

HISTORICAL CAUSES AND CONSEQUENCES OF ECOLOGICAL CRISES IN CENTRAL ASIA**Jamshidbek Olimboy o'g'li Dushamov**

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Abstract: This article examines the historical causes and long-term consequences of ecological crises in Central Asia on the basis of the principles of historicism, comparative analysis, systemic approach, and cause-and-effect methodology. It provides a detailed analysis of the ecological consequences of the agrarian policies of the Russian Empire and the Soviet Union beginning in the nineteenth century, the origins of the Aral Sea crisis, the problems of desertification and water scarcity, the impact of ecological crises on regional security and geopolitics, and the evolution of ecological policy during the years of independence.

Keywords: ecological crisis, Central Asia, Aral Sea, water resources, cotton monoculture, desertification, Soviet agrarian policy, climate change, ecological security, regional cooperation

1. Introduction

The Central Asian region — Uzbekistan, Kazakhstan, Tajikistan, Kyrgyzstan, and Turkmenistan — is rich in natural resources but has historically been caught in the vortex of severe ecological problems. Ecological crises in the region are not accidental phenomena; rather, they are the inevitable outcome of centuries of political-economic decisions, colonial policies, and planned economic management.

In the nineteenth century, the conquest of Central Asia by the Russian Empire and its economic policy aimed at turning the region into a raw material base became the first systematic source of ecological problems. Later, during the Soviet period, this process entered a new stage with the establishment of cotton monoculture and the construction of massive irrigation systems. The misguided decisions taken during this era continue to shape the ecological, economic, and demographic situation of the region to this day¹.

A scholarly study of the historical roots of ecological crises is necessary not only to understand past mistakes but also to outline pathways for sustainable development in the future. This article provides a comprehensive analysis of the historical stages of ecological problems in Central Asia, their structural causes, and their long-term consequences from the perspective of the historian-researcher.

2. Main Part

To properly assess the ecological history of Central Asia, it is necessary to take into account the region's distinctive natural conditions. The area is predominantly arid, with limited water resources, and for centuries its population has sustained life through irrigated agriculture in the basins of the Amu Darya and Syr Darya rivers. Ancient written sources by Arab geographers and Chinese travelers confirm that the earliest irrigation canals in these river basins were constructed as early as the 4th–3rd centuries BCE². During the medieval period, the use of water resources in Central Asia was relatively stable. The ancient irrigation culture of Khorezm, Fergana, and the Zarafshan valleys managed water and land resources in a comparatively balanced manner. However, between the sixteenth and eighteenth centuries, political instability, interstate wars, and changes in trade routes led to the destruction of numerous irrigation facilities and the reduction of cultivated lands.

¹ Obertreis Julia. *Imperial Desert Dreams*. – Göttingen: Vandenhoeck & Ruprecht, 2017. – P. 34.

² Bichsel Christine. *Conflict Transformation in Central Asia*. – London: Routledge, 2009. – P. 18.

In the second half of the nineteenth century, the conquest of Central Asia by the Russian Empire radically transformed the region's economy. With the establishment of the Turkestan Governor-Generalship between 1860 and 1880, the Russian administration began to consistently implement policies aimed at turning Central Asia into a cotton-producing base. According to the research of academician B.V. Lunin, cotton fields in the Fergana Valley covered 14,000 hectares in 1880, but by 1915 this figure had exceeded 260,000 hectares³.

It was during the Russian imperial period that the first large-scale irrigation projects were constructed — the initial stages of the Mirzachol and Hungry Steppe canals date to this era. However, at this stage ecological problems had not yet acquired a systemic character, since irrigated agriculture was still conducted on a relatively limited scale. The true roots of ecological crisis lie in the economic policies of the Soviet period⁴.

With the establishment of Soviet power in Central Asia, the region's economic specialization deepened further. From the 1920s onward, the policy of cotton monoculture (Russian: *khlopkovaya monokultura*) became a central direction of state policy. In the 1930s–1940s, collectivization and the introduction of the kolkhoz system completely deprived peasants of the freedom to choose their crops. The main shortcoming of Soviet economic planning was that it prioritized short-term economic indicators (cotton output) over long-term ecological consequences. As shown in the research of scholar Ju.L. Obertreis, in order to meet cotton production targets, cultivated areas were continuously expanded: in 1940, cotton fields in Central Asia covered 1.5 million hectares, but by 1980 this figure had exceeded 3.2 million hectares⁵.

