

International Congress on Economics, Management and Business Studies
Hosted Online from New York, USA
Date: 23rd November, 2026
Website: https://econferencia.com

MECHANISMS FOR DEVELOPING ECOTOURISM AND PROTECTING NATURAL ECOSYSTEMS UNDER CLIMATE CHANGE

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Abstract
The thesis examines the organizational and economic mechanisms for developing ecotourism and protecting natural ecosystems under climate change. A conceptual model of climate-adaptive ecotourism governance is proposed, and recommendations are developed for its implementation in the protected natural areas of Uzbekistan.

Keywords: ecotourism, climate change, natural ecosystems, protected natural areas, climate adaptation, carrying capacity, payments for ecosystem services, sustainable tourism, local communities, green finance.

Annotatsiya
Tezisda iqlim o‘zgarishi sharoitida ekoturizmni rivojlantirish va tabiiy ekotizimlarni muhofaza qilishning tashkiliy-iqtisodiy mexanizmlari tadqiq etilgan. Ekoturizmni iqlimga moslashuvchan boshqarishning konseptual modeli taklif qilinib, uni O‘zbekistonning muhofaza etiladigan tabiiy hududlarida joriy etish bo‘yicha takliflar ishlab chiqilgan.



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Kalit so‘zlar: ekoturizm, iqlim o‘zgarishi, tabiiy ekotizimlar, muhofaza etiladigan tabiiy hududlar, iqlimga moslashuv, rekreatsion sig‘im, ekotizim xizmatlari uchun to‘lov, barqaror turizm, mahalliy hamjamiyatlar, yashil moliyalashtirish.

Аннотация

В тезисе исследованы организационно-экономические механизмы развития экотуризма и охраны природных экосистем в условиях изменения климата. Предложена концептуальная модель климатически адаптивного управления экотуризмом и разработаны рекомендации по её внедрению на особо охраняемых природных территориях Узбекистана.

Ключевые слова: экотуризм, изменение климата, природные экосистемы, особо охраняемые природные территории, адаптация к изменению климата, рекреационная ёмкость, плата за экосистемные услуги, устойчивый туризм, местные сообщества, зелёное финансирование.

Introduction

Climate change has become a structural factor that reshapes both the demand for nature-based travel and the condition of the ecosystems on which such travel depends. Tourism occupies a dual position in this process: it is highly sensitive to changes in temperature, precipitation and seasonality, and at the same time it contributes to greenhouse gas emissions through transport and accommodation. As D. Scott argues, sustainable tourism cannot remain credible unless it treats climate change as a central rather than a peripheral concern [1].

Ecotourism is commonly presented as the segment best placed to reconcile economic development with nature conservation. In M. Honey’s widely cited

interpretation, genuine ecotourism minimizes environmental impact, builds environmental awareness, generates direct financial benefits for conservation and empowers local people [2]. These benefits, however, are not automatic. Where warming accelerates habitat degradation, the resource base of ecotourism itself erodes, and unmanaged visitor flows may intensify the pressure on already vulnerable ecosystems.

The problem is particularly acute for Uzbekistan, an arid country whose rivers depend on mountain runoff. V.E. Chub's assessment documents a warming trend in the republic and its consequences for hydrometeorological processes, agro-climatic conditions and water resources [3]. At the same time, the country possesses a diverse network of reserves, national parks and other protected natural areas that are increasingly promoted as ecotourism destinations [4].

The aim of this thesis is to substantiate a set of organizational and economic mechanisms that allow ecotourism to grow while strengthening, rather than depleting, the resilience of natural ecosystems. The study employs systematization of the scientific literature, comparative and logical-structural analysis, and conceptual modelling.

