



FACTORS ENABLING ECOLOGICAL SUSTAINABILITY IN CENTRAL ASIA

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Abstract

This article presents a narrative policy analysis of the key factors enabling ecological sustainability in the Central Asian region. Drawing on institutional reports, international agency publications, and regional policy documents, the study identifies eight enabling factors: regional cooperation mechanisms, circular economy transition, glacier conservation, afforestation and land restoration, biodiversity conservation, green economy development, institutional governance reform, and international financial mobilisation. Climate change, water scarcity, glacier retreat, desertification, and air pollution are examined as the primary environmental stressors. The analysis reveals that achieving ecological sustainability requires an integrated approach, sustained political will, and coordinated transboundary governance, an objective that decades of post-Soviet regional cooperation have only partially fulfilled.

Keywords: Ecological sustainability, Central Asia, climate change, water resources, regional cooperation, green economy, glaciers, desertification, transboundary governance.

1. Introduction

Central Asia ranks among the world's most ecologically vulnerable regions. The Intergovernmental Panel on Climate Change (IPCC, 2022) identifies Central Asia as a climate change hotspot where warming rates significantly exceed the global average. Rising temperatures, accelerating glacier retreat, and deepening water



Modern American Journal of Biological and Environmental Sciences

ISSN (E): 3067-7920

Volume 2, Issue 6, June 2026

Website: usajournals.org

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scarcity pose compounding threats to the region's environmental security [6]. These challenges are inherently transboundary: river systems, airsheds, and shared ecosystems cross five national borders, requiring cooperative rather than unilateral responses.

Regional environmental cooperation in Central Asia has a substantive institutional history. The Interstate Commission for Water Coordination (ICWC) was established in 1992, and the International Fund for Saving the Aral Sea (IFAS) in 1993. Despite more than three decades of operation, both bodies have achieved limited results: Aral Sea desiccation continued, water-sharing disputes persist, and transboundary air quality remains unaddressed. This track record of partial effectiveness provides an important baseline against which new initiatives must be assessed.

The First Regional Ecological Summit, convened in Astana, Kazakhstan in April 2026, marked a renewed political commitment to joint environmental action [1]. Heads of state adopted the "Central Asia Ecological Solidarity" declaration and a Programme of Action for 2026–2030 in cooperation with the United Nations [4]. This article analyzes the key factors enabling ecological sustainability in Central Asia, covering regional cooperation, climate adaptation, water governance, biodiversity conservation, green economy transition, and financial mechanisms. The aim is to assess which combinations of factors are likely to produce durable outcomes, informed by the region's institutional experience.

2. Methodology

This study employs a narrative policy analysis approach, synthesizing evidence from international institutional reports, peer-reviewed secondary sources, and regional policy documents. Sources were selected based on three criteria: (1) relevance to Central Asian environmental governance, (2) institutional credibility or peer-review status, and (3) publication within the period 2020–2026 to reflect current conditions, with earlier landmark studies included where foundational.

The analytical framework draws on transboundary environmental governance theory (Ostrom, 1990; Young, 2002), which distinguishes between formal



institutional structures and the social-ecological conditions determining whether cooperation produces compliance and outcomes. Eight thematic factors were identified through systematic content analysis of summit declarations, UN agency reports, and national policy documents. Each factor is assessed for (a) evidence of deployment, (b) quantifiable outcomes where data exist, and (c) alignment with governance theory.

Limitations: reliance on institutional and grey literature introduces potential reporting bias. Independent evaluation data for several 2026 initiatives are not yet available, and government-reported statistics (e.g., tree-planting figures) may not have been independently verified. Several claims derived from 2026 summit press releases (references 1–4, 7–8) reflect political commitments rather than peer-reviewed findings; these are treated as evidence of policy intent, not empirical outcomes.

3. Ecological Stressors in Central Asia

3.1. Climate Change

Central Asia is one of the regions most exposed to climate change. The IPCC Sixth Assessment Report (2022) documents warming at approximately twice the global average across the region, increasing drought frequency, flood intensity, and the occurrence of extreme heat events [6].

Glaciers in the Tian Shan and Pamir-Alay systems are retreating at roughly four times the global average rate (Farinotti et al., 2020). Since an estimated 30–60% of regional freshwater derives from glacier melt, continued retreat represents a structural threat to water supply on a decadal timescale [7].

3.2. Water Scarcity

The Aral Sea desiccation, driven by Soviet-era irrigation diversion from the Amu Darya and Syr Darya, remains one of the twentieth century's most documented environmental disasters (Micklin, 2007). The sea lost approximately 90% of its volume between 1960 and 2010. Downstream ecological and public health



impacts—salinised soils, dust storms laced with pesticide residues, elevated rates of respiratory and renal disease—continue to affect millions of people [5].