The construction of massive irrigation projects — the Great Fergana Canal (1939), the Great Karakum Canal (1954), the Southern Mirzachol Canal, the Amu-Bukhara Canal, and other large-scale irrigation systems — reached unprecedented dimensions in Central Asian history. These projects did indeed make possible the reclamation of new lands and increased agricultural productivity in the short term. However, their ecological costs were not calculated. Alongside the expansion of irrigation systems, several serious ecological problems emerged. First, since most canals were unlined earthen channels, water losses reached 40–60 percent. Second, due to poor soil permeability, groundwater levels rose and salinization intensified. According to the research of V.A. Dukhovny and his co-author V. Sokolov, by the late 1980s more than 60 percent of irrigated lands in Central Asia had been affected by varying degrees of salinization, reducing yields by 20–40 percent⁶.

Excessive use of pesticides and mineral fertilizers also became one of the main sources of ecological problems. Between the 1960s and 1980s, pesticide application per hectare in Central Asia was among the highest in the world. According to the data of researcher N. Pala and others, in the Aral Sea region DDT and other chlorinated organic toxins were detected in water, soil, and the human body at levels 10–30 times higher than permissible norms⁷.

Another consequence of Soviet cotton policy was the disruption of food security. In order to meet cotton production targets, land previously allocated for grain, vegetables, and fruit cultivation was also planted with cotton. This situation created difficulties in supplying the population with food products. As noted in sources analyzing Uzbekistan's economy under Islam Karimov, by the late 1980s Uzbekistan imported 60 percent of the grain required for domestic consumption from other republics⁸.

³ Лунин Б. В. История Узбекистана в источниках. – Ташкент: Фан, 1988. – С. 176.

⁴ Obertreis Julia. Imperial Desert Dreams. – Göttingen: Vandenhoeck & Ruprecht, 2017. – P. 78.

⁵ Obertreis Julia. Imperial Desert Dreams. – Göttingen: Vandenhoeck & Ruprecht, 2017. – P. 210.

⁶ Dukhovny V.A., Sokolov V. Integrated Water Resources Management. – Tashkent: SIC ICWC, 2009. – P. 88.

⁷ Pala N., Mirzaev N., Stulina G. Pesticide contamination in Central Asia // Irrigation and Drainage. – 2004. – Vol. 53, No. 2. – P. 169.

⁸ Spoor Max. Agrarian Transition in Former Soviet Central Asia // Journal of Peasant Studies. – 2004. – Vol. 31, No. 1. – P. 117.

The Aral Sea crisis entered world history as one of the greatest ecological disasters of the twentieth century. Until 1960, the Aral Sea ranked as the fourth-largest lake in the world, with a surface area of 68,000 km² and a water volume of 1,064 km³. Beginning in 1960, when the waters of the Amu Darya and Syr Darya were diverted almost entirely for irrigation, the inflow to the sea virtually ceased.

According to the fundamental research of Philip P. Micklin, the pace of desiccation was initially slow but accelerated sharply from the 1970s onward. By 1989, the sea had split into two separate basins — the Greater and Lesser Aral. By 2007, the surface area had shrunk to approximately 14,000 km², only 21 percent of its original size, while the water volume had declined by more than 90 percent⁹.

The newly formed Aralkum Desert now emits between 75 and 150 million tons of salty dust annually. This dust contaminates agricultural lands, releases toxic substances into the atmosphere, and alters the regional climate. Scientific studies have confirmed that salt and pesticide particles originating from the Aralkum reach as far as Afghanistan, Pakistan, and even Europe. The demographic consequences of the Aral crisis were equally devastating. According to UNDP regional reports, respiratory diseases, cancer, and infant mortality are the leading causes of death in Karakalpakstan and Khorezm. Liver diseases in the Aral region occur at rates 5–7 times higher than the regional average. Since the 1990s, migration from Karakalpakstan has sharply increased, leaving many villages depopulated¹⁰.

