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Article

Mechanisms for Sustainable Tourism Development in Degraded Arid Landscapes: Prospects for the Aral Sea Region

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Abstract: Land degradation and desertification are among the most pressing threats to arid regions, yet the same degraded landscapes increasingly attract visitors drawn by their stark beauty, their scientific interest and their cautionary environmental narratives. This article asks how tourism can be developed sustainably in such settings, using the Aral Sea region of Uzbekistan - and the autonomous Republic of Karakalpakstan in particular - as a critical case. The desiccation of the Aral Sea, the emergence of the Aralkum salt desert and the resulting salt-and-dust storms constitute one of the most severe human-induced environmental disasters of the modern era. Drawing on reports of the World Tourism Organization (UN Tourism), the World Economic Forum and the United Nations Development Programme, peer-reviewed literature, and policy documents, the study uses a qualitative case-study design to develop a typology of tourism forms suited to degraded arid landscapes and a multi-level framework of the mechanisms - regulatory, economic, capacity-related and knowledge-based - required to make such tourism sustainable. The results show that the degraded landscape can function as a legitimate and valuable tourism resource when four conditions are met: visitor pressure is matched to ecological carrying capacity; revenue is recycled into restoration such as saxaul afforestation of the dried seabed; local communities own a meaningful share of the value created; and the ethical hazards of profiting from catastrophe are managed through interpretation and education. The article positions tourism not as a stand-alone sector but as one instrument within an integrated green-economy and ecological-restoration agenda, and discusses the principal tensions, risks and transferable lessons for other degraded drylands.

Keywords: sustainable tourism; degraded landscapes; desertification; Aral Sea; Aralkum; Karakalpakstan; ecological restoration; dark tourism; green economy.

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1. Introduction

Arid and semi-arid lands cover roughly two-fifths of the Earth's land surface and support some of its most vulnerable populations. These drylands are acutely exposed to land degradation and desertification - the persistent loss of biological and economic productivity caused by climatic variability and unsustainable human activity. Where degradation is severe, the conventional resource base collapses: agriculture fails, water becomes scarce or saline, and communities face impoverishment and out-migration. Conventional development responses, predicated on intensifying the very land and water use that caused the damage, are ill-suited to such conditions. There is therefore growing interest in development pathways that can generate value from degraded landscapes without further depleting them, and tourism - long associated with pristine rather than damaged environments - has emerged as an unexpected candidate.

This interest reflects a broader evolution in tourism itself. Alongside conventional nature and cultural tourism, a family of niche forms has grown rapidly: dark and disaster tourism, which engages with sites of tragedy and loss; 'last-chance' tourism, in which visitors seek to witness environments before they vanish; geotourism and scientific tourism, focused on landforms and natural processes; and community-based tourism, which centres local livelihoods and culture. For degraded arid landscapes, these forms are not marginal curiosities but potentially the core of a viable visitor economy, because the degradation itself - the dramatic, otherworldly, cautionary character of a ruined environment - becomes the attraction. The central challenge is that this attraction is fragile, ethically fraught and easily spoiled; tourism in degraded landscapes can either reinforce decline or contribute to recovery, depending on how it is governed.

The stakes are considerable. Desertification affects a substantial share of the world's drylands and is projected to intensify under climate change, threatening the livelihoods of hundreds of millions of people and driving environmental migration. For the communities concerned, the loss of productive land is not an abstraction but the disappearance of the economic base on which households and towns were built. In this context, any activity capable of generating income and dignity from a degraded landscape - without demanding the water and soil the landscape no longer has - acquires outsized importance. Tourism's appeal in degraded drylands rests on exactly this property: it can, in principle, monetise scenery, story and scientific interest rather than extracting further from an exhausted resource base. Whether it does so sustainably, however, is precisely what is at issue.

No location embodies this challenge more vividly than the Aral Sea region. In 1960 the Aral Sea was among the largest inland bodies of water on Earth, covering roughly 68,000 square kilometres; the diversion of the Amu Darya and Syr Darya rivers for cotton irrigation caused it to shrink to about 28,687 square kilometres by 1998, and in 2014 its eastern basin dried completely for the first time in modern history [1]. The exposed seabed has become the Aralkum, a salt desert spanning several million hectares, from which wind lifts on the order of a hundred million tonnes of salt, dust and agrochemical residue each year, spreading toxic storms across the region and beyond [2], [3]. The consequences for Karakalpakstan have included serious public-health burdens, the destruction of the fishing economy and widespread impoverishment [4]. The crisis has become a global symbol of environmental mismanagement - and, increasingly, a destination for travellers drawn to the stranded ships of Moynaq and the eerie expanse of the former seabed [5].

The policy environment has shifted decisively toward recovery and green development. In May 2021 the United Nations General Assembly declared the Aral Sea region a zone of ecological innovations and technologies, calling for the deployment of environmentally sound technologies and the introduction of green-economy principles [6]. Uzbekistan's national Strategy for the Transition to a Green Economy for 2019-2030 provides the domestic framework [7], while large-scale ecological restoration - notably the afforestation of the dried seabed with drought-tolerant saxaul - is already under way with support from the United Nations Development Programme and other partners [8], [9]. Tourism has been elevated to a national priority, and international agencies have begun to back sustainable tourism and green enterprise specifically in Karakalpakstan [10]. These developments create both an opportunity and an obligation: to ensure that the tourism now emerging in the region develops along sustainable rather than extractive lines.

The aim of this article is to identify and organise the mechanisms required to develop tourism sustainably in degraded arid landscapes, using the Aral Sea region as a case study. It pursues three objectives: to establish the conditions under which a degraded landscape can serve as a legitimate tourism resource; to construct a typology of the tourism forms appropriate to such settings; and to specify the multi-level mechanisms - regulatory, economic, capacity-related and knowledge-based - that determine whether the resulting

tourism is sustainable. The contribution is a transferable analytical framework that links the distinctive character of degraded landscapes to concrete instruments of governance and finance. The article follows the IMRAD structure: Section 2 sets out the study area and methods; Section 3 presents the landscape resource, the typology, the mechanism framework, the restoration-tourism nexus and the governance arrangements; Section 4 discusses tensions, risks and transferability; and Section 5 concludes.

2. Materials and Methods

2.1. Study area

The study focuses on the Aral Sea region of Uzbekistan, administratively the Republic of Karakalpakstan, which occupies the country's arid north-west and covers approximately 166,600 square kilometres with a population under two million. The region encompasses the southern (Uzbek) portion of the former Aral Sea, the rapidly expanding Aralkum desert, the Amu Darya delta and its residual wetlands, the Ustyurt Plateau, and the towns of Nukus and Moynaq. It is simultaneously the epicentre of the Aral disaster and the focus of the most ambitious recovery efforts, which makes it an ideal critical case for examining how tourism might be built sustainably on degraded ground. Because the processes at work - desiccation, salinisation, dust emission, afforestation and managed recovery - are common to many drylands, lessons drawn here are intended to be transferable to other degraded arid regions.

2.2. Research design and data sources

The study employs a qualitative, single-case research design oriented toward concept and framework development rather than hypothesis testing. Evidence was drawn from three bodies of material: international agency reports, including the UN Tourism-UNEP analysis of tourism in the green economy [11], the foundational UNEP green-economy report [12], and the World Economic Forum's Travel & Tourism Development Index 2024 [13], [14]; policy and programme documents, including the 2021 United Nations resolution [6], Uzbekistan's green-economy strategy [7], and UNDP restoration and development materials for the Aral Sea region [8], [10]; and peer-reviewed and reputable secondary literature on the region's environment, restoration and tourism, notably the nature-based-solutions review by Alikhanova and Bull [15], the ecotourism study by Saidmamatov and colleagues [16], and environmental reporting on desiccation and afforestation [1], [9], [2].

Two analytical procedures were applied. First, qualitative content analysis was used to extract, from these sources, the forms of tourism associated with degraded landscapes and the instruments through which they are governed; these were organised inductively into the typology of Figure 1 and the mechanism framework of Figure 2. Second, descriptive secondary indicators - the sea's surface area, dust emissions and afforested area - were compiled to characterise the landscape resource and the progress of restoration (Table 1, Figure 3). The design carries the limitations of secondary, single-case work, including dependence on published sources, the approximate nature of some quantitative series and limited statistical generalisability; these are addressed in Section 4.4. Triangulation across independent sources was used to improve reliability, and figures are reported as approximate where primary data are incomplete.

3. Results

3.1. The degraded landscape as a tourism resource

The first result is that severe degradation, paradoxically, can create rather than destroy tourism value. The Aral Sea region's appeal rests precisely on the visible evidence of catastrophe and the drama of an unfolding recovery: the rusting trawlers of Moynaq stranded dozens of kilometres from water, the vast saline flats of the Aralkum, the abrupt escarpments of the Ustyurt Plateau, and the new saxaul plantations advancing across the former seabed. These features support forms of tourism - disaster, last-chance, scientific and educational - that depend on degradation as their subject matter. Table 1 summarises

the key indicators that define this resource and the recovery now under way; together they convey both the scale of the loss and the emergence of a restoration narrative that is itself becoming a visitor attraction.

Table 1. Key indicators of Aral Sea desiccation, its impacts and ongoing restoration.

Indicator	Value / status	Source
Surface area, 1960	~68,000 km2 (among the largest lakes on Earth)	[1], [9]
Surface area, 1998	~28,687 km2	[1]
Eastern (South Aral) basin, 2014	Dried completely for the first time in modern history	[1]
Aralkum desert (exposed seabed)	Several million hectares of new salt desert	[15]
Salt and dust emitted annually	On the order of 100 million tonnes	[2], [3]
Saxaul afforestation, Uzbek seabed (approx. 5 years)	~1.7 million hectares planted	[8], [9]
Saxaul first-year survival (improved method)	Raised from ~20-30% to ~78% with container seedlings	[8], [17]
International status (2021)	UN 'zone of ecological innovations and technologies'	[6]

Source: compiled by the authors from the cited references; physical values are approximate.

The human dimension of this resource cannot be separated from its physical features. The same desiccation that produced the Aralkum has imposed a heavy toll on Karakalpakstan's people: the collapse of a fishing industry that once employed tens of thousands, elevated rates of respiratory and other illnesses associated with airborne salt and dust, and persistent poverty and out-migration [2], [4]. This human story is integral to the region's tourism, both as the ethical context within which disaster tourism must operate and as the source of the cultural resilience - the crafts, music, cuisine and hospitality of the Karakalpak people - that gives the destination depth beyond its ruined seascape. A tourism that engages honestly with this dimension, rather than reducing the region to a backdrop, is both more responsible and more compelling.

This resource is, however, double-edged. It is finite and fragile: the restoration that lends the region its narrative of hope also gradually softens the very starkness that attracts disaster and last-chance visitors, while uncontrolled visitation can scar the seabed, disturb wildlife and accumulate waste. It is ethically charged, since profiting from a humanitarian and ecological tragedy risks trivialising suffering unless handled with care. And it is unevenly distributed, concentrated around a small number of iconic sites whose over-use would undermine both their appeal and the communities that depend on them. The sustainability of tourism in this landscape therefore cannot be taken for granted; it must be engineered through deliberate choices about which forms of tourism to encourage and how to govern them.

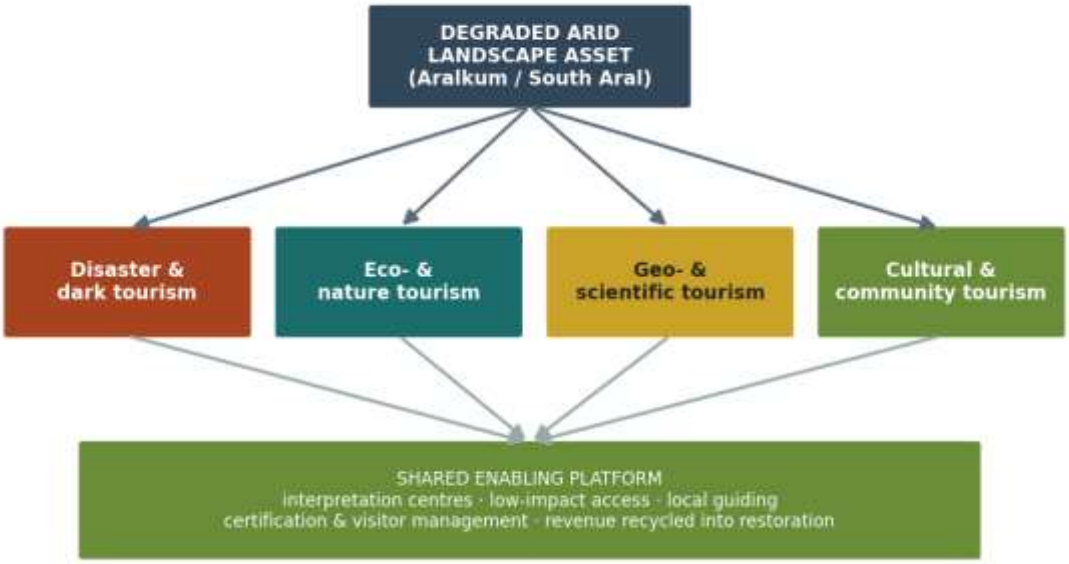
3.2. A typology of tourism forms for degraded arid landscapes

The second result is a typology of the tourism forms suited to degraded arid landscapes, presented in Figure 1 and detailed in Table 2. Four forms are distinguished. Disaster and dark tourism engages directly with the catastrophe, centred on Moynaq and the former seabed, and carries the greatest ethical and management sensitivity. Eco- and nature tourism focuses on the surviving and recovering ecosystems - the delta wetlands, migratory birds and the saiga antelope - and depends on strict limits to avoid harming

what it celebrates. Geo- and scientific tourism treats the region as a natural laboratory of desiccation, salinisation and restoration, attractive to researchers, students and specialist travellers, and aligns naturally with the area's designation as a zone of ecological innovation. Cultural and community tourism builds on Karakalpak heritage, crafts, cuisine and events, and is the form most able to distribute income locally. These are not mutually exclusive; the most resilient strategy combines them, supported by a shared enabling platform of interpretation, low-impact access, certification and revenue recycling.

Of the four forms, disaster and dark tourism demands the most careful handling, because it is both the region's most distinctive draw and its most ethically sensitive. International experience with sites of tragedy suggests that the difference between respectful remembrance and exploitative spectacle lies in interpretation: in whose story is told, by whom and to what end. For the Aral Sea region this means foregrounding the causes of the disaster, the lived experience of the affected communities and the science of recovery, and ensuring that local people are narrators and beneficiaries rather than backdrop. Handled this way, dark tourism becomes a form of environmental education with global resonance; handled carelessly, it risks reducing a humanitarian tragedy to a photo opportunity.

Figure 1. A typology of tourism forms for degraded arid landscapes



Source: authors' own elaboration.

Table 2. Typology of tourism forms in degraded arid landscapes, with Aral Sea examples and key risks.

Form	Description	Aral Sea example	Key risk to manage
Disaster & dark tourism	Engagement with sites of environmental or human tragedy	Moynaq ship graveyard; former seabed	Ethical trivialisation; site erosion
Eco- & nature tourism	Visitation of surviving and recovering ecosystems	Sudochie wetlands; saiga range; birdlife	Disturbance of fragile habitats
Geo- & scientific tourism	Study of landforms, processes and restoration	Aralkum; Ustyurt escarpments; saxaul plots	Access logistics; safety in remote terrain

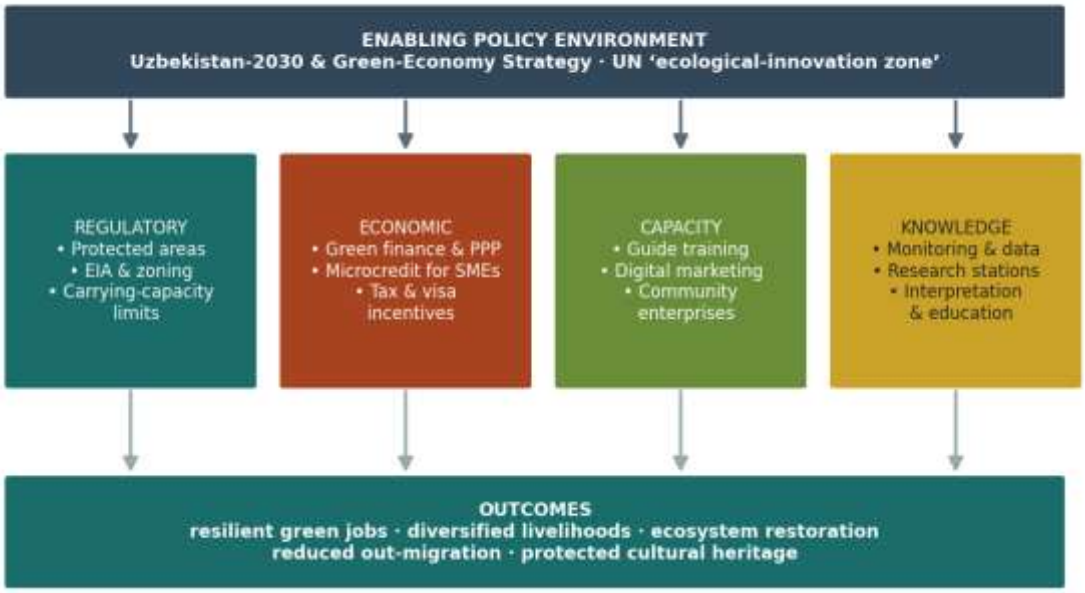
Cultural & community tourism	Heritage, crafts, cuisine and events	Nukus museums; yurt crafts; Stihia festival	Benefit leakage; commodification of culture

Source: authors' elaboration based on [15], [16], [18], [5].

3.3. A multi-level framework of mechanisms

The third and central result is a multi-level framework of the mechanisms that determine whether tourism in a degraded arid landscape is sustainable, shown in Figure 2 and elaborated in Table 3. The framework is organised in three tiers. At the top sits the enabling policy environment - Uzbekistan's green-economy strategy and the United Nations designation of the region as an ecological-innovation zone - which legitimises and finances green development [6], [7]. In the middle sit four families of mechanism that translate policy into practice. Regulatory mechanisms protect the resource through protected-area designation, environmental impact assessment, zoning and, critically, carrying-capacity limits. Economic mechanisms mobilise and direct investment through green and blended finance, public-private partnerships, microcredit for small enterprises, and targeted tax and visa incentives. Capacity mechanisms build the human and organisational foundations through guide and hospitality training, digital-marketing support and community enterprise development. Knowledge mechanisms underpin the whole system through monitoring, research stations, interpretation and environmental education. At the base lie the outcomes the system is designed to deliver: resilient green jobs, diversified livelihoods, ecosystem restoration, reduced out-migration and protected cultural heritage.

Figure 2. Multi-level mechanism framework for sustainable tourism in the degraded Aral Sea region



Source: authors' own elaboration.

The framework's essential claim is that these mechanisms are complementary and must operate together. Regulation without finance produces rules that cannot be implemented; finance without regulation invites over-development; capacity without either yields trained people with nothing to manage; and all three without knowledge proceed blind to their own impacts. In degraded landscapes the interdependence is especially acute, because the resource is fragile and the margin for error small. Table 3 sets out the instruments associated with each mechanism family and the actors best placed to lead them.

Table 3. Mechanisms, instruments and lead actors for sustainable tourism in degraded arid landscapes.

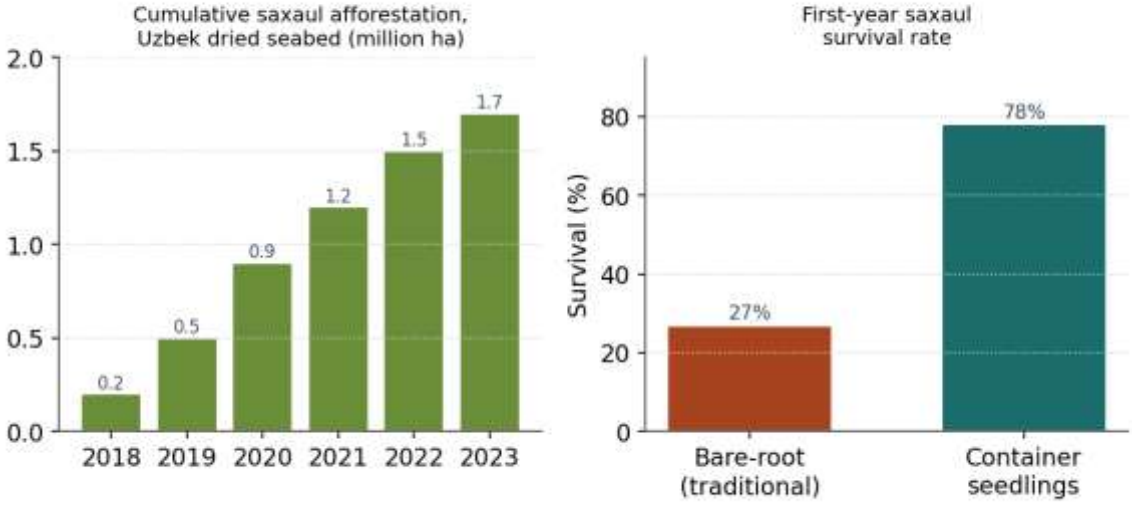
Mechanism family	Illustrative instruments	Principal lead actors
Regulatory	Protected-area designation; EIA; zoning; carrying-capacity limits; waste and access rules	National and Karakalpakstan authorities; environmental agencies
Economic	Green and blended finance; PPPs; SME microcredit; tax and visa incentives [6]	Government; banks and donors; private operators
Capacity	Guide and hospitality training; digital-marketing support; community enterprise development [10]	UNDP and partners; vocational institutions; community organisations
Knowledge	Environmental monitoring; research stations; interpretation centres; education [15]	Universities; research institutes; NGOs

Source: authors' elaboration based on [11], [15], [6], [10].

3.4. The restoration-tourism nexus

The fourth result concerns the reciprocal relationship between ecological restoration and tourism, which is the distinctive feature of sustainable tourism in a recovering landscape. Restoration of the Aral seabed centres on afforestation with saxaul, a drought- and salt-tolerant shrub whose deep roots stabilise the soil, fix shifting sand and suppress the salt-and-dust storms that blight the region. Over recent years roughly 1.7 million hectares have been planted on the Uzbek portion of the dried seabed, and improved techniques using container-grown seedlings have raised first-year survival from the traditional twenty to thirty per cent to around seventy-eight per cent [8], [9], [17]. Figure 3 illustrates both the cumulative scale of planting and the survival improvement. This restoration matters for tourism in two ways. First, it is itself becoming an attraction and an educational subject, embodying the region's identity as a zone of ecological innovation and offering visitors a narrative of recovery rather than mere ruin. Second, it depends on sustained finance, and tourism can contribute to that finance through visitor fees, voluntary contributions and the broader economic case it builds for protecting the landscape.

Figure 3. Indicators of ecological restoration underpinning tourism assets



Source: compiled from UNDP 'Green Aral Sea' and Mongabay reporting (values approximate/representative).

The nexus is therefore a virtuous circle when properly designed: restoration enhances the landscape and its story, attracting visitors; visitor revenue and advocacy help fund and legitimise further restoration; and the resulting ecological gains reduce the dust storms and health burdens that constrain the region's habitability and its capacity to host tourism at all. The same logic underpins the wider integration of tourism with the green-economy agenda, in which visitor services, renewable energy, climate-smart agriculture and ecosystem restoration are planned together rather than in isolation [11], [15]. Tourism, in this conception, is not an alternative to restoration but one of its financing and communication instruments.

The ecological logic of this circle is reinforced by the wider co-benefits of restoration. Saxaul plantations not only suppress dust and stabilise the seabed but also sequester carbon, create habitat and, over time, support grazing and non-timber products that diversify rural incomes [15], [8]. Each of these co-benefits strengthens the case for protecting and visiting the landscape, and each is more bankable when tourism demonstrates a continuing economic interest in the region's recovery. The restoration-tourism nexus is therefore best understood as one strand of a denser web of green-economy linkages, in which ecological and economic returns are produced together.

3.5. Stakeholders, governance and monitoring

The final result addresses implementation: who must act, and how progress is to be tracked. Sustainable tourism in the Aral Sea region depends on a broad coalition of stakeholders with distinct but interlocking roles, summarised in Table 4. Government and Karakalpakstan authorities set policy, designate protected areas and provide infrastructure; communities supply guiding, hospitality, crafts and consent; private enterprises and small and medium-sized firms deliver most services and bear most commercial risk; international agencies such as UNDP, together with bilateral donors, provide finance, capacity-building and convening; academic and research institutions generate the monitoring and interpretation on which knowledge mechanisms rely; and non-governmental organisations, including conservation bodies, link tourism to biodiversity protection. Effective governance requires that these actors coordinate through transparent, participatory arrangements with explicit benefit-sharing, so that the communities bearing the costs of the disaster also capture a fair share of the value tourism creates.

Table 4. Principal stakeholders and their roles in sustainable tourism for the Aral Sea region.

Stakeholder	Role and contribution
National & Karakalpakstan authorities	Policy, protected-area designation, infrastructure, visa and investment frameworks
Local communities	Guiding, hospitality, crafts, cultural interpretation and local consent
Private operators & SMEs	Delivery of accommodation, transport, tours and services; commercial investment
UN agencies & donors (e.g., UNDP)	Finance, capacity-building, restoration programmes and convening [10]
Universities & research institutes	Monitoring, scientific tourism content and interpretation [15]
NGOs & conservation bodies	Biodiversity protection; community engagement; certification advocacy

Source: authors' elaboration based on [15], [8], [10].

Because sustainability claims are easily asserted and hard to verify, the framework must be coupled to a monitoring system that tracks outcomes across environmental, economic, social and governance dimensions. Table 5 proposes a concise set of indicators - from dust-storm frequency and afforested area to local employment share, out-migration and the proportion of revenue retained locally - together with plausible data sources. Such monitoring is not a bureaucratic afterthought but the knowledge mechanism that allows carrying-capacity limits to be set and adjusted, benefit-sharing to be audited, and the restoration-tourism nexus to be steered over time.

Table 5. Illustrative monitoring indicators for sustainable tourism in the Aral Sea region.

Dimension	Indicator	Indicative data source
Environmental	Dust-storm frequency; afforested area; key species abundance	Remote sensing; forestry and restoration records [8]
Economic	Visitor numbers; tourism jobs; SME revenue and survival	National statistics; enterprise surveys [13]
Social	Local employment share; out-migration; community satisfaction	Household surveys; municipal records
Governance	Share of revenue retained locally; certified operators; participation	Operator audits; certification schemes

Source: authors' elaboration.

4. Discussion

4.1. From assets to mechanisms

The results reframe the development question for degraded arid landscapes. The binding issue is not whether such landscapes possess tourism assets - the Aral Sea region demonstrably does - but whether the mechanisms exist to convert those assets into sustainable outcomes. This shift of emphasis, from assets to mechanisms, is the article's principal argument. It implies that the most consequential decisions are institutional and financial rather than promotional: how carrying capacity is set and enforced, how investment is mobilised and directed, how local people are trained and organised, and

how impacts are monitored. Where these mechanisms are weak, even abundant assets will be degraded or captured; where they are strong, even a damaged landscape can support a durable visitor economy that contributes to its own recovery.

This interpretation is consistent with the nature-based-solutions literature, which treats restoration and human well-being as joint products of integrated intervention rather than as competing aims [15], and with the green-economy framing that positions tourism as one of several sectors capable of decoupling welfare from environmental pressure [12], [11]. It also accords with the readiness evidence from the region, which identifies finance, capacity and infrastructure - rather than a shortage of attractions - as the dominant constraints on ecotourism development [16]. The mechanism framework of Figure 2 is, in effect, a map of where effort and money should be concentrated.

It also follows that evidence and measurement are not peripheral. Because the sustainability of tourism in a fragile landscape turns on staying within ecological and social limits, the capacity to observe those limits - through dust and biodiversity monitoring, visitor counts, enterprise accounts and community feedback - is itself a core mechanism rather than a reporting formality. The monitoring indicators proposed in Table 5 are intended to make the framework operational, converting general commitments to sustainability into specific, auditable quantities that can trigger management responses when thresholds are approached. In degraded landscapes, where recovery is slow and damage can be rapid, such adaptive, evidence-led governance is the difference between tourism that heals and tourism that harms.

The Aral Sea region also enjoys an advantage that many degraded drylands lack: an exceptional degree of national and international political attention. The designation of the region as a United Nations zone of ecological innovations and technologies, the dedicated trust-fund architecture and the prominence of the Aral crisis in Uzbekistan's development agenda together create access to concessional finance, technical partnership and policy priority that can de-risk early, otherwise-unbankable tourism and restoration investments [6]. This attention is a wasting asset, however; it must be converted into durable institutions and revenue streams while it lasts, so that the region's green economy can stand on its own once the spotlight moves on.

4.2. Tensions and risks

Four tensions complicate this agenda. The first is ethical: tourism centred on disaster risks commodifying suffering. The stranded ships of Moynaq are not merely scenery but evidence of livelihoods destroyed and health damaged, and a tourism that treats them as spectacle without acknowledging their human meaning would be exploitative. The mitigation lies in interpretation and education that foreground the causes and consequences of the disaster and the agency of local people, reframing dark tourism as a form of environmental learning [18], [5]. The second tension is ecological: the carrying capacity of a fragile, water-scarce landscape is low, and the same visitation that brings income can erode the seabed, disturb the saiga and recovering birdlife, and consume scarce water. Carrying-capacity limits and strict site management are therefore non-negotiable.

The third tension is distributive. Tourism value chains can leak, with profits captured by external operators while host communities bear the costs of congestion and cultural commodification. In a region already impoverished by the loss of its fishing economy, such leakage would compound injustice; explicit benefit-sharing, local procurement and community ownership are the safeguards. The fourth tension is temporal and lies at the heart of the restoration-tourism nexus: successful restoration gradually diminishes the stark, ruined character that draws disaster and last-chance visitors, even as it improves habitability and supports nature and scientific tourism. Managing this transition - shifting the destination's narrative from catastrophe toward recovery and innovation as restoration proceeds - is a strategic task that a monitoring-informed, adaptive governance system is well placed to handle.

Climate change overlays all four tensions. Rising temperatures and more frequent extreme heat shorten the comfortable visitor season, intensify the dust-storm regime and place additional stress on the saxaul plantations on which restoration depends. The same warming that threatens the region's habitability also raises the stakes of the last-chance tourism that draws some visitors, creating an uncomfortable alignment between the destination's appeal and its peril. Planning for sustainable tourism in the Aral Sea region must therefore be climate-adaptive from the outset, designing infrastructure, schedules and interpretation around a hotter, dustier and more variable future rather than around present conditions alone.

