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THE ARAL SEA CRISIS IN UZBEKISTAN AND THE HISTORICAL TRANSFORMATION OF WATER POLICY (1960–2025)

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Abstract. *This article analyses the historical transformation of the Aral Sea crisis and of water policy in Uzbekistan between 1960 and 2025. It argues that the Aral Sea crisis should be examined not merely as an environmental catastrophe but as a long-term governance challenge at the intersection of irrigation economics, cotton-centred planning, transboundary water cooperation, human security, and climate adaptation. The study reconstructs three successive policy models: the Soviet hydro-technical production model (1960–1991); the post-independence crisis-mitigation and regional-institution model (1991–2016); and the post-2017 water-security, human-security, and modernization model. Quantitative synthesis shows that the sea's surface area contracted by roughly nine-tenths, its volume by more than nine-tenths, and its salinity rose more than tenfold. The article concludes that the realistic objective is no longer the restoration of the historical sea but the conversion of the Aral region into a habitable, productive, and ecologically secure territory through water-saving technology, digital monitoring, ecosystem restoration, protection of downstream interests, and strengthened regional water diplomacy.*

Keywords: *Aral Sea region, Aral Sea, water policy, irrigation, Amu Darya, Syr Darya, transboundary waters, water security, climate adaptation, Uzbekistan.*

INTRODUCTION

Until the second half of the twentieth century, the Aral Sea was one of the most important natural water bodies of Central Asia. International scholarship records that by 1960 it covered roughly 67,500 km² and held more than 1,000 km³ of water (Micklin et al., 2014:9; Gaybullaev et al., 2012). From the 1960s onward, however, a large share of the flow of the Amu Darya and the Syr Darya was redirected to irrigate cotton, rice, and

other crops. As a result, the sea's natural water balance collapsed, its level fell, salinity rose, the fishing industry disappeared, and the Aral region was beset by salt-dust storms, soil salinization, and a deterioration in drinking-water quality.

The relevance of this study lies in the fact that the Aral crisis is not merely a historical subject. It remains a central analytical field for understanding Uzbekistan's present water policy, agricultural modernization, climate security, the sustainable development of Karakalpakstan, and transboundary cooperation across Central Asia. Data from the World Bank, the Food and Agriculture Organization (FAO), the United Nations Development Programme (UNDP), and other international institutions indicate that agriculture accounts for the overwhelming majority of water consumption in Uzbekistan and that irrigation infrastructure is of strategic importance to the national food system (World Bank, 2024:1).

The aim of the research is to provide a systematic analysis of the causes and consequences of the Aral Sea crisis and of the stages through which water policy in Uzbekistan has changed across the period 1960–2025. The study pursues four tasks: first, to characterize the Soviet irrigation–production model and its ecological consequences; second, to assess the regional water-governance institutions of the post-independence period; third, to analyse the post-2017 reforms from the standpoint of water security; and fourth, to identify the priorities of the new policy model that had taken shape by 2025. The article applies historical-legal, comparative, systemic, and causal methods of analysis.

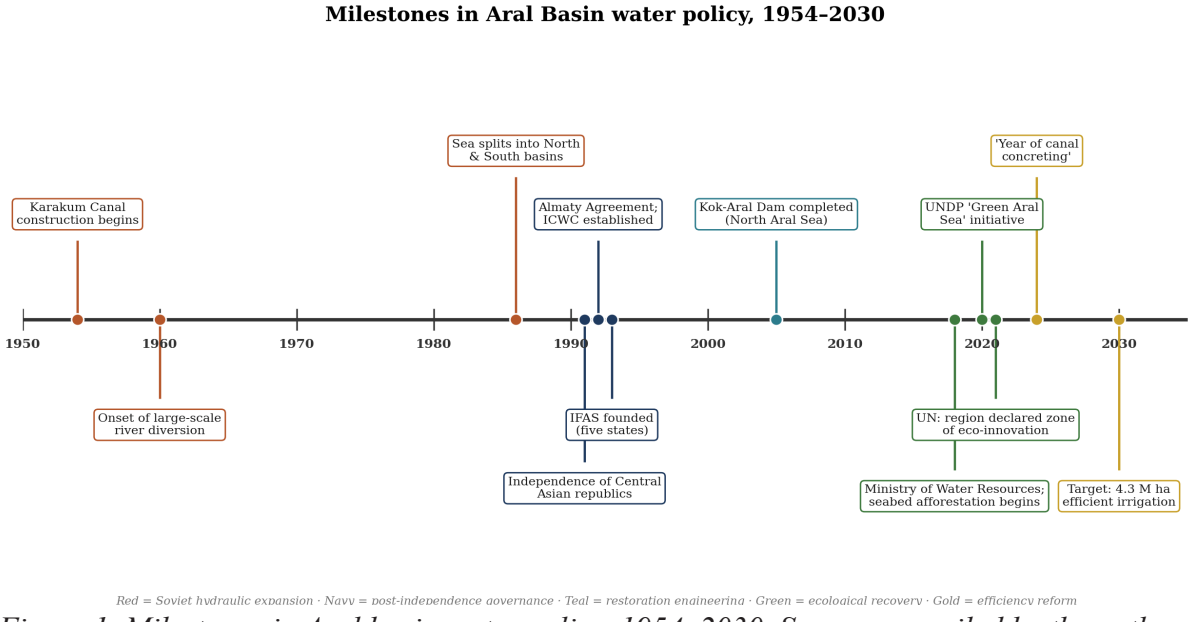

Figure 1. Milestones in Aral basin water policy, 1954–2030. Source: compiled by the authors from the sources cited in the text.

MAIN PART

The Aral Sea was a closed water body, not directly connected to any ocean, and its stability depended on a delicate balance among the flows of the Amu Darya and the Syr Darya, precipitation, and evaporation. Until the mid-twentieth century this balance was not seriously disturbed. The sharp expansion of irrigated land, the construction of new canals, the prioritization of cotton within the command economy, and the treatment of water as a limitless production input rather than an economically valued resource became the principal causes of the crisis.

Two ideas stood at the centre of Soviet water policy: cotton self-sufficiency and the incorporation of desert lands into production through irrigation. As World Bank analysts Tarr and Trushin observed, the expansion of irrigation for cotton was the decisive factor in the decline of inflow to the Aral Sea, whereas climatic factors explain only a small part of that decline (Tarr & Trushin, 2006:2). In this sense the Aral crisis was not a