The economic losses were immense. The fishing industry of the Aral Sea collapsed entirely: in 1960, more than 40,000 tons of fish were harvested, but by the mid-1990s the industry had disappeared. According to the research of Michael H. Glantz, the direct economic losses associated with the Aral crisis amount to tens of billions of U.S. dollars¹¹. The impact of the Aral crisis on regional security also deserves attention. Competition over the environment and resources became a new source of interstate tension. Disputes over water distribution and flows of ecological migrants intensified particularly in the late 1990s and early 2000s. This situation demonstrates that the Aral crisis is not only an ecological problem but also a geopolitical one.

The addition of climate change to anthropogenic ecological problems has created a new and destructive combination for Central Asia. According to the Sixth Assessment Report of the IPCC (AR6, 2021), the average annual temperature in Central Asia has risen by 1.5–2°C over the past 100 years, significantly higher than the global average¹². The most severe consequence of climate change for the region is the rapid melting of the Tien Shan and Pamir glaciers. As noted in the study by A. Sorg and colleagues published in *Nature Climate Change*, since 1960 the total volume of glaciers in Central Asia has decreased by 27 percent. Although glacier melt temporarily increases river flow, in the long term it leads to the depletion of water reserves and a sharp intensification of water scarcity in the region¹³.

Desertification processes are also accelerating. Rising temperatures have caused the desert zone to expand northward. The boundaries of the Karakum and Kyzylkum deserts are shifting, and areas that were once humid are becoming increasingly arid. This process has also affected agricultural lands, reducing the area available for cultivation.

⁹ Micklin Philip P. The Aral Sea Disaster // Annual Review of Earth and Planetary Sciences. – 2007. – Vol. 35. – P. 56.

¹⁰ UNDP. National Human Development Report: Uzbekistan. – Tashkent: UNDP, 2008. – P. 64.

¹¹ Glantz Michael H. Creeping Environmental Problems and Sustainable Development in the Aral Sea Basin. – Cambridge: Cambridge University Press, 1999. – P. 88.

¹² IPCC. Climate Change 2021: The Physical Science Basis. – Cambridge: Cambridge University Press, 2021. – P. 1048.

¹³ Sorg A. et al. Climate change impacts on glaciers and runoff in Tien Shan // Nature Climate Change. – 2012. – Vol. 2, No. 10. – P. 705.

Biodiversity is under serious threat. On the one hand, habitat change, and on the other, the drying of water bodies and soil degradation, have accelerated the extinction of many plant and animal species. According to the *Global Land Outlook* report of UNCCD (2022), more than 40 million hectares of land in Central Asia have been fully or partially degraded¹⁴.

The impact of climate change on agriculture is also intensifying. According to World Bank research, by 2050 grain and cotton yields in Central Asia may decline by 20–30 percent due to climate change. This situation will further aggravate food security and accelerate rural-to-urban migration. The issue of climate migration is becoming increasingly urgent. According to reports by the International Organization for Migration (IOM), climate-related internal migration in Central Asia has increased by 20 percent since the 2000s. The World Bank's *Groundswell* report (2021) notes that if current trends continue, by 2050 more than 2 million climate migrants may emerge in the region¹⁵.

After gaining independence in 1991, the Central Asian states adopted different strategies to address their ecological legacy. During the first decade (1991–2001), the priority of political and economic stabilization often relegated environmental policy to a secondary position. However, the scale of the Aral crisis was so immense that it inevitably attracted international attention¹⁶.

In 1992, the Central Asian states established the International Fund for Saving the Aral Sea (IFAS). This was the first significant institutional step toward regional ecological cooperation. Within IFAS, the Interstate Commission for Water Coordination (ICWC) also operated, coordinating the distribution of water resources. Yet the effectiveness of these organizations was often limited by political disagreements and financial constraints.

Uzbekistan has been one of the most active states in the sphere of environmental policy during the years of independence. Especially after Shavkat Mirziyoyev became president in 2016, environmental policy underwent profound renewal. In 2018, by presidential decree, the *State Program for the Development of the Aral Sea Region* was adopted. Within this program, saxaul and other plants were sown in the Aralkum Desert, and by 2020 more than 1 million hectares of the dried seabed had been afforested with trees and shrubs¹⁷.

