essential for enhancing the resilience and sustainability of tourism destinations. Despite growing recognition of this interdependence, the interaction between built and green infrastructure remains comparatively underexplored, particularly in emerging tourist regions.

Studies on urban park systems demonstrate that the spatial patterns of supply and demand for cultural ecosystem services significantly influence visitor behavior and the intensity of recreational use (Liu et al., 2021). Green infrastructure is increasingly recognized as a multifunctional component of territorial development, contributing to ecological stability, landscape quality, and human wellbeing (Thompson et al., 2023; Beltramo et al., 2024; Thirumarpan & Robinson, 2025). Within tourism studies, green spaces and nature-based solutions are associated not only with environmental conservation but also with improved visitor experience and enhanced destination attractiveness.

Empirical research suggests that exposure to green environments is associated with reduced stress, improved mood, and enhanced psychological well-being. These effects are particularly relevant in tourism contexts, where environmental quality directly influences visitor satisfaction and the perceived value of the destination. Recent research demonstrates that the relationship between green space and physical health is not uniform across population groups, as gender-specific differences may significantly influence health outcomes and access to environmental benefits (Sillman et al. 2022). Moreover, studies in environmental psychology indicate that the restorative effects of green spaces are observed across different population groups, including adolescents, women, and socially vulnerable communities (Zhang et al., 2020; Rigolon, 2021; Russo et al., 2024; Ijatuyi & Yessoufou, 2025). At the same time, recent research demonstrates that the integration of green and hard infrastructure plays a crucial role in enhancing sustainability and resilience of tourism destinations (Alfehaid, 2025; Trung, 2025).

From a landscape architecture perspective, the effectiveness of green infrastructure depends on spatial composition, accessibility, diversity, and design quality. Well-designed green spaces can facilitate physical activity, promote social interaction, and support psychological resilience. In this regard, green infrastructure may be understood not merely as a passive environmental background, but as an active, experience-shaping component of tourism systems.

In addition to social and health-related benefits, green infrastructure is also associated with economic and governance outcomes. Natural and semi-natural spaces can support economic diversification, local employment, and conservation financing, while contributing to the inclusiveness of tourism development. Consequently, nature-based solutions are increasingly considered as important instruments for achieving a balance between economic development and environmental sustainability.

Research on Lake Alakol provides a diverse, though somewhat fragmented, body of knowledge covering natural, environmental, and tourism-related processes. Existing studies have addressed remote sensing of water bodies, shoreline dynamics, environmental risks, recreational potential, tourist satisfaction, and aspects of carrying capacity.

Early research primarily focused on improving remote sensing techniques and monitoring methods, enabling more accurate delineation of water surfaces and supporting ecological analysis of aquatic systems (Yuyue et al., 2021). Subsequent studies examined geomorphological processes and shoreline vulnerability, identifying high-risk zones and assessing the impact of recreational activities on coastal soils and surface waters (Medeu et al., 2023; Mukayev et al., 2023).

More recent studies have expanded the analytical scope to include recreational capacity, social impacts, tourist satisfaction, and cultural landscape characteristics (Kishkenbayeva & Baisarina, 2024; Valeyev et al., 2024). By 2025, research began to address tourism potential, development barriers, and both physical and social carrying capacity, as well as aspects of landscape planning for recreational areas (Kanatuly et al., 2025; Kishkenbayeva et al., 2025; Valeyev et al., 2025; Kerimbay et al., 2025). The literature emphasizes that sustainable tourism development requires not only the preservation of natural and cultural assets but also their integration into coherent spatial and infrastructure systems (Aldybaev & Zakiryanov, 2021; Tubekova et al., 2024).

Existing research has significantly contributed to understanding individual components of the destination system. However, further work is needed to integrate these elements within a unified spatial and management framework. The analysis indicates a research gap in the integration of green infrastructure into the planning and management of tourism destinations. In particular, the role of green infrastructure as a mechanism for regulating tourist flows, mitigating anthropogenic pressure, and enhancing the overall quality of the tourism environment remains relatively underexplored.

This gap is especially evident regarding the destination, where the rapid growth of tourism activity is not yet fully supported by a comprehensive, systems-based planning approach. Existing studies provide valuable insights into individual components of the destination; however, an integrated model that links green infrastructure, carrying capacity, spatial organization, and culturally sensitive development remains lacking.

Accordingly, the present study seeks to address this gap by proposing a holistic framework that combines principles of sustainable tourism, nature-based solutions, and destination governance. Within this framework, green infrastructure is conceptualized as a foundational element of a resilient tourism system, enabling a more balanced alignment between economic development, environmental protection, and the well-being of both visitors and local communities.

3 | RESEARCH METHODS

To describe the comprehensive consciousness of destination renaturing, a planning framework grounded in AEEB principles was developed. Within this framework, the concept of a specialized park was elaborated, identifying and structuring key recreational functions - sporting, ethno-cultural, health-related, and educational, while integrating botanical gardens as an independent functional and spatial component.

The developed AEEB model and its description were subsequently examined by experts at the National Institute of Intellectual Property (Qazpatent, 2025), resulting in the registration of copyright for the landscape design work, 'Designed Plan of 'Alakol Ethno–Eco Bagshasy' (January 20, 2025). The research focuses on the proposed AEEB located in the eastern part of Lake Alakol. Its position within the destination's tourism-influenced zone provides the necessary geographical context and supports the selection of the site as a potential instrument for regulating visitor flows within the regional tourism system (Figure 1).

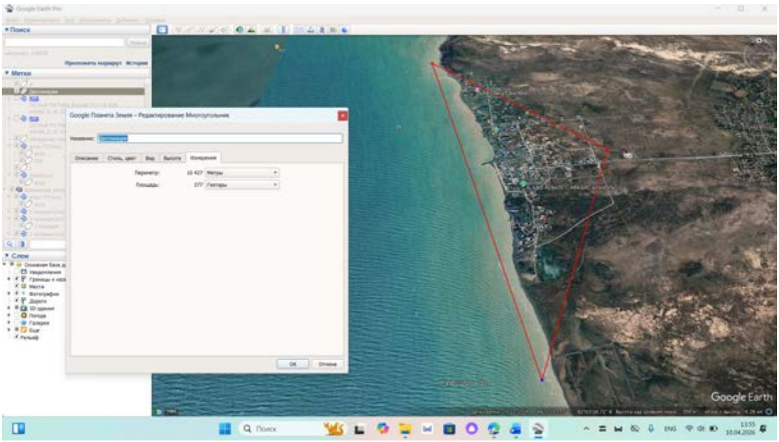
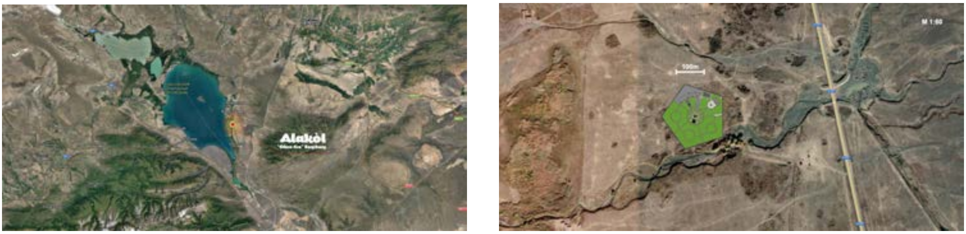


Figure 1 The destination area

The study area was delineated using high-resolution satellite imagery in Google Earth Pro, with polygon-based mapping enabling precise definition of the boundaries of the coastal destination site. The total area of the selected territory is approximately 400 hectares, calculated using built-in geospatial measurement tools. The spatial configuration of the site is characterized by a predominantly coastal morphology combined with adjacent urbanized and semi-natural landscapes, which is essential for subsequent capacity assessment and planning decisions. The applied geospatial approach provides a reliable foundation for further modeling of the park development concept.

In the first stage of the study, the spatial model of the AEEB was developed in SketchUp (v.21.1.299) at a 1:1 scale to maintain dimensional consistency. Considering the open steppe landscape and the project's conceptual stage, a limited tolerance for positional accuracy was accepted, while the project site itself was georeferenced with sufficient precision.

Figure 2 presents the overall configuration of the AEEB and its relationship with the surrounding landscape.



The eastern part of Lake Alakol — Situation map of the AEEB location

Figure 2 Location of the proposed AEEB

The spatial positioning of the proposed AEEB within the eastern part of Lake Alakol highlights its integration into the broader regional landscape. The location serves as a transitional interface among aquatic, riparian, and steppe ecosystems, thereby increasing the ecological and recreational value of the site. At a finer scale, the situation map reveals the internal configuration of the AEEB, including planned functional zones and its proximity to natural water channels and existing transport infrastructure. This spatial context is essential for understanding both the area's environmental sensitivity and its potential for sustainable park development.

In the second stage of the study, the assessment of the AEEB's recreational capacity combines normative, spatial, and temporal components, reflecting a comprehensive approach to evaluating visitor load. In line with this approach, a review of regulatory documents and scientific literature was conducted to justify the selection of a recreational load indicator. Current Kazakhstani legal frameworks recognize the concept of recreational load but do not provide standardized numerical thresholds for visitor density in urban green parks. Therefore, for the purpose of this study, a normative benchmark of 50 persons per hectare was adopted, as recommended in urban landscaping and planning guidelines for open-access natural areas (Andreeva et al., 2020).

In the third stage, the spatial parameters of the AEEB were defined in accordance with the project layout. The total park area is 4 hectares (40,000 m²) and was fully accounted for in the capacity calculations. In addition, the analysis incorporates the spatial characteristics of circulation infrastructure, including 4,804 m² of pedestrian sidewalks and 1,721 m² of cycleway area, as these elements determine the internal distribution and intensity of visitor flows.

The calculations follow the methodological approach proposed by Nikolaeva et al. (2025), which provides a structured framework for estimating recreational capacity using area-based indicators, turnover coefficients, and correction factors. This methodology was selected for its applicability to open-access recreational areas and its ability to explicitly link spatial parameters to visitor-use intensity (Table 1).

Table 1 Source framework and its adaptation for recreational capacity assessment

Component	Source formula	Adapted approach	Applied formula
Turnover coefficient	$Rf = T/Td$	Directly adopted	$Rf = 6$
Base capacity (BCC)	BCC $= (A/Au) \times Rf \times t$	Applied without correction factors	BCC $= (A/Au) \times Rf \times t$
Normative area	$Au = 10000/50$	Converted to an individual space	$Au = 200$ m^2/visitor
Simultaneous capacity	A/Au	Baseline interpretation	$A/Au = 200$
Daily capacity	BCC $\times\ t\ (t = 1)$	Throughput interpretation	BCCday $= 1200$ visits/day
Seasonal capacity	BCC $\times\ t$	60-day period	BCCseason $= 72000$ visits
Full RCC model	RCC $=$ PCC $\times$ MC	Not applied	–
Correction factors	$Cf = 1 - L/T$	Not applied	–
Management coefficient	MC variable	MC $= 1$	MC $= 1$

Note: compiled by the authors.

The presented model structure and its adaptation provide a transition from the theoretical formulation of the problem to a quantitative assessment of the recreational capacity of the territory. In this context, the basic element of the calculation scheme is the standard area per visitor, reflecting the permissible level of anthropogenic load and ensuring comparability of the results. The corresponding indicator is determined by the following formula (1):

$$A_u = \frac{10{,}000}{50} = 200 \text{ m}^2/\text{person} \tag{1}$$

where:

A_u – the area required per visitor (m^2/person);

10,000 – the area of one hectare (m^2);

50 – the standard of permissible recreational load (people/ha).

The total area of the AEEB is 40,000 m². Based on the defined normative area, the simultaneous recreational capacity of the territory is calculated by formula (2):

$$C_s = \frac{A}{A_u} \tag{2}$$

where:

C_s – the simultaneous recreational capacity (visitors);

A – the total area of the territory (m^2);

A_u – the normative area per visitor (m^2/person).

This value represents the maximum number of visitors that can be accommodated simultaneously without exceeding the accepted recreational load. To incorporate the temporal dimension of visitor use, a turnover coefficient is introduced (3):

$$R_f = \frac{T}{T_d} \tag{3}$$

where:

R_f – the turnover coefficient;

T – the daily operating time (hours);

T_d – the average duration of a visit (hours).

The integrated recreational capacity, combining spatial and temporal parameters, is determined as follows (4):

$$\text{BCC} = \left(\frac{A}{A_u}\right) \times R_f \times t \tag{4}$$

where:

BCC – the recreational capacity (visits over a given period);
A – the total area (m^2);
A_u – the normative area per visitor (m^2/person);
R_f – the turnover coefficient;
t – the duration of the analyzed period (days).

The daily recreational capacity is therefore:

$$\text{BCC}_{day} = 200 \times 6 = 1,200\ visits/day \tag{5}$$

For the peak tourism period of 60 days, the seasonal capacity is estimated as:

$$\text{BCC}_{season} = 1,200 \times 60 = 72,000\ visits \tag{6}$$

The daily value represents visitor throughput rather than simultaneous presence, which aligns with contemporary interpretations of carrying capacity as a dynamic process.

To complement the overall assessment, the adequacy of internal circulation infrastructure is evaluated using area-based indicators. The pedestrian space available per visitor is calculated as (7):

$$S_p = \frac{A_p}{N} \tag{7}$$

where:

S_p – the pedestrian space per visitor (m^2/person);
A_p – the total pedestrian area (m^2);
N – the daily visitor flow (visitors/day).

The performance of cycling infrastructure is evaluated using the following indicators (6):

$$D_c = \frac{N}{A_c}, \quad S_c = \frac{A_c}{N} \tag{8}$$

where:

D_c – the density of users (visitors/m^2);
S_c – the space per cyclist (m^2/person);
A_c – the cycleway area (m^2).

Although the full framework of recreational capacity assessment may include correction coefficients and management factors, this study applies to a simplified model due to limited empirical data on visitor behaviour and environmental conditions. The management coefficient is therefore assumed to be equal to 1, allowing the analysis to focus on directly measurable parameters while maintaining transparency and consistency with more advanced approaches that may be applied in future research.

While the framework for assessing recreational capacity includes a range of correction coefficients and a management factor, this study adopts a simplified approach that focuses on baseline spatial and temporal capacity. The choice is mainly driven by data availability. The calculation of correction coefficients (C_f) requires detailed and consistent empirical data on environmental conditions, visitor behaviour, safety, and socio-cultural interactions. For the study area, such data are currently limited and not systematically collected, which could introduce a high degree of uncertainty into the results (Table 2).

Table 2 Comparison between the normative model and the simplified approach applied in this study

Component	Full Normative Model	Simplified Model	Rationale
Overall structure	RCC $=$ PCC $\times$ MC	Not applied	Focus on baseline capacity
PCC	PCC $=$ BCC $\times$ Cf	Not applied	Lack of data
BCC	BCC $= (A/Au) \times Rf \times t$	Fully applied	Core parameter
Normative area	Standard value	Adopted	Comparability
Turnover coefficient	$Rf = T/Td$	Applied	Captures dynamics
Correction factors	$Cf = 1 - L/T$	Not applied	Data uncertainty
Management coefficient	Reflects infrastructure	MC $= 1$	Low infrastructure
Temporal parameter	Flexible t	Day + season	Tourism seasonality
Output	Adjusted capacity	Baseline capacity	Planning purposes

Note: compiled by the authors.

In addition, the management coefficient (MC) is intended to capture the role of infrastructure and governance in regulating visitor flows. However, given the relatively low level of tourism infrastructure and the park's predominantly natural character, its influence at this stage is minimal. For this reason, it was assumed to be equal to 1.

The simplified model, therefore, focuses on parameters that can be directly measured and interpreted with greater reliability, namely the spatial capacity of the area and the temporal dynamics of its use. This enables more transparent and robust estimation of recreational capacity, particularly in contexts where monitoring data is limited. At the same time, the approach remains compatible with the full normative framework and can be further developed in future studies as more detailed empirical data become available.

4 | RESULTS

The calculated indicators of AEEB recreational capacity are directly derived from the defined normative, spatial, and temporal parameters. Based on the adopted standard of 50 persons per hectare, the individual spatial requirement equals 200 m^2 per visitor. Given a park area of 40,000 m^2, the baseline simultaneous capacity is estimated at 200 visitors. Incorporating the turnover coefficient (k = 6), calculated as the ratio of daily operating time to the average visit duration, yields a daily visitor flow of 1,200 visits. For the peak summer period of 60 days, the total seasonal capacity reaches 72, 000 visits.

These findings indicate that the proposed model can accommodate visitor use at a level consistent with the adopted normative threshold. At the same time, the estimated daily value reflects visitor turnover rather than simultaneous presence, allowing recreational capacity to be interpreted as a dynamic process. This interpretation is consistent with current approaches to carrying capacity assessment, which emphasize regulating visitor flows rather than maintaining fixed density limits. In general, the master plan of AEEB is organised through functional zoning, integrating recreational, cultural, and service elements into a coherent system.

Figure 3 presents the zoning structure and the network of interconnected facilities, allowing interpretation of visitor distribution and internal circulation.

(a) Master Plan (b) Interconnected tourist facilities

Figure 3 The main sections of the AEEB

To preserve the destination's aquatic ecosystem and reduce anthropogenic pressure from tourist flows, a conceptual model of the AEEB was developed using situational mapping and master planning principles. The model brings together seasonal park zones, an Ethno village (aul), and supporting functional facilities to organize visitor movement and distribute recreational activities more evenly across the site.

As shown in Figure 3, the AEEB master plan includes ten interconnected 10 functional zones: the Ethno village (aul), Winter Garden, Spring Garden, Autumn Garden, Administrative Zone, Greenhouse Complex, Parking Area, Ticket Office, Locker Room and Bike Rental Area, and a Pond. These elements are arranged to form a coherent spatial structure for both domestic and international visitors, while maintaining clear functional differentiation. The plan was developed at a scale of 1:12, where 1 cm on the map corresponds to 12 m in actual distance. In this context, the proposed green infrastructure is intended to support the provision of Alternative Ecosystem Services (AES), particularly during peak tourist seasons. It also reflects ethno-ecological values, linking recreational use with cultural identity and landscape-sensitive planning approaches.

AEEB's concept adopts an integrated tourism planning and sustainability-oriented design approach to develop a conceptual model of an ethno-aul as a cultural tourism destination (Figures 4).

The diagram shows a three-dimensional perspective visualization of an ethno-aul as a key functional element of the AEEB concept integrated into a system of seasonal park spaces. The spatial composition includes traditional yurts grouped around a central public area that performs a cultural and communicative function. Landscaping of the territory is represented by elements of landscape design, including alleys, decorative plantings and buffer green zones, which helps to reduce anthropogenic stress and create a comfortable recreational environment.

Figure 4 Perspective model of the Ethno-aul and seasonal parks

The methodological framework is based on the principles of sustainable tourism development, cultural landscape planning, and visitor experience design, ensuring a balance between cultural preservation, economic viability, and environmental responsibility. The research applies to a functional zoning method combined with a systems approach, where the Ethno-Aul is conceptualized as an interconnected spatial system. Each structural element (yurts, stage, and guest houses) is assigned a specific function contributing to the overall tourism ecosystem. The central performance stage acts as a socio-cultural anchor, supporting the transmission of intangible cultural heritage through performances and public events.

The spatial organization of yurts reflects a thematic clustering strategy aligned with tourism demand and sustainability considerations. A museum yurt is designed to preserve and interpret cultural heritage, contributing to educational tourism. Multiple restaurant yurts, offering both national and international cuisine of Kazakhstan, support gastronomic tourism diversification while distributing visitor flows and reducing spatial congestion. A specialized national cuisine yurt emphasizes local food traditions and promotes the use of regional products, aligning with the principles of sustainable food systems (Figure 5).

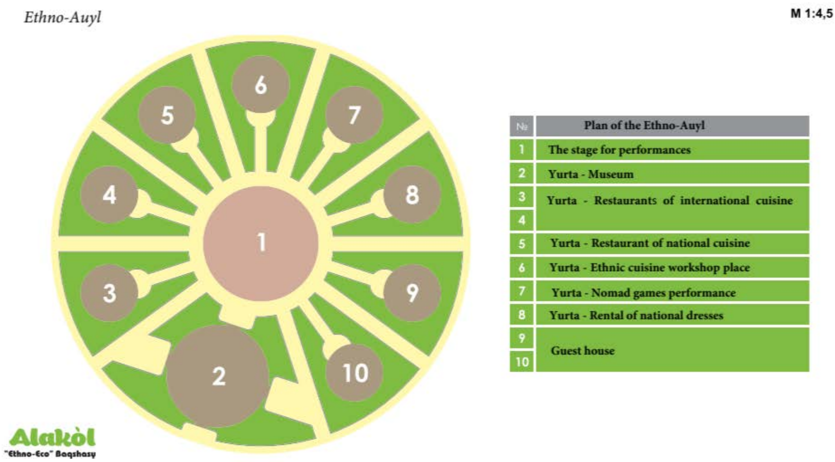


Figure 5 Spatial layout of the ethno-aul with 10 yurts

An ethnic cuisine workshop yurt introduces participatory formats, enabling tourists to engage in hands-on cultural practices, which enhances the experience economy dimension of the destination. The inclusion of a nomadic game's yurt supports the preservation and demonstration of traditional sports, while the national costume rental yurt facilitates immersive and interactive engagement with cultural identity. The accommodation component, represented by guest houses, is integrated into the spatial model to encourage longer visitor stays and increase the economic sustainability of the site. Their placement considers environmental carrying capacity and minimizes potential pressure on core cultural zones.

The overall layout is designed according to principles of sustainable spatial planning, including efficient circulation patterns, balanced distribution of functions, and the reduction of environmental impact. The model incorporates considerations of visitor flow management, resource efficiency, and cultural authenticity, ensuring that both tangible and intangible heritage elements are preserved while maintaining tourism attractiveness (Figure 6).

Figure 6 General view of AEEB

The general view of the park reveals a well-organized spatial structure, the composition emphasizes accessibility and visual coherence, with pathways, greenery, and built features integrated into a unified and balanced environment. All visual materials are used as analytical tools rather than merely descriptive illustrations, supporting the interpretation of spatial organization and functional relationships within the proposed system.

From a spatial perspective, the calculated capacity suggests that the AEEB can function as a regulating element within the tourism system of the destination. The concentration of visitor activity within a planned and functionally organized space creates conditions for the redistribution of tourist flows away from environmentally sensitive shoreline areas. This redistribution reduces the likelihood of uncontrolled anthropogenic pressure on coastal ecosystems, which are particularly vulnerable under conditions of seasonal concentration of tourism. In addition, an important aspect is the compliance of the AEEB with international standards of the Global Sustainable Tourism Standards (GSTC, 2025).

The estimated capacity values also provide a quantitative basis for evaluating the adequacy of internal infrastructure. Given the projected daily flow of 1,200 visits, the relationship between visitor intensity and the provision of pedestrian and cycling space becomes a critical factor. The alignment between circulation infrastructure and calculated visitor load supports the conclusion that spatial design elements can perform a regulatory function by influencing movement patterns and reducing local congestion within the park area.

The model enhances the multifunctionality of the destination by integrating ecological, cultural, and educational components. This approach supports sustainable tourism development while also generating socio-economic benefits for local communities, including employment opportunities and the promotion of cultural heritage (Figure 7).

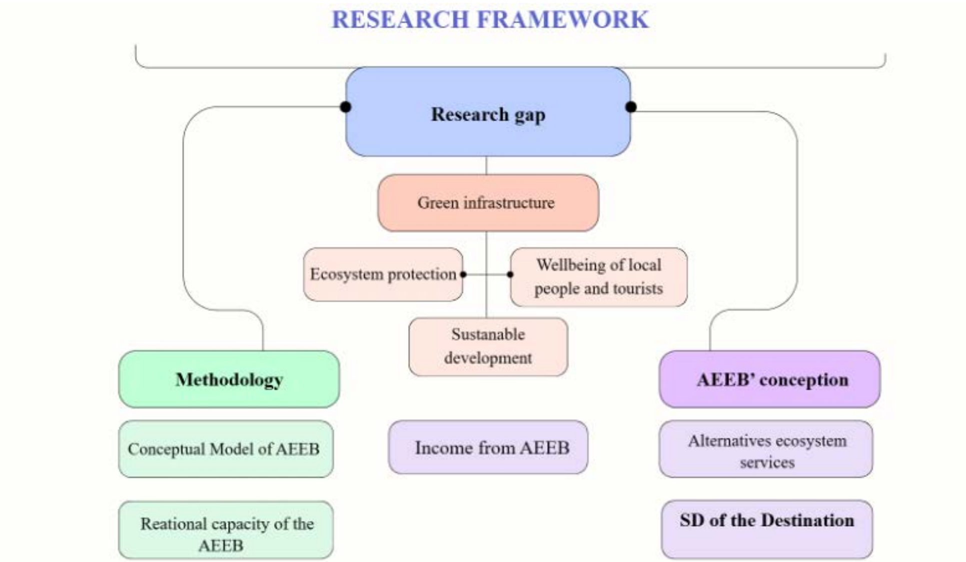


Figure 7 Research framework between the research gap, methodology and AEEB conception

The findings of this study suggest that the AEEB framework can be meaningfully embedded within territorial planning instruments, particularly in the preparation of master plans for the Alakol coastline. Its methodological contribution lies in translating general sustainability principles into spatially defined and functionally differentiated elements. This enables a more nuanced regulation of recreational pressure, supports the preservation of ecosystem integrity, and enhances the overall visitor experience. At the same time, the model treats recreational capacity as a dynamic process shaped by temporal distribution and visitor turnover, rather than as a fixed threshold, which reflects current approaches in destination management.

Furthermore, the results should be interpreted with consideration of methodological limitations. The absence of correction coefficients reflecting environmental conditions, visitor behaviour, and socio-cultural factors introduces a degree of uncertainty into the estimated capacity values. In addition, using a constant turnover coefficient does not account for intra-day variations in visitor intensity during the peak summer period. These factors may lead to a moderate overestimation of actual carrying capacity under real use conditions.

Despite these limitations, the applied approach provides a transparent and internally consistent basis for estimating recreational capacity under conditions of limited empirical data. The results can serve as an initial benchmark for further refinement of the model, including incorporating monitoring data and developing adaptive management mechanisms.

This is particularly relevant for destinations characterized by short and intensive summer tourism periods, where the ability to quantitatively assess and regulate recreational load is a key condition for sustainable territorial development.

5 | CONCLUSION

This study demonstrates that the proposed AEEB concept can be regarded as a viable spatial and managerial framework for sustainable tourism development at the destination level. The results suggest that the model enables the integration of environmental, social, and functional components within a coherent planning approach, contributing to the regulation of recreational pressure, the preservation of ecosystem integrity, and the enhancement of visitor experience.

A key contribution of the study is the understanding of recreational capacity as a dynamic process shaped by temporal distribution and visitor flow, rather than a static spatial constraint. This perspective is consistent with contemporary approaches to destination management and supports a more adaptive understanding of carrying capacity in tourism systems.

The findings also point to several governance-related implications. In particular, the integration of nature-based solutions into planning practices, the prioritization of local community well-being, and the adaptation of the model to specific territorial contexts emerge as critical conditions for sustainable tourism development. In this regard, the AEEB concept can be considered a transferable framework with potential relevance beyond the Alakol region.

The alignment of the proposed model with the Concept for the Development of the Tourism Industry of the Republic of Kazakhstan for 2023–2029 further supports its practical applicability. The framework is consistent with key policy directions, including infrastructure monitoring, capacity building within the tourism sector, the development of sustainable tourist routes, the strengthening of investment mechanisms, and the promotion of environmentally responsible tourism.

Overall, the study contributes to the integration of renaturing, green infrastructure, ecosystem services, recreation, well-being, and rural sustainability within a single analytical framework. While the proposed model demonstrates applicability at the conceptual and planning levels, its implementation in practice requires further empirical validation, particularly regarding long-term environmental and socio-economic outcomes.

AUTHOR CONTRIBUTION

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Writing – Review and Editing: Gulnur Rakhimzhanova, Kamshat P. Mussina.

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