Ensuring Legal Protection of Biological Diversity Regulations for Safeguarding Ecosystem

Olim Narzullaeva [a, *], Anor Mukasheva [b], Sadikova Dilafruz [a]

[a] Tashkent State University of Law, Tashkent, Uzbekistan
[b] Law and Public Administration of the University of Narxoz, Astana, Kazakhstan

* Corresponding Author: o.narzullayev@tsul.uz

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ABSTRACT

The legal protection of biodiversity constitutes a central concern within ecological law theory because it directly contributes to maintaining ecosystem stability and supporting sustainable development. This study aims to analyze the normative framework of biodiversity protection and evaluate its effectiveness in addressing urgent ecological challenges, including species extinction, habitat degradation, and the impacts of climate change. The research employs a normative-legal approach by examining primary and secondary legal materials and applies qualitative analysis to conduct a comparative study of international and national legal standards. The findings demonstrate three critical points. First, although international agreements provide a normative foundation for biodiversity governance, their implementation remains constrained by weak enforcement mechanisms, interpretive ambiguities, limited financial resources, and fragmented institutional coordination. Second, the study highlights the necessity of adopting a holistic and system-based approach to biodiversity governance to confront increasing environmental pressures such as water scarcity, habitat fragmentation, and the decline of endangered species and urban green areas. Third, the research stresses the importance of strengthening institutional capacity and refining legal instruments to secure the long-term resilience of biodiversity initiatives. This study contributes to the development of enforceable and context-sensitive legal strategies, thereby offering valuable insights for policymakers and environmental law practitioners in advancing biodiversity conservation.

1. Introduction

The continuous degradation of the environment and the accelerated loss of biodiversity in recent decades represent some of the most urgent ecological challenges confronting humanity. The Central Asian region, particularly Uzbekistan and Kazakhstan, contains unique ecosystems and valuable natural resources, yet faces serious threats to its biological wealth.[1] These threats stem from anthropogenic pressures, the effects of climate change, and deficiencies in

[1] Nan Xia, 'Adapting Legal Regimes: Ensuring Access, Equity, and Protection of Genetic Resources in Chinese Aquaculture', *Aquaculture*, 600 (2025), 742245 https://doi.org/https://doi.org/10.1016/j.aquaculture.2025.742245

legal and institutional governance. In this context, the legal protection of biodiversity becomes a decisive instrument not only for conserving natural ecosystems but also for promoting sustainable development, safeguarding food security, and protecting public health.[2]

Biodiversity protection in Uzbekistan has been examined from a legal perspective and has generated important theoretical insights. Nevertheless, existing research does not provide a comprehensive comparative analysis of the legislative frameworks of Uzbekistan and Kazakhstan. The incorporation of international conventions into domestic legal systems and the assessment of their practical effectiveness have also received limited attention. In addition, the mechanisms of implementation within national legislation, along with the challenges that hinder their enforcement, remain insufficiently explored.[3]

The central legal problem addressed in this study lies in the inconsistency between national legislation and international obligations on biodiversity protection. This inconsistency is reinforced by ineffective legal mechanisms, weak interdepartmental coordination, and gaps in practical application. Although regulatory acts are often adopted, they frequently lack clear mechanisms and sufficient financial support for implementation, which significantly reduces the effectiveness of legal measures in addressing environmental damage.[4] The purpose of this study is to conduct a comparative analysis of the legislative frameworks of Uzbekistan and Kazakhstan, examine their compatibility with international law, and formulate scientifically grounded legal recommendations.[5] The scientific novelty of this research is its comprehensive and systematic comparison of the two countries' legal systems, with particular attention to the

[2] Rene Abcede and Weena Gera, 'Examining the Coherence of Legal Frameworks for Ecosystem Services toward Sustainable Mineral Development in the Association of Southeast Asian Nations', *Ecosystem Services*, 29 (2018), 228–39 https://doi.org/https://doi.org/10.1016/j.ecoser.2017.04.003

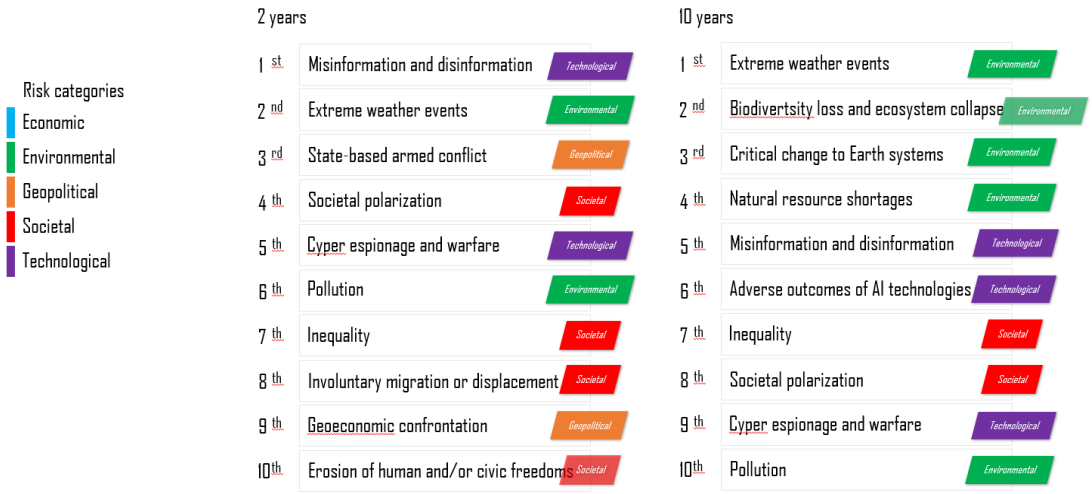
[3] Maruf Maruf, Yen-Chiang Chang and Ling Yang, 'Managing Institutional Interlinkages for the Protection of Marine Environment in the East Asian Seas Region and beyond: The Case of Marine Plastic Pollution', *Ocean & Coastal Management*, 255 (2024), 107232 https://doi.org/https://doi.org/10.1016/j.ocecoaman.2024.107232