In the sphere of international cooperation, Uzbekistan advanced several important initiatives. In 2018, President Mirziyoyev proposed at the 73rd session of the UN General Assembly the creation of a special UN program for the Aral Sea region. In 2021, by resolution of the UN General Assembly, the Aral Sea region was recognized as a “zone of ecological innovation and technology.” This diplomatic achievement enhanced Uzbekistan's reputation in the international environmental arena¹⁸. Kazakhstan achieved notable success in partially restoring the Small Aral. In 2005, with World Bank assistance, the Kokaral Dam was constructed, increasing the Syr Darya's inflow into the Small Aral, raising the water level by 4 meters, and enabling the partial revival of fisheries. Although limited in scale, this experiment demonstrated that ecological problems can be addressed through technological solutions¹⁹.

For Tajikistan and Kyrgyzstan, the issue of water resources manifests differently: being located upstream, they possess significant potential for hydropower development. However, large hydropower projects such as Rogun and Toktogul have generated diplomatic tensions with downstream states — Uzbekistan, Turkmenistan, and Kazakhstan — over water distribution. International organizations — UNDP, UNEP, the World Bank, and GIZ (Germany) — play an important role in the development of regional ecological cooperation. These organizations

¹⁴ UNCCD. *Global Land Outlook 2022*. – Bonn: UNCCD, 2022. – P. 134.

¹⁵ World Bank. *Groundswell: Acting on Internal Climate Migration*. Part 2. – Washington D.C.: World Bank, 2021. – P. 65.

¹⁶ Wegerich K. *Hydro-hegemony in the Amu Darya Basin // Water Policy*. – 2008. – Vol. 10, No. S2. – P. 71.

¹⁷ O'zbekiston Respublikasi Prezidentining PF-5303-son Farmoni. 2018.

¹⁸ UN General Assembly. Resolution 75/218. – New York: UN, 2021. – P. 2.

¹⁹ Aladin N.V., Micklin P., Plotnikov I.S. *Restoration of Aral Sea Ecosystem // Lakes & Reservoirs*. – 2009. – Vol. 14, No. 4. – P. 325.

actively support ecological projects in the region by providing financial resources, technological assistance, and institutional capacity-building. Yet their impact often depends on the presence or absence of political will²⁰.

The impact of ecological problems on regional security is intensifying. The combination of water scarcity, land degradation, and ecological migration increases the risk of social instability in rural areas. Several researchers describe ecological crises in Central Asia as a “slow-moving” security threat — one that may not lead directly to military conflict but is capable of undermining stability in the long term.

3. Conclusion

The ecological crises in Central Asia are the inevitable outcome of centuries of political and economic decisions. Colonial policies of the nineteenth century, Soviet-era cotton monoculture, the construction of massive irrigation systems without consideration of ecological consequences, and the excessive exploitation of resources — all together drew the region into the vortex of ecological catastrophe. The Aral Sea crisis became the most dramatic expression of this contradictory process. Within just a few decades, the world’s fourth-largest lake virtually disappeared, and the ecological, demographic, economic, and geopolitical consequences of this disaster continue to affect the region to this day. The Aral crisis has entered history as one of the largest man-made ecological disasters on a global scale.

Climate change is further deepening existing problems. Glacier melt, intensifying drought, accelerating desertification, and declining biodiversity — combined with anthropogenic ecological issues — have created a systemic zone of risk. This situation highlights Central Asia as one of the most vulnerable regions in the world to climate change. During the years of independence, the environmental policies of the region’s states have developed in different ways. Uzbekistan’s initiatives to restore the Aral Sea region, Kazakhstan’s experience in partially reviving the Small Aral, and international organizations’ regional ecological projects have all produced positive results. Yet these efforts have not yet expanded proportionately to the scale of the problems.