Main part

The analysis shows that climate change affects ecotourism through three interrelated channels. The first is direct climatic: higher summer temperatures, heatwaves and shifting seasons change the comfort of outdoor activities and redistribute visitor flows across the year. The second is environmental: glacier retreat, reduced river flow, drought, desertification and wildfires transform landscapes, wildlife habitats and the visual appeal of destinations. The third is institutional and market-related: emission-reduction policies, rising transport costs and the growing climate awareness of travelers change the conditions under

which destinations compete. Scott stresses that the tourism sector must respond on both fronts, adapting to climate impacts while reducing its own emissions [1]. For ecotourism this dual task is especially pressing, since its product is the ecosystem itself.

The ecotourism potential of Uzbekistan is concentrated in four groups of ecosystems: the mountain ecosystems of the Western Tien Shan and Gissar-Alay, the riparian tugai forests of the Amu Darya and Zarafshan valleys, the desert ecosystems of the Kyzylkum and Ustyurt, and wetlands such as the Aydar-Arnasay lake system. According to R.S. Amriddinova and A.Yu. Talibova, the protected-area network at the time of their study comprised 8 state reserves, 2 national parks, a biosphere reserve and 9 state nature sanctuaries (zakazniks), covering about 20,520 km², or roughly 5% of the national territory [4]. Each ecosystem group faces its own combination of climate risks, so a uniform approach to ecotourism management is inadequate. Table 1 matches these risks with differentiated development and protection mechanisms.

Table 1. Climate-related risks to the main ecotourism ecosystems of Uzbekistan and corresponding mechanisms

Ecosystem group	Representative sites	Main climate-related risks	Ecotourism development mechanism	Ecosystem protection mechanism
Mountain and glacial ecosystems (Western Tien Shan, Gissar-Alay)	Chatkal Biosphere Reserve, Ugam-Chatkal National Park, Gissar Reserve	Glacier retreat, changes in snow cover and runoff, mudflows and landslides, upward shift of vegetation belts	Seasonally diversified trekking, birdwatching and educational trails; guides certified in climate-risk management	Dynamic carrying-capacity limits; seasonal closure of core zones; monitoring of glaciers and the snowline

Ecosystem group	Representative sites	Main climate-related risks	Ecotourism development mechanism	Ecosystem protection mechanism
Riparian tugai forests (Amu Darya, Zarafshan)	Lower Amu Darya Biosphere Reserve, Zarafshan Reserve	Reduced river flow, falling groundwater, salinization, fire risk	Small-group wildlife observation (e.g., Bukhara deer); community homestays in buffer zones	Guaranteed environmental flows; entry fees earmarked for restoration; fire-prevention regimes
Desert ecosystems (Kyzylkum, Ustyurt)	Kyzylkum Reserve, "Jeyran" Ecocenter	Heat extremes, prolonged drought, desertification, dust storms	Shoulder-season, early-morning and night tours; yurt camps powered by renewable energy	Rangeland and saxaul restoration; anti-poaching patrols co-financed by tourism revenue
Wetland and lake ecosystems	Aydar-Arnasay lake system, Sudochye wetlands (Aral Sea region)	Fluctuating water levels, salinization, loss of habitat for migratory birds	Birdwatching tourism with seasonal visitor quotas; citizen-science programs for visitors	Water allocation for wetlands; protection of nesting and stopover sites; biodiversity monitoring

Source: compiled by the author based on [3; 4].

On the basis of this differentiation, the thesis proposes a conceptual model of the mechanism for climate-adaptive ecotourism development and ecosystem protection (Figure 1). The model treats ecotourism not as an autonomous market activity but as an instrument of climate adaptation policy. Its central idea is a closed loop: part of the revenue generated by ecotourism is channeled back into ecosystem protection, which in turn sustains the natural assets that attract visitors.