[4] Bader H Shirah and Marwa O Zakour, 'Chapter 22 - Digital Transformations: A Detailed Examination of Emerging Solutions in the Asia-Pacific Region', in *Digital Healthcare, Digital Transformation and Citizen Empowerment in Asia-Pacific and Europe for a Healthier Society*, ed. by Patricia Ordóñez De Pablos, Mohammad Nabil Almunawar, and Muhammad Anshari, Information Technologies in Healthcare Industry (Academic Press, 2025), V, 505–37 https://doi.org/https://doi.org/10.1016/B978-0-443-30168-1.00001-3

[5] Faith Miller and others, 'Bridging the Gaps: Advancing Preconception Nutrition in South Asia through Evidence, Policy, and Action', *The Lancet Regional Health - Southeast Asia*, 36 (2025), 100585 https://doi.org/https://doi.org/10.1016/j.lansea.2025.100585

incorporation of international conventions, including the Convention on Biological Diversity adopted in Rio de Janeiro, into domestic law.[6]

Table 1. Global risks ranked by severity over the short and long term



Source: The Global Risks Report 2025

The Global Risks 2025 Report, the identifies biodiversity loss and ecosystem collapse as among the most pressing medium-term threats to environmental stability, economic activity, and human well-being. The destruction of natural capital and the rapid extinction of species threaten both terrestrial and marine ecosystems, creating far-reaching consequences for sustainable development. According to the International Union for Conservation of Nature (IUCN), 73 species and subspecies are currently listed as endangered, underscoring the urgency of global conservation measures. The Global Environment Facility further warns that biodiversity is declining at an unprecedented rate, with rare genes, species, and ecosystems rapidly disappearing. If current trends continue, nearly half of all species could face extinction within the next century due to human-driven factors such as habitat loss, pollution, and climate change. The Living Planet Index, prepared by the Zoological Society of London, confirms that biodiversity loss has accelerated two- to threefold over the past two decades. Complementing this evidence, a 2022 study published in Science Advances projects that climate change alone may cause the extinction of 6–10% of all species by 2050 and up to 27% by 2100.

Within this context, the legal framework for biodiversity protection in Uzbekistan has been critically examined. The Law on Nature Protection (1992) remains a foundational act governing the conservation of land, water, forests, air, flora, and fauna. While it outlines general measures to prevent ecosystem damage,

[6] Alexis C Dennis and others, 'The Development, Evolution, and Maintenance of Structural Racism for the Study of Health Inequities: An Expanded Framework for Asian, Black, Hispanic, Indigenous, and White Americans', *Social Science & Medicine*, 383 (2025), 118383 https://doi.org/https://doi.org/10.1016/j.socscimed.2025.118383

the law lacks specific enforcement and financing mechanisms, limiting its practical effectiveness.[7] Strengthening financial provisions and introducing clearer implementation tools are therefore essential. The Law on the Protection and Use of Wildlife (2019) represents a more recent attempt to align national regulation with international standards. However, the law omits a precise definition of "poaching," a term widely applied in international environmental law, creating ambiguity in enforcement. Moreover, wildlife monitoring procedures are not clearly established, reducing the law's effectiveness in practice.[8]

The Law on Protected Natural Areas provides a legal basis for the management and rational use of protected territories. Nevertheless, it fails to specify which state bodies are authorized to oversee implementation, and its reliance on vague normative language, such as "may be used" or "may be leased," undermines enforceability. Similarly, the revised Law on the Protection and Use of the Flora introduces important greening and reforestation initiatives, yet lacks a systematic environmental impact assessment and monitoring framework to evaluate their long-term effectiveness.[9]v

The two- and ten-year forecasts of the Global Threats Index provide a comprehensive assessment of emerging risks to global security and sustainable development. In the short term, technological and social risks, particularly disinformation, cyber espionage, and societal polarization, dominate the threat landscape. These findings demonstrate that the rapid transformation of the information environment, combined with the misuse of digital technologies, significantly increases the potential for mass manipulation and erosion of public trust. At the same time, persistent social challenges such as inequality, forced migration, and restrictions on civil liberties continue to hinder progress toward building sustainable and inclusive societies.[10]

Long-term risks are predominantly associated with environmental degradation, underscoring the urgency of rethinking consumption patterns, resource

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[7] Barbara Janusz-Pawletta, Marhabo Yodalieva and Nadira Mukhamejan, 'Chapter 33 - Stakeholder Dialogue for Improved Water Management in the Central Asian Region', in *Safeguarding Mountain Social-Ecological Systems, Vol 2*, ed. by Stefan Schneiderbauer and others (Elsevier, 2024), pp. 255–59 https://doi.org/https://doi.org/10.1016/B978-0-443-32824-4.00015-8

[8] Lidan Guo and others, 'An Approach to Complex Transboundary Water Management in Central Asia: Evolutionary Cooperation in Transboundary Basins under the Water-Energy-Food-Ecosystem Nexus', *Journal of Environmental Management*, 351 (2024), 119940 https://doi.org/https://doi.org/10.1016/j.jenvman.2023.119940

[9] P Jeya Sheela and others, 'Legal Landscape and a Few Case Studies of Natural Products' Sales in India: Challenges and Resolutions', *Natural Product Research*, 2025 https://doi.org/https://doi.org/10.1080/14786419.2025.2475363

[10] Lam Thi Mai Huynh, Jie Su and Alexandros Gasparatos, 'Differentiated Trajectories of Ecosystem-Based Adaptation for Urban Coastal Defence in the Asian-Pacific Region: A Biodiversity–Climate–Society Nexus Perspective', *Ocean & Coastal Management*, 270 (2025), 107799 https://doi.org/https://doi.org/10.1016/j.ocecoaman.2025.107799

management, and the anthropogenic impact on ecological systems. Climate change, biodiversity loss, and ecosystem degradation are identified as strategic threats with global implications. According to the 2024 UN Environment Programme report, Central Asia is among the regions most vulnerable to biodiversity loss, desertification, and water scarcity.[11] In Uzbekistan, the Law on Environmental Protection (2021, revised in 2023) and the National Strategy on Biodiversity Conservation to 2030 emphasize the integration of biodiversity goals into national policy. Kazakhstan has also strengthened its legal framework through the Environmental Code of 2021 and the adoption of the Concept for Transition to a Green Economy 2050, which prioritizes sustainable use of ecosystems and climate resilience. Despite these initiatives, implementation remains limited due to financial constraints, weak interdepartmental coordination, and insufficient monitoring mechanisms.[12]