From the perspective of scientific recommendations, Central Asian states must act in several key directions to ensure ecological security:

- First, establish a system for joint regional management of water resources;
- Second, modernize irrigation technologies and improve water efficiency;
- Third, update and implement national strategies for climate change adaptation;
- Fourth, strengthen ecological education and raise public environmental awareness;
- Fifth, make effective use of international financial institutions for ecological projects.

Historical analysis demonstrates that ecological problems never resolve themselves. Their mitigation requires political will, long-term strategic planning, regional cooperation, and international support. The efforts of Central Asian states in this regard represent the only path to leaving behind a stable and environmentally healthy environment for future generations of the region.

References

1. Obertreis Julia. *Imperial Desert Dreams: Cotton Growing and Irrigation in Central Asia, 1860–1991*. – Göttingen: Vandenhoeck & Ruprecht, 2017.
2. Bichsel Christine. *Conflict Transformation in Central Asia: Irrigation Disputes in the Ferghana Valley*. – London: Routledge, 2009.

²⁰ Lioubimtseva E., Henebry G.M. Climate and environmental change in arid Central Asia // *Journal of Arid Environments*. – 2009. – Vol. 73, No. 11. – P. 963.

3. Lunin B.V. *Istoriya Uzbekistana v istochnikakh: Uzbekistan v soobshcheniyakh puteshestvennikov i uchenykh.* – Tashkent: Fan, 1988.
4. Craumer Peter R. *Rural and Agricultural Development in Uzbekistan.* – London: Royal Institute of International Affairs, 1995.
5. Dukhovny V.A., Sokolov V. *Integrated Water Resources Management: Putting Good Theory into Real Practice. Central Asian Experience.* – Tashkent: SIC ICWC, 2009.
6. Pala N., Mirzaev N., Stulina G. *Pesticide contamination in Central Asia // Irrigation and Drainage.* – 2004. – Vol. 53, No. 2.
7. Spoor Max. *Agrarian Transition in Former Soviet Central Asia: A Comparative Study of Uzbekistan and Kyrgyzstan // Journal of Peasant Studies.* – 2004. – Vol. 31, No. 1.
8. Micklin Philip P. *The Aral Sea Disaster // Annual Review of Earth and Planetary Sciences.* – 2007. – Vol. 35.
9. UNDP (United Nations Development Programme). *National Human Development Report: Uzbekistan.* – Tashkent: UNDP, 2008.
10. Glantz Michael H. *Creeping Environmental Problems and Sustainable Development in the Aral Sea Basin.* – Cambridge: Cambridge University Press, 1999.
11. IPCC. *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report.* – Cambridge: Cambridge University Press, 2021.
12. Sorg A., Bolch T., Stoffel M., Solomina O., Beniston M. *Climate change impacts on glaciers and runoff in Tien Shan (Central Asia) // Nature Climate Change.* – 2012. – Vol. 2, No. 10.
13. UNCCD (United Nations Convention to Combat Desertification). *Global Land Outlook 2022.* – Bonn: UNCCD, 2022.
14. World Bank. *The Cost of Climate Change for Central Asia.* – Washing World Bank, 2021.
15. World Bank. *Groundswell: Acting on Internal Climate Migration. Part 2.* – Washington D.C.: World Bank, 2021.
16. Wegerich K. *Hydro-hegemony in the Amu Darya Basin // Water Policy.* – 2008. – Vol. 10, No. S2.
17. O‘zbekiston Respublikasi Prezidentining 2018 yil 18 yanvardagi PF-5303-son Farmoni «Orolbo‘yi hududini rivojlantirish davlat dasturi to‘g‘risida». – Toshkent: Qonun hujjatlari milliy bazasi, 2018.
18. United Nations General Assembly. *Resolution 75/218: Special Programme for the Aral Sea Basin.* – New York: UN, 2021.
19. Aladin N.V., Micklin P., Plotnikov I.S. *Restoration of Aral Sea Ecosystem // Lakes & Reservoirs: Science, Policy and Management for Sustainable Use.* – 2009. – Vol. 14, No. 4.
20. Lioubimtseva E., Henebry G.M. *Climate and environmental change in arid Central Asia: Impacts, vulnerability, and adaptations // Journal of Arid Environments.* – 2009. – Vol. 73, No. 11.