4.3. Policy implications and transferability

Several implications follow for the Aral Sea region and for degraded drylands more generally. Tourism should be planned as one instrument within an integrated green-economy and restoration strategy, not as a stand-alone sector, so that visitor infrastructure, afforestation, renewable energy and water management reinforce one another. Investment should be sequenced to address the binding constraints first, concentrating early public and donor resources on finance, capacity-building and basic infrastructure. Governance should be participatory and equipped with carrying-capacity limits, certification and transparent benefit-sharing from the outset, rather than retrofitted after damage has occurred. And the region's special international status should be used deliberately to attract the concessional finance and technical partnerships that de-risk early investment [6]. Because desiccation, salinisation, dust emission and afforestation are common to many drylands, the typology of Figure 1 and the mechanism framework of Figure 2 are offered as transferable tools, to be adapted to local ecological, cultural and institutional conditions elsewhere.

Financing deserves particular attention, because it is the mechanism on which the others depend and the one least likely to emerge spontaneously in a poor, peripheral region. The architecture now in place - the United Nations Multi-Partner Human Security Trust Fund for the Aral Sea region, bilateral donor programmes and the green-economy commitments of the national government - provides a foundation, but converting it into investable tourism and restoration projects requires intermediation: project preparation, blended-finance structures that combine concessional and commercial capital, and microcredit channels that reach community enterprises [10]. Regional cooperation adds a further dimension, since the Aral basin is shared with Kazakhstan and the wider Central Asian states, and coordinated routing, marketing and environmental management could enlarge the market and reduce costs for all. Tourism in the Aral Sea region is thus embedded in a financial and geopolitical context that extends well beyond Karakalpakstan's borders.

The transferability of these lessons should not be overstated, but neither should it be dismissed. Degraded drylands differ widely in their ecology, culture, governance and accessibility, and a typology or mechanism set that fits the Aral Sea region will require adaptation elsewhere. What travels is not a blueprint but a method: begin by asking what kind of tourism a degraded landscape can honestly support; identify the binding constraints, which are typically finance, capacity and infrastructure rather than attractions; design regulatory, economic, capacity and knowledge mechanisms together rather than singly; and anchor the whole in an explicit commitment to local benefit and ecological recovery. Shrinking lakes and degraded oasis systems across the arid belt face structurally similar dilemmas and could adapt the same method to their own circumstances.

4.4. Limitations

This study shares the limitations of secondary, single-case research. It depends on published documents, agency reports and existing scholarship, and several quantitative indicators - particularly the extent of the Aralkum, annual dust emissions and afforested area - are approximate and drawn from sources using different methods and reference

dates. The typology and mechanism framework are conceptual syntheses intended to organise thinking and guide practice, not empirically validated models; their components have not been tested through primary fieldwork, visitor research or enterprise-level analysis. The single-case design supports analytical rather than statistical generalisation. Future work should test the framework with primary data - visitor and community surveys, enterprise economics and ecological monitoring - and should evaluate specific instruments, such as carrying-capacity schemes or benefit-sharing arrangements, in order to move from the qualitative characterisation offered here toward measurable evidence of sustainability.

5. Conclusions

The desiccation of the Aral Sea created one of the modern era's most severe degraded arid landscapes; the same landscape is now attracting visitors and, with them, the possibility of a new and more sustainable economy. This article has argued that the decisive question is not whether degraded arid landscapes can attract tourism - the Aral Sea region shows that they can - but whether the mechanisms exist to make that tourism sustainable. Building on a typology of four tourism forms suited to such landscapes, it has set out a multi-level framework in which regulatory, economic, capacity and knowledge mechanisms, anchored in an enabling green-economy policy environment, together convert a fragile and ethically charged resource into resilient livelihoods, ecological restoration and protected heritage.

Four conditions emerge as decisive: matching visitor pressure to a low ecological carrying capacity; recycling revenue into restoration such as saxaul afforestation of the dried seabed; securing a meaningful local share of the value created; and managing the ethical hazards of profiting from catastrophe through interpretation and education. Where these conditions are met, tourism becomes part of the recovery rather than a further pressure upon it, operating as one instrument within an integrated agenda of green growth and ecological restoration. The Aral Sea region, precisely because its degradation is so extreme and its recovery so ambitious, offers a demanding but instructive template for sustainable tourism in degraded drylands worldwide.

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