The analysis shows that technological and environmental risks are deeply interconnected and cannot be addressed in isolation. Tackling these complex problems requires integrated approaches that combine legal, political, and scientific instruments. Strengthening cooperation among states, private actors, and civil society is essential for advancing effective solutions. Scientifically grounded, long-term strategies in the areas of information security, environmental protection, and social justice must be developed and implemented. The latest global risk assessments indicate that the current challenge is not only to evaluate risks but also to design enforceable legal and institutional mechanisms capable of addressing their root causes, thereby ensuring ecological sustainability, social stability, and international security.[13]

A major problem in biodiversity governance in Uzbekistan lies in the gap between legislation and its practical implementation. Illegal logging remains widespread in certain regions, while systems for assessing vegetation loss are poorly developed. Climate change and anthropogenic pressures further accelerate the decline of plant cover. Although Uzbekistan has adopted a legislative framework for the protection of biological resources, its effectiveness in practice remains low. Weak legal mechanisms, insufficient monitoring, and limited state

[11] Michael Manthey and others, 'Cold Winter Deserts of Central Asia (Turan)', in *Imperiled: The Encyclopedia of Conservation*, ed. by Dominick A DellaSala and Michael I Goldstein (Oxford: Elsevier, 2022), pp. 291–302 https://doi.org/https://doi.org/10.1016/B978-0-12-821139-7.00017-9

[12] Mochammad Fadjar Wibowo and others, 'Insights Into the Current and Future State of AI Adoption Within Health Systems in Southeast Asia: Cross-Sectional Qualitative Study', *Journal of Medical Internet Research*, 27 (2025) https://doi.org/https://doi.org/10.2196/71591

[13] S Rostro-García and others, 'Leopards on the Edge: Assessing Population Status, Habitat Use, and Threats in Southeast Asia', *Biological Conservation*, 299 (2024), 110810 https://doi.org/https://doi.org/10.1016/j.biocon.2024.110810

capacity in preventing illegal logging, uncontrolled plant collection, and ecosystem restoration continue to undermine conservation efforts.[14]

The challenges in this field have been addressed in a number of scholarly works. E.P. Korovin analyzed barriers to the adaptation of international legal norms into national legislation and emphasized the necessity of expanding the legal powers of state bodies, particularly by enhancing public participation in environmental governance. S.Yu. Yunusov examined the impact of agricultural activities on ecosystems and highlighted the inadequacy of sanctions for illegal plant harvesting and tree felling, stressing the importance of strengthening and increasing the independence of environmental inspections. Similarly, O. Sodikov and Sh. Turdiev pointed to the absence of a reliable state cadastral system for biological resources, arguing that this deficiency prevents accurate ecosystem assessment and informed decision-making. They proposed the creation and regular updating of a national biodiversity cadastre. Furthermore, O. Mukhamedzhanov identified significant legal vacuums in regulating biotechnology and genetic engineering, particularly concerning genetically modified organisms (GMOs), and argued for stronger legal mechanisms and scientific evaluation tools. Reports jointly prepared by UNDP and the Global Environment Facility (GEF) also criticized the lack of technical infrastructure and insufficient biodiversity databases in Uzbekistan.

Building upon these findings, this study advances several proposals for improving national legislation. Key priorities include strengthening the monitoring system, increasing sanctions for illegal logging and harvesting, and developing legal mechanisms to address biotechnology-related and genetic risks.[15] The scientific novelty of this research lies in its focus on strengthening the legal status of environmental inspectorates and public oversight bodies, enhancing sanctions for tree felling, establishing a comprehensive biodiversity cadastre, and promoting environmental awareness among the population. By addressing both institutional and cultural dimensions of biodiversity protection, this study contributes new insights to ongoing debates on the reform of environmental law in Uzbekistan.[16]

The concept of protection and use of bioresources rests on the classification of biological resources into four functional groups: material, environmental or

[14] Ji-Qin Ni, 'A Review of Household and Industrial Anaerobic Digestion in Asia: Biogas Development and Safety Incidents', *Renewable and Sustainable Energy Reviews*, 197 (2024), 114371 https://doi.org/https://doi.org/10.1016/j.rser.2024.114371

[15] William D Moreto and others, 'Self-Legitimacy among Rangers in Africa, Asia, and Latin America: An Empirical Assessment', *Biological Conservation*, 260 (2021), 109220 https://doi.org/https://doi.org/10.1016/j.biocon.2021.109220

[16] Lucy Cash, Rikki Gumbs and Eleanor S Devenish-Nelson, 'Assessing Gecko Susceptibility to International Wildlife Trade: A Novel Trait-Based Framework', *Biological Conservation*, 311 (2025), 111397 https://doi.org/https://doi.org/10.1016/j.biocon.2025.111397

organizing, spiritual and aesthetic, and informational. Within this framework, it is essential to formulate and consistently apply an integrated approach to the sustainable use of biological resources. Biodiversity, understood as the intricate web of life encompassing all living organisms and their interactions, constitutes both a source of inspiration and the foundation for the resilience of ecosystems.[17] Nevertheless, human activities such as habitat destruction, pollution, unsustainable exploitation of natural resources, and the accelerating effects of climate change have triggered an alarming global biodiversity crisis. Species extinction is occurring at an unprecedented pace, ecosystems are being degraded, and the delicate ecological balance is increasingly disrupted.[18]

In this context, biodiversity conservation seeks to equip individuals, communities, and institutions with knowledge and practical instruments for the preservation and restoration of ecological diversity. Building on the insights of scientists, environmental lawyers, and conservation practitioners worldwide, this research advances a holistic approach that integrates traditional knowledge, legal mechanisms, and community-based initiatives. The safeguarding of biodiversity, the rational utilization of biological resources, and the assurance of environmental security represent some of the most pressing socio-legal issues of contemporary global governance. The Red Book of the International Union for Conservation of Nature records seventy-three species and subspecies of animals whose continued survival raises concern across the international community. Furthermore, according to the Global Environment Facility, the loss of biodiversity, including the erosion of unique genes, species, and ecosystems, represents an existential threat. If the current pace of biodiversity loss persists, nearly half of the species on Earth may disappear within a century due to anthropogenic pressures.[19]

The study of biodiversity assumes critical importance as a means of identifying mechanisms that guarantee both the protection of biological resources and the right to their rational use. The challenges extend to environmental governance, which includes the regulation of natural resource use, the maintenance of ecological stability, the limited implementation of state cadastre and monitoring systems, and the governance of biotechnologies and genetic engineering. Further difficulties arise in biodiversity monitoring, sectoral financing, the valuation of ecosystem services, and the conduct of scientific research. These issues underscore

[17] Ying Chen and others, 'Is There Scope for Growth? Mapping Habitat Suitability for Asian Elephant (Elephas Maximus) across Its Range in China', *Global Ecology and Conservation*, 47 (2023), e02665 https://doi.org/https://doi.org/10.1016/j.gecco.2023.e02665

[18] Ma. Gregoria Joanne P Tiquio, Nicolas Marmier and Patrice Francour, 'Management Frameworks for Coastal and Marine Pollution in the European and South East Asian Regions', *Ocean & Coastal Management*, 135 (2017), 65–78 https://doi.org/https://doi.org/10.1016/j.ocecoaman.2016.11.003

[19] Parul Baranwal, Saroj Kumar Nayak and Manoj Kumar Jindal, 'Chapter 13b - River Policy: Navigating Asia's Water Needs in a Changing Climate', in *River Basin Ecohydrology in the Indian Sub-Continent*, ed. by Manish Kumar and others, Ecohydrology from Catchment to Coast (Elsevier, 2024), pp. 379–412 https://doi.org/https://doi.org/10.1016/B978-0-323-91545-8.00017-6

the need for comprehensive policies and coordinated institutional efforts that strengthen both legal and scientific approaches to biodiversity protection.

2. Research Method

This study employed a doctrinal legal research method designed to conduct a systematic analysis of legal texts and norms relating to biodiversity protection. The primary aim is to evaluate the effectiveness of legal mechanisms and innovations, while also examining the interaction between regulatory provisions and their practical implementation. The research is conceptual and normative in nature, relying on a comprehensive review of laws, regulations, case law, policy documents, and academic literature on environmental law.[20] It adopts a descriptive and explanatory strategy, not only to outline existing norms but also to assess their effectiveness and propose normative improvements. Data were collected from a wide range of sources, including expert interviews with leading legal scholars, proceedings of scientific conferences, monographs, international reports, and specialized studies on environmental law and biodiversity management.[21] The analysis proceeded in several stages, beginning with categorizing legal acts according to their type and legal force at the international, regional, and national levels. A comparative analysis of Uzbekistan and Kazakhstan, supplemented by selected foreign jurisdictions, was then undertaken to evaluate similarities and differences in legal approaches. Content analysis of legal texts and academic studies was used to identify recurring shortcomings and opportunities for innovation. Based on this integrated methodology, the study developed normative proposals for strengthening institutional mechanisms, enforcement measures, and public participation in biodiversity protection.[22]

3. Results and Discussion

Strengthening Legal Protection of Biological Diversity in Uzbekistan

The accession of Uzbekistan to the Convention on Biological Diversity in 1995 served as a turning point in harmonizing national law with international environmental standards. Core legal instruments, such as the Law "On Nature Protection" (1992), the Law "On the Protection of the Flora" (2016, revised 2021), and the Law "On the Protection and Use of Wildlife" (2019), provide a structured basis for regulating the use of natural resources and conserving endangered species. The publication of the updated "Red Book of Uzbekistan" in 2022 further

[20] Emma Capulli and others, 'Ethical and Legal Implications of Health Monitoring Wearable Devices: A Scoping Review', *Social Science & Medicine*, 370 (2025), 117685 https://doi.org/https://doi.org/10.1016/j.socscimed.2025.117685

[21] Emanuele Bigagli, 'The International Legal Framework for the Management of the Global Oceans Social-Ecological System', *Marine Policy*, 68 (2016), 155–64 https://doi.org/https://doi.org/10.1016/j.marpol.2016.03.005

[22] Abcede and Gera.

reinforced legal measures by identifying species requiring urgent protection and integrating conservation priorities into state policy.[23]

The results also indicate that biodiversity protection has been operationalized through ecosystem-specific initiatives. The Aral Sea region exemplifies the state's ecological response, where large-scale reforestation under the "Green Belt" program restored nearly two million hectares of degraded land. Similarly, the designation of the Kyzylkum Biosphere Reserve in 2017 and the strengthening of the Surkhandarya State Reserve in 2020 reflect targeted conservation strategies for fragile desert and mountain-steppe ecosystems.[24]

The existing of legislation remains predominantly declarative and lacks adequate financial and enforcement mechanisms. Weak ecological monitoring and insufficient coordination between institutions reduce the impact of legal frameworks. Recognizing these deficiencies, Uzbekistan adopted the Strategy for Biodiversity Conservation (2023–2030), which introduces new directions for integrating ecosystem services into national development plans, mobilizing green financing, and aligning with the Sustainable Development Goals. These findings confirm that while significant progress has been achieved, long-term sustainability requires stronger institutional capacity, precise legal instruments for climate adaptation, and more effective enforcement of biodiversity protection laws.[25]

The Law of the Republic of Uzbekistan "On the Protection and Use of Wildlife" of October 21, 2019, constitutes one of the central regulatory instruments for ecosystem conservation, as it establishes the legal foundations for the protection, rational use, and restoration of wildlife resources. This law functions as a cornerstone in preserving Uzbekistan's biodiversity and maintaining ecological balance by regulating state responsibilities, public participation, and liability for violations concerning wildlife management. However, despite its importance, the law in its new edition reveals critical gaps in definitional clarity. Notably, it omits an explicit definition of "poaching," which in international environmental law is universally understood as the illegal hunting, capture, or destruction of wild animals in violation of established hunting and fishing regulations. This omission

[23] Ying Liu, 'How Does Economic Recovery Impact Green Finance and Renewable Energy in Asian Economies', *Renewable Energy*, 208 (2023), 538–45 https://doi.org/https://doi.org/10.1016/j.renene.2023.01.084

[24] Filip Aggestam and Diana Mangalagiu, 'Is Sharing Truly Caring? Environmental Data Value Chains and Policymaking in Europe and Central Asia', *Environmental Science & Policy*, 114 (2020), 152–61 https://doi.org/https://doi.org/10.1016/j.envsci.2020.07.012

[25] Bianca Zoletto and Daniele Cicuzza, 'Heath Forest in Tropical Southeast Asia: Its Ecology and Conservation Risk', in *Imperiled: The Encyclopedia of Conservation*, ed. by Dominick A DellaSala and Michael I Goldstein (Oxford: Elsevier, 2022), pp. 114–28 https://doi.org/https://doi.org/10.1016/B978-0-12-821139-7.00235-X

creates interpretative challenges, particularly when aligning national legislation with transboundary biodiversity governance and enforcement mechanisms.[26]

In addition, Article 21 of the Law provides for the monitoring of wildlife and their habitats, requiring the collection, systematization, and analysis of ecological data under the framework of the national system of environmental monitoring. While the provision reflects international best practice, its implementation remains largely programmatic. The law does not specify the concrete procedural mechanisms through which such monitoring must be conducted, nor does it establish clear institutional mandates or financing schemes. Without detailed regulations or subsidiary legal instruments, the monitoring regime risks remaining declarative in nature, potentially reducing Article 21 to a non-operative provision. To address this gap, Uzbekistan's Strategy for Biodiversity Conservation (2023–2030) calls for modernization of monitoring systems, integration of digital technologies, and harmonization with global biodiversity databases. Strengthening these procedural aspects is essential to ensure that the legal framework evolves from a declaratory regime into an effective system of biodiversity governance and enforcement.[27]v

Theoretical and legal aspects of the preservation, restoration, and reproduction of bioresources under a special protection regime, as well as the regulation and development of protected natural areas in the Republic of Uzbekistan, constitute a critical component of contemporary environmental law. Scientific, technical, and organizational recommendations in this field cannot be effectively implemented without coherent and comprehensive legal norms. The law on protected natural areas provides that state management of such areas shall be exercised by specially authorized government bodies. However, the law does not clearly specify the composition and scope of authority of these general and specialized state bodies, which creates legal ambiguity. Moreover, the legislation often contains vague provisions, such as "may be given for use," "may be leased," or "may be implemented on a paid basis," which lack binding force and weaken enforceability. These shortcomings reflect a structural gap in Uzbekistan's environmental legislation.[28]

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[26] Milomir Stefanović and others, 'Range-Wide Phylogeography of the Golden Jackals (Canis Aureus) Reveals Multiple Sources of Recent Spatial Expansion and Admixture with Dogs at the Expansion Front', *Biological Conservation*, 290 (2024), 110448 https://doi.org/https://doi.org/10.1016/j.biocon.2024.110448

[27] Jasper A J Eikelboom and others, 'Will Legal International Rhino Horn Trade Save Wild Rhino Populations?', *Global Ecology and Conservation*, 23 (2020), e01145 https://doi.org/https://doi.org/10.1016/j.gecco.2020.e01145

[28] Ram Swaroop Meena and Sandeep Kumar, 'Soil Quality Protection Policies and Plans to Ensure Sustainability', in *Encyclopedia of Soils in the Environment (Second Edition)*, ed. by Michael J Goss and Margaret Oliver, Second Edi (Oxford: Academic Press, 2023), pp. 457–72 https://doi.org/https://doi.org/10.1016/B978-0-12-822974-3.00120-8

Given the growing role of national parks in biodiversity protection, scholars and practitioners increasingly argue for the adoption of a distinct Law On Nature Parks to address specific governance issues. Such a law should define the responsibilities of the Ministry of Ecology, Tourism, and other state agencies; regulate financial relations, tourism activities, and publishing within national parks; and establish accountability mechanisms for violations. Similarly, the law on the protection and use of flora (as amended in 2022) introduces important measures to preserve biodiversity and the gene pool of endangered plant species, while also regulating quotas for the use of flora. However, unresolved challenges remain in harmonizing this law with related acts, such as the Regulation on Hunting and Fishing in the Territory of Uzbekistan, which establishes administrative liability for violations but lacks clarity regarding specific sanctions.[29]

To strengthen biodiversity protection, Uzbekistan requires stricter legal provisions that clearly articulate rights, obligations, and penalties, rather than general calls to "participate" or "strengthen" conservation measures. A more coherent and detailed legislative framework will enhance ecological stability, ensure effective resource use, and align Uzbekistan's environmental governance with international best practices and its commitments under the Paris Agreement and the Convention on Biological Diversity.[30]

Strengthening Legal Protection of Biological Diversity in Kazakhstan

Comparative legal analysis highlights that the legislative frameworks governing biodiversity protection vary significantly across countries. For example, in Kazakhstan, the primary regulatory foundation is the Ecological Code of the Republic of Kazakhstan (2021), supplemented by the Law "On Specially Protected Natural Areas" (2006) and the Law "On the Protection, Reproduction and Use of Wildlife" (2004).[31] These legal acts establish comprehensive mechanisms for nature protection, resource management, and biodiversity conservation. The Ecological Code plays a central role by codifying fundamental environmental principles. Article 17 enshrines the precautionary principle, which prioritizes ecological safeguards in the presence of scientific uncertainty. Article 18 introduces the principle of sustainable development, mandating a balance between economic

[29] Astrid Alexandra Andersson and others, 'CITES and beyond: Illuminating 20 Years of Global, Legal Wildlife Trade', *Global Ecology and Conservation*, 26 (2021), e01455 https://doi.org/https://doi.org/10.1016/j.gecco.2021.e01455

[30] Emilie Auditeau and others, 'Herbal Medicine for Epilepsy Seizures in Asia, Africa and Latin America: A Systematic Review', *Journal of Ethnopharmacology*, 234 (2019), 119–53 https://doi.org/https://doi.org/10.1016/j.jep.2018.12.049

[31] Noah Zerbe, 'Biodiversity, Ownership, and Indigenous Knowledge: Exploring Legal Frameworks for Community, Farmers, and Intellectual Property Rights in Africa', *Ecological Economics*, 53.4 (2005), 493–506 https://doi.org/https://doi.org/10.1016/j.ecolecon.2004.10.015

growth and environmental security.[32] Article 19 operationalizes the "polluter pays" principle, obligating those who cause environmental harm to bear the costs of mitigation and restoration. Moreover, Article 72 requires Environmental Impact Assessments (EIA) as a mandatory condition for approving new business projects, thereby integrating preventive environmental governance into the economic planning process.[33]

Kazakhstan has also developed targeted legislation for the management of protected areas. The Law "On Specially Protected Natural Areas" (2006) regulates the status, establishment, and protection regimes of national parks, reserves, and sanctuaries. This law prohibits activities that could damage sensitive ecosystems, protects rare and endangered species of flora and fauna, and promotes the integration of Kazakhstan's protected territories into international conservation networks such as UNESCO's World Heritage system and the IUCN program. Over the past three decades, Kazakhstan's environmental policy has evolved through a series of state concepts of ecological security.[34]

The first State Concept of Environmental Security, adopted in 1996 under Presidential Decree No. 2967, sought to reduce environmental pollution and mitigate the negative externalities of rapid industrialization. However, the framework primarily relied on reactive measures, lacked sufficient financing, and was constrained by outdated environmental standards. A second Concept of Environmental Security, adopted in 2003, shifted the focus toward preventive strategies by attempting to reduce environmental risks associated with economic activities.[35] vIn practice, it still operated reactively and failed to prevent systemic ecological degradation. Recognizing these limitations, Kazakhstan launched the Concept for Transition to a "Green Economy" in 2013, which signaled a paradigm shift in national policy. This concept emphasizes proactive measures such as the adoption of environmentally friendly technologies, reduction of pollutant emissions, expansion of renewable energy, rehabilitation of degraded ecosystems, and conservation of biodiversity. It aligns national environmental governance

[32] L M Korytny and I V Zherelina, 'International River and Lake Basins of Asia: Conflicts and Avenues for Cooperation', *Geography and Natural Resources*, 31.2 (2010), 101–8 https://doi.org/https://doi.org/10.1016/j.gnr.2010.06.003

[33] Paul Gepts, 'Biocultural Diversity and Crop Improvement', *Emerging Topics in Life Sciences*, 7.2 (2023), 151–96 https://doi.org/https://doi.org/10.1042/ETLS20230067

[34] Titilayo Ilori and others, 'Genetics of Chronic Kidney Disease in Low-Resource Settings', *Seminars in Nephrology*, 42.5 (2022), 151314 https://doi.org/https://doi.org/10.1016/j.semnephrol.2023.151314

[35] Alexia Saleme Aona de Paula Pereira and others, 'Contribution of Rural Settlements to the Deforestation Dynamics in the Legal Amazon', *Land Use Policy*, 115 (2022), 106039 https://doi.org/https://doi.org/10.1016/j.landusepol.2022.106039

with global sustainability agendas, particularly the United Nations Sustainable Development Goals (SDGs) and the Paris Agreement commitments.[36]

The transition to a "green economy" in Kazakhstan emerged as a strategic response to the limitations of previous environmental management models. Although the country possesses a relatively developed legislative framework, significant challenges persist in biodiversity protection. Key issues include the degradation of natural ecosystems caused by intensive mining activities, the expansion of industrialized agriculture, and rapid urbanization. In addition, illegal hunting and poaching continue to threaten populations of rare and endangered species, most notably the saiga antelope (*Saiga tatarica*). The persistence of these problems is compounded by inadequate funding for biodiversity conservation programs, which delays the restoration of fragile ecosystems, and by weak enforcement mechanisms that undermine compliance with environmental legislation.[37]

Recent scientific studies emphasize that Kazakhstan's shift towards a green economy not only enhances environmental quality but also strengthens economic resilience through more efficient and sustainable use of natural resources. In this regard, state management plays a central role. The Ministry of Ecology and Natural Resources of the Republic of Kazakhstan is the primary authority responsible for formulating and implementing environmental policy.[38] In line with the Ecological Code of 2021 (amended in 2023), the Ministry develops and approves regulatory acts, coordinates national and regional environmental strategies, and oversees the licensing of environmentally sensitive activities.[39] It also issues environmental permits, conducts state ecological expertise, and exercises environmental control over compliance with regulations. Furthermore, the Ministry organizes programs of national importance, regulates greenhouse gas emissions, and ensures the protection of the ozone layer. It also coordinates

[36] Laura Enthoven, 'How Do Local Communities Perceive Marine Protected Area Governance, Management, Surrounding Development, and Outcomes? A Systematic Review', *Journal of Environmental Management*, 391 (2025), 126570 https://doi.org/https://doi.org/10.1016/j.jenvman.2025.126570

[37] Sergio Peña Neira, 'Interpretation and Application of International Legal Obligation in a National Legal System: Taking Seriously Benefit Sharing from the Utilization of Genetic Resources in India', *Anuario Mexicano de Derecho Internacional*, 17 (2017), 651–95 https://doi.org/https://doi.org/10.22201/iij.24487872e.2017.17.11048

[38] Laurenz Rafael Gewiss and others, 'Population Assessment and Impact of Trade on the Asian Water Dragon (Physignathus Cocincinus Cuvier, 1829) in Vietnam', *Global Ecology and Conservation*, 23 (2020), e01193 https://doi.org/https://doi.org/10.1016/j.gecco.2020.e01193

[39] Vicky W Y Lam and Daniel Pauly, 'Status of Fisheries in 13 Asian Large Marine Ecosystems', *Deep Sea Research Part II: Topical Studies in Oceanography*, 163 (2019), 57–64 https://doi.org/https://doi.org/10.1016/j.dsr2.2018.09.002

Kazakhstan's commitments under international environmental treaties, particularly those relating to climate change and biodiversity conservation.[40]

This institutional framework demonstrates Kazakhstan's intention to harmonize environmental protection with sustainable economic growth. However, the effectiveness of these measures depends on strengthening enforcement mechanisms, increasing financial allocations for conservation, and expanding international cooperation to address transboundary ecological challenges. The Ministry of Ecology and Natural Resources of the Republic of Kazakhstan operates through two key committees: the Committee for Environmental Regulation and Control, and the Committee for Forestry and Fauna. These bodies are central to the implementation of state environmental policy, particularly in biodiversity conservation and sustainable use of natural resources. In addition, scientific institutes, universities, and environmental non-governmental organizations (NGOs) play a significant role by providing research, advocacy, and technical expertise in policy development and implementation.[41]

In the context of global climate change and intensified anthropogenic pressure, Kazakhstan has prioritized several strategic measures to safeguard biodiversity.[42] First, the expansion of specially protected natural areas (SPNAs) remains a cornerstone of national policy. According to official reports, Kazakhstan has committed to increasing the coverage of reserves, national parks, and sanctuaries to at least 10 percent of its territory by 2030, aligning with the Kunming-Montreal Global Biodiversity Framework (2022). Second, the state is actively enhancing environmental monitoring systems through the application of digital technologies, remote sensing, and satellite-based observation, which enable more accurate assessment of ecosystem health. Third, stricter measures against poaching have been introduced, including amendments to the Criminal Code in 2020 that impose heavier penalties for illegal hunting of rare and endangered species such as the saiga antelope.[43]

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[40] Berfin Şenik and Osman Uzun, 'Unraveling Landscape Connectivity: The Impact of Mega-Projects on Istanbul's Northern Forests and Conservation Pathways', *Journal for Nature Conservation*, 87 (2025), 126995 https://doi.org/https://doi.org/10.1016/j.jnc.2025.126995

[41] Zahra Mohammadi and Seid Mahdi Jafari, 'Chapter 6 - Regulatory Principles on Food Nanoparticles Legislated by Asian and Oceanian Countries', in *Safety and Regulatory Issues of Nanoencapsulated Food Ingredients*, ed. by Seid Mahdi Jafari, Nanoencapsulation in the Food Industry (Academic Press, 2021), VII, 201–38 https://doi.org/https://doi.org/10.1016/B978-0-12-815725-1.00006-9

[42] David J Spielman and Adam Kennedy, 'Towards Better Metrics and Policymaking for Seed System Development: Insights from Asia's Seed Industry', *Agricultural Systems*, 147 (2016), 111–22 https://doi.org/https://doi.org/10.1016/j.agsy.2016.05.015

[43] Lian P Koh and others, 'Biodiversity State and Trends in Southeast Asia', in *Encyclopedia of Biodiversity (Second Edition)*, ed. by Simon A Levin, Second Edi (Waltham: Academic Press, 2013), pp. 509–27 https://doi.org/https://doi.org/10.1016/B978-0-12-384719-5.00357-9

Equally important is the promotion of sustainable resource use, particularly in agriculture and industry, alongside the development of renewable energy sources to reduce ecological degradation. Kazakhstan also emphasizes international cooperation, engaging in transboundary biodiversity initiatives with Russia, China, and Central Asian states, while securing financial and technical support from the Global Environment Facility (GEF) and the United Nations Development Programme (UNDP).[44]

The trajectory of Kazakhstan's environmental legislation reflects a shift from the adoption of the Concept of Ecological Security in 1996 to the approval of the Green Economy Concept in 2013, which emphasizes integration of environmental principles into broader socio-economic planning. Current reforms highlight the need to strengthen interagency cooperation, advance ecotourism as a financing tool for SPNAs, and integrate artificial intelligence into environmental monitoring. Future legislative improvements should focus on strengthening enforcement mechanisms, increasing state and private sector funding for conservation programs, and aligning national law with international biodiversity commitments. Such measures will enable Kazakhstan to minimize ecological risks and secure long-term biodiversity resilience.[45]

Scientific and technological innovation has become a decisive factor in modern governance and development strategies. Around the world, innovation serves as both a driver of economic competitiveness and a tool for environmental sustainability. In this context, biodiversity conservation is increasingly framed as a field where legal innovation, institutional reforms, and technological progress intersect. For Kazakhstan, a country with vast ecosystems and significant natural resources, the integration of biodiversity protection into legal and policy frameworks is no longer optional but a national imperative.[46]

Kazakhstan possesses one of the largest territories in Eurasia, encompassing diverse ecosystems such as steppe, desert, semi-arid zones, and mountain ranges. These areas host unique species, including the critically endangered saiga antelope, snow leopard, and a variety of endemic flora. However, the country has faced ecological crises caused by industrial development, poaching, desertification, and the legacy of Soviet-era resource exploitation. In response,

[44] Gohar A Petrossian and others, 'A Synthesis of Wild Animal-Related Trade Laws in Some of the World's Most Biodiverse Countries', *Journal of Environmental Management*, 354 (2024), 120141 https://doi.org/https://doi.org/10.1016/j.jenvman.2024.120141

[45] Markéta Ondračková and others, 'The Role of North American Bullhead Catfish as Parasite Reservoirs in Central European Fishing Grounds', *Aquaculture*, 599 (2025), 742100 https://doi.org/https://doi.org/10.1016/j.aquaculture.2024.742100

[46] Suh-Yong Chung, 'Strengthening Regional Governance to Protect the Marine Environment in Northeast Asia: From a Fragmented to an Integrated Approach', *Marine Policy*, 34.3 (2010), 549–56 https://doi.org/https://doi.org/10.1016/j.marpol.2009.10.011

Kazakhstan has progressively restructured its environmental governance, aligning it with international standards and obligations.[47]

The Ecological Code of Kazakhstan (2021) represents a landmark reform. This code consolidates ecological regulation under a modernized legal framework that reflects global principles such as the precautionary approach, sustainable development, and the polluter-pays principle. It also requires businesses to adopt the "best available technologies" (BAT) to reduce environmental harm and obliges state authorities to conduct environmental assessments before approving industrial projects. Biodiversity protection is embedded in this legal system through the regulation of protected areas, environmental monitoring, and liability for ecological damage.[48]

Complementing this framework, the Law on Specially Protected Natural Areas (2006) establishes different categories of conservation zones, including national parks, nature reserves, and biosphere territories. These areas now cover approximately 9 percent of Kazakhstan's territory, and recent state strategies aim to increase this proportion to meet international biodiversity targets. However, enforcement challenges remain. Illegal hunting continues to threaten the survival of the saiga antelope, despite international recognition of Kazakhstan's anti-poaching efforts. Likewise, habitat loss caused by agriculture, mining, and infrastructure development remains a persistent challenge.[49]

Kazakhstan has also embraced forward-looking policy instruments. The Concept for the Transition to a Green Economy (2013) set a national agenda for reducing dependency on fossil fuels, rehabilitating degraded lands, and expanding renewable energy sources. Biodiversity conservation plays a role in this agenda through ecosystem services valuation and land restoration initiatives. Moreover, the Strategic Development Plan of Kazakhstan until 2025 prioritizes environmental safety and the sustainable use of biological resources as central elements of national security.[50]

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[47] P M Dolman, N J Collar and R J Burnside, 'Captive Breeding Cannot Sustain Migratory Asian Houbara Chlamydotis Macqueenii without Hunting Controls', *Biological Conservation*, 228 (2018), 357–66 https://doi.org/https://doi.org/10.1016/j.biocon.2018.10.001

[48] Kayla D Stan, Arturo Sanchez-Azofeifa and Hendrik F Hamann, 'Widespread Degradation and Limited Protection of Forests in Global Tropical Dry Ecosystems', *Biological Conservation*, 289 (2024), 110425 https://doi.org/https://doi.org/10.1016/j.biocon.2023.110425

[49] Sunil Bahl and others, 'Chapter 76 - Immunization and Vaccine-Preventable Diseases in the Asia-Pacific Region', in *Plotkin's Vaccines (Eighth Edition)*, ed. by Walter Orenstein and others, Eighth Edi (Philadelphia: Elsevier, 2023), pp. 1560-1577.e2 https://doi.org/https://doi.org/10.1016/B978-0-323-79058-1.00076-1

[50] Robert Pomeroy and others, 'Improving Marine Fisheries Management in Southeast Asia: Results of a Regional Fisheries Stakeholder Analysis', *Marine Policy*, 65 (2016), 20–29 https://doi.org/https://doi.org/10.1016/j.marpol.2015.12.002

Internationally, Kazakhstan is a party to the Convention on Biological Diversity (CBD) and the Nagoya Protocol, which obligate the state to regulate access to genetic resources and ensure equitable benefit-sharing. Implementation has been gradual, but recent reforms indicate growing attention to biotechnology regulation, gene banks, and digital biodiversity monitoring. These measures reflect an effort to integrate scientific progress with legal frameworks in order to manage ecosystems more effectively.[51]

Despite these achievements, structural challenges persist. Weak enforcement capacity, fragmented governance, and limited financing restrict the effectiveness of conservation measures. Furthermore, balancing economic priorities with ecological protection remains a political dilemma, as extractive industries continue to dominate Kazakhstan's economy.[52] Nevertheless, the adoption of advanced ecological legislation, integration of international standards, and increasing use of technological innovation demonstrate Kazakhstan's intention to position biodiversity protection as a cornerstone of its sustainable development model.[53]

Kazakhstan's recent environmental legal reforms highlight the growing interconnection between biodiversity protection, scientific innovation, and sustainable growth. By strengthening enforcement mechanisms, expanding protected areas, and enhancing regional cooperation across Central Asia, Kazakhstan can transform its legal commitments into tangible ecological outcomes. Such efforts will ensure that biodiversity conservation supports not only environmental security but also the country's long-term economic and social resilience.[54]

4. Conclusion

The results of this study demonstrate that strengthening the effectiveness of legal mechanisms for biodiversity protection plays a critical role in advancing environmental governance. A well-developed legal framework serves as the foundation for regulating the conservation and sustainable use of biological resources, while also ensuring that environmental protection measures are integrated into broader state policies. One of the most urgent priorities is the

[51] Anna Tengberg and Annadel S Cabanban, 'Lessons Learned from Investing in Marine and Coastal Management Initiatives in the East Asian Seas', *Marine Policy*, 38 (2013), 355–64 https://doi.org/https://doi.org/10.1016/j.marpol.2012.06.013

[52] Jocelyne S Sze and others, 'Indigenous Lands in Protected Areas Have High Forest Integrity across the Tropics', *Current Biology*, 32.22 (2022), 4949-4956.e3 https://doi.org/https://doi.org/10.1016/j.cub.2022.09.040

[53] Yuanming Zhang and others, 'Characteristics and Utilization of Plant Diversity and Resources in Central Asia', *Regional Sustainability*, 1.1 (2020), 1–10 https://doi.org/https://doi.org/10.1016/j.regsus.2020.08.001

[54] Kulyanda K Nurasheva and others, 'Capital Inflow and Investment Attractiveness of Central Asian Countries (on the Example of Kazakhstan)', *Regional Science Policy & Practice*, 16.9 (2024), 100039 https://doi.org/https://doi.org/10.1016/j.rspp.2024.100039

establishment of a comprehensive state cadastre of fauna and flora, which would provide reliable data on species distribution and conservation status. Equally important is the development of scientific databases that systematize information on biodiversity and facilitate evidence-based policymaking. In addition, the research highlights the need to expand the network of protected natural areas, to implement restoration programs for rare and endangered species, and to strengthen enforcement mechanisms against the illegal exploitation of biological resources. Measures such as the establishment of special environmental funds and the introduction of payment systems for the use of biological resources can also enhance accountability and generate sustainable financing. The comparative analysis of Kazakhstan and Uzbekistan indicates that, while both countries have established legal foundations for the protection of biodiversity and transboundary resources, practical implementation continues to face serious obstacles. These include institutional fragmentation, insufficient monitoring capacity, and limited coordination across agencies. Therefore, effective protection requires not only stronger enforcement but also enhanced regional cooperation, particularly with regard to shared ecosystems.

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