The Caspian Sea level has fallen by approximately two metres since the 1990s and is projected to decline a further 8–21 metres under moderate climate scenarios. In 2026, Central Asian leaders declared 26 March as “International Day of the Aral Sea and the Amu Darya and Syr Darya Rivers,” signalling renewed political attention to this long-standing crisis [7].

3.3. Air Pollution

Air pollution causes an estimated 65,000–71,000 premature deaths annually in Central Asia, and several countries in the region rank among the world’s most polluted (UNEP, 2026) [2]. Dust and sand storms originating from degraded land surfaces, including the former Aral Sea bed, compound pollution from energy and transport sectors [1].

3.4. Land Degradation and Desertification

At least 20% of Central Asia’s land area has undergone degradation through salinisation, wind and water erosion, and declining soil organic matter, all consequences of both Soviet-era land management and ongoing misuse (ADB, 2023). Tugai riparian forests, among the region’s most biodiversity-rich ecosystems, have contracted severely and continue to degrade [6].

4. Factors Enabling Ecological Sustainability

4.1. Regional Cooperation Mechanisms

Effective transboundary governance is the foundational enabling factor. The 2026 Regional Ecological Summit established eight priority areas [1]:

1. Combating climate change
2. Ensuring food security and ecosystem stability
3. Adapting to natural hazards and strengthening economic resilience
4. Reducing air pollution and improving waste management
5. Developing mechanisms to achieve environmental targets



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6. Sustainable management of natural resources
 7. A just and inclusive green transition
 8. Building ecological and digital competencies

The distinction from prior initiatives (ICWC, IFAS) lies in the explicit inclusion of air quality, biodiversity, and waste, all domains previously absent from regional institutional mandates. Whether the new framework will generate binding obligations and enforcement mechanisms, rather than declaratory commitments, will determine its effectiveness relative to predecessors.

4.2. Transition to a Circular Economy

The circular economy concept (extending product lifecycles, recovering materials, and decoupling growth from resource throughput) differs from the broader “green economy” in its focus on production system redesign rather than consumption-side efficiency. Central Asian leaders established a regional circular economy cooperation platform in 2026.

World Bank (2021) projections indicate that Kazakhstan alone could generate approximately \$1.3 billion in net economic benefit through a \$289 million circular economy investment in the construction sector, while reducing sector greenhouse gas emissions by 5%. Comparable analyses for Uzbekistan, Tajikistan, and Kyrgyzstan are limited in the published literature, representing a research gap.

4.3. Glacier Conservation and Water Resource Management

Glaciers function as natural water storage, releasing melt water during dry seasons when demand peaks. Their accelerating retreat (Farinotti et al., 2020) threatens to disrupt this temporal buffering within decades. A dedicated multilateral glaciers monitoring platform was established at the 2026 summit.

UNEP’s Environmental Performance Review (EPR) process is examining transboundary water allocation and management frameworks across the region, with particular attention to modernising ICWC’s mandate and data-sharing protocols.



4.4. Afforestation and Land Restoration

The “Green Shield of Central Asia” resolution calls for a continuous network of shelterbelts (planted rows of trees and shrubs) along the region’s southern agricultural margin, targeting desertification, dust storm suppression, and biodiversity corridors. This approach draws on proven practice from China’s “Three-North Shelterbelt” programme and the African Great Green Wall initiative. Uzbekistan’s “Yashil Makon” (Green Space) programme has planted nearly one billion trees and shrubs since its inception. More than two million hectares of saxaul forest have been established on the former Aral Sea bed, reducing windblown salt and dust emissions [6]. Independent monitoring of survival rates and carbon sequestration for these plantings has not yet been published.

4.5. Biodiversity Conservation

Central Asia harbours over 300 wild species of fruit and nut trees, many of which are ancestors of cultivated varieties of global agronomic importance. Habitat loss and climate stress threaten this genetic heritage. An initiative to establish a “Central Asian Red Book” (a regional endangered species register) was proposed at the 2026 summit.

In Kyrgyzstan, a UNEP-supported “Central Asian Mammals and Climate Adaptation” project established an 800,000-hectare green corridor connecting fragmented habitats across the Tian Shan.

4.6. Renewable Energy and Green Economy Transition

The “green economy” encompasses renewable energy development, energy efficiency, sustainable agriculture, and low-carbon transport. In Central Asia, energy sector decarbonisation is the most tractable near-term lever:

- **Kazakhstan:** nuclear power plant development; expansion of wind and hydroelectric capacity
- **Uzbekistan:** utility-scale solar and wind projects; modernisation of hydroelectric stations



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- **Tajikistan:** expansion of existing hydropower potential (already >90% of electricity)
 - **Kyrgyzstan:** development of small run-of-river hydroelectric stations

Uzbekistan has met its Paris Agreement Nationally Determined Contribution (NDC) target of a 35% reduction in greenhouse gas emissions intensity ahead of schedule and has committed to doubling this reduction by 2035. The country's solar irradiance resources (among the highest in Central Asia) position it favourably for utility-scale photovoltaic deployment.

The circular economy (Section 4.2), renewable energy, and energy efficiency are distinct policy levers within the broader green economy concept and should be tracked and funded separately to avoid conflation.

4.7. Institutional Governance and Policy Mechanisms

UNECE launched an Environmental Performance Review (EPR) cycle for Central Asia in 2026 [4], covering:

1. Climate, air quality, and public health
2. Rational use of water resources
3. Biodiversity and ecosystems
4. Waste and chemical management

The EPR process provides peer-reviewed, independent assessments of national environmental governance, establishing benchmarks against which future progress can be measured, an improvement on self-reported national statistics.

4.8. Financial Mechanisms and International Investment

A regional climate and ecology investment portfolio was established in 2026 to aggregate and direct climate finance to priority projects. Key multilateral sources include:

- **Green Climate Fund (GCF):** direct access modalities available to all five countries
- **Global Environment Facility (GEF):** active programmes in biodiversity, land degradation, and water



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- **Asian Development Bank:** Central Asia Regional Economic Cooperation (CAREC) environmental window
 - **World Bank:** ongoing portfolio in water, energy, and land management
- UN's International Methane Emissions Observatory supports satellite-based detection of methane leaks from the region's substantial fossil fuel extraction and processing infrastructure, representing a short-term climate mitigation opportunity with measurable, rapid impact.

5. Barriers and Strategies to Overcome Them

5.1. Structural Barriers

Barrier	Specific manifestation in Central Asia
Limited domestic finance	Environmental budgets represent <1% of GDP in most countries; climate finance absorption capacity is low
Ageing Soviet-era infrastructure	Irrigation systems lose 40–60% of water to seepage and evaporation; energy grids are inefficient (ADB, 2023)
Weak institutional cooperation	ICWC has no enforcement authority; upstream-downstream conflicts (Kyrgyzstan/Tajikistan vs. Kazakhstan/Uzbekistan) remain unresolved (Micklin, 2007)
Technology and capacity gaps	Limited domestic capacity for satellite monitoring, lifecycle assessment, or green building certification
Data scarcity	Transboundary environmental monitoring data are inconsistently shared or withheld for political reasons

5.2. Evidence-Based Strategies

1. **Green Climate Fund and GEF accreditation:** Uzbekistan and Kazakhstan are direct access entities; Tajikistan and Kyrgyzstan should accelerate accreditation to reduce transaction costs of accessing international climate finance
2. **Blended finance instruments:** ADB and World Bank partial risk guarantees can mobilise private sector co-investment in renewable energy and water infrastructure at scale



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3. **Remote sensing and open data:** Copernicus satellite data (freely available) can substitute for ground-based monitoring where cross-border data sharing remains politically constrained
 4. **ICWC mandate expansion and enforcement:** Elevating ICWC to treaty-based authority with graduated sanctions for non-compliance would address the core governance gap that has persisted since 1992
 5. **Regional green bond standard:** A Central Asian green taxonomy aligned with the EU Green Bond Standard would attract international institutional investors to regional environmental infrastructure

6. Conclusions and Recommendations

Achieving ecological sustainability in Central Asia is a complex, multidimensional undertaking. The 2026 Regional Ecological Summit represents genuine political progress over prior decades of declaratory cooperation. However, the historical performance of ICWC and IFAS (active since 1992 and 1993 respectively) demonstrates that institutional declarations do not automatically translate into environmental outcomes. The critical differentiating factors for the new framework will be binding commitments, independent monitoring, and enforcement mechanisms.

Five priorities are recommended:

1. **Mandate ICWC reform:** Elevate the body from coordination to treaty-based authority with enforceable water allocation rules and graduated penalties for non-compliance
2. **Accelerate GCF and GEF direct access:** Tajikistan and Kyrgyzstan should complete accreditation within 24 months to reduce dependence on intermediaries and lower project transaction costs
3. **Establish a regional environmental data platform:** Open, satellite-supplemented monitoring data should be shared in real time across all five states and made publicly accessible to support independent verification of national commitments



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4. **Fund independent survival audits for afforestation programmes:** Government-reported tree-planting figures require independent field verification to establish credible carbon sequestration and land restoration baselines
 5. **Apply an inclusive green transition lens:** Energy sector decarbonisation must protect the energy access of rural and low-income populations; Kazakhstan's nuclear option and Uzbekistan's natural gas phase-down each require careful social impact assessment

The ecological future of Central Asia depends on whether the 2026 political commitments are operationalised through binding governance structures, adequately financed, and independently monitored, a lesson drawn directly from three decades of regional environmental cooperation that fell short of its stated goals.

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Modern American Journal of Biological and Environmental Sciences

ISSN (E): 3067-7920

Volume 2, Issue 6, June 2026

Website: usajournals.org

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