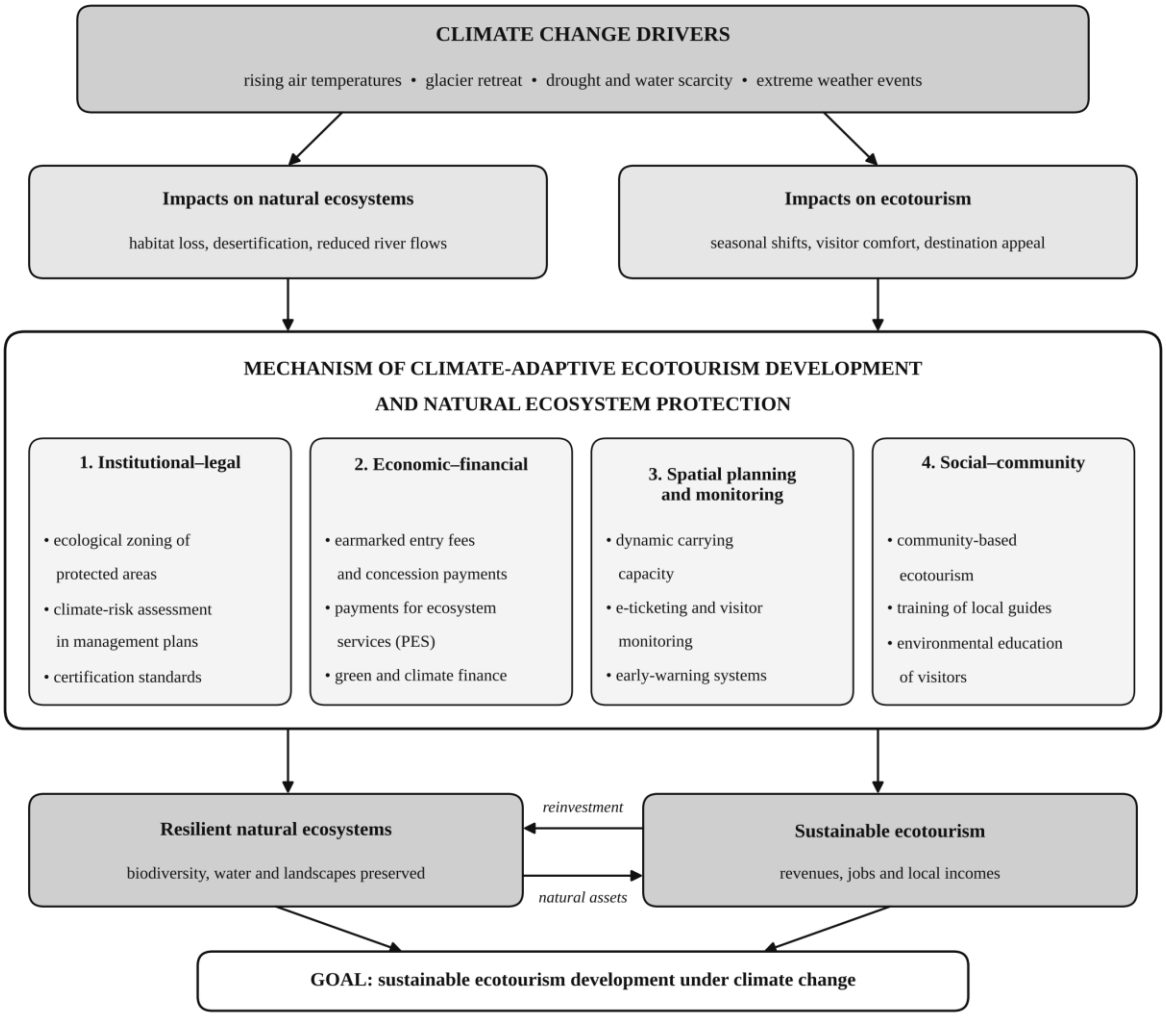


Figure 1. Conceptual model of the mechanism for climate-adaptive ecotourism development and natural ecosystem protection

Source: developed by the author.

The mechanism consists of four interconnected sub-mechanisms.

Institutional and legal sub-mechanism. It includes ecological zoning of protected areas into core, buffer and recreational zones, the mandatory integration of climate-risk assessment into protected-area management plans and regional tourism programs, and certification standards for eco-lodges, guesthouses and tour operators. Clear rules on concessions and benefit-sharing prevent ecotourism from turning into uncontrolled commercialization of fragile territories.

Economic and financial sub-mechanism. Ecotourism justifies itself only when it produces direct financial benefits for conservation and for local people [2]. In practice this requires earmarking a fixed share of entry fees, concession payments and eco-charges for ecosystem restoration. It also requires payments for ecosystem services, under which downstream water users and tourism businesses co-finance the conservation of mountain watersheds, and the attraction of green bonds and international climate finance to adaptation projects in protected areas.

Spatial planning and monitoring sub-mechanism. Its key instrument is a dynamic, climate-adjusted carrying capacity of an ecotourism site:

$$CC(dyn) = CC(base) \times K(clim), \quad (1)$$

where CC(base) is the baseline carrying capacity of the site (visitors per day), determined by its physical and ecological conditions, and K(clim) is a climate correction coefficient ($0 < K(clim) \leq 1$) reflecting current climatic stress: heat, fire danger, water level or snow cover. During periods of extreme heat, high fire danger or low water, K(clim) falls and the permitted number of visitors is reduced automatically. The instrument is implemented through electronic ticketing, visitor counters and early-warning information from the national

hydrometeorological service, whose long-term observations document the growing climatic stress on the country's ecosystems [3].

Social and community sub-mechanism. Communities living in buffer zones are both the most exposed to climate risks and the most effective guardians of ecosystems. Community-based ecotourism (homestays, local guiding, crafts and gastronomy) diversifies rural incomes and reduces dependence on climate-sensitive agriculture and on resource extraction such as fuelwood cutting and overgrazing. Training guides in environmental interpretation and climate-risk communication, together with environmental education of visitors, turns every tour into a channel of climate literacy [2].

Finally, the mechanism includes a mitigation component: low-carbon transport to destinations (rail and electric shuttles), renewable energy and water-saving technologies in eco-lodges, and disclosure of the carbon footprint of tour packages. These measures are not optional additions but conditions for the long-term legitimacy of ecotourism in a carbon-constrained economy [1].

Conclusions and recommendations

The study leads to three conclusions. First, under climate change ecotourism should be regarded not only as a market segment but as an instrument of climate adaptation and conservation policy: its sustainability depends on whether it strengthens the resilience of the ecosystems it uses. Second, climate risks in Uzbekistan differ substantially across mountain, riparian, desert and wetland ecosystems, so ecotourism management must be ecosystem-specific rather than uniform (Table 1). Third, the proposed four-component mechanism (institutional and legal, economic and financial, spatial planning and monitoring, social and community) closes the loop between ecotourism revenues and ecosystem protection (Figure 1).

On this basis, the following recommendations are put forward:

1. Integrate climate-risk assessment into the management plans of protected natural areas and into the tourism development programs of regions with high ecotourism potential.
2. Introduce a dynamic, climate-adjusted carrying capacity, starting with the most visited mountain sites of the Western Tien Shan, supported by electronic ticketing and visitor monitoring.
3. Earmark a fixed share of entry fees and concession payments for ecosystem restoration, and pilot a payment-for-ecosystem-services scheme for mountain watersheds.
4. Establish a national "climate-smart ecotourism" certification for eco-lodges, guesthouses and tour operators covering energy, water, waste and transport.
5. Expand community-based ecotourism in the buffer zones of reserves and national parks, and train local guides in environmental interpretation and climate-risk communication.
6. Include courses on climate-adaptive ecotourism management in university tourism programs and mobilize international climate finance, such as the Green Climate Fund and the Global Environment Facility, for adaptation projects in protected areas.

Implementation of these measures would allow Uzbekistan to expand ecotourism while preserving the natural capital on which the long-term competitiveness of its tourism sector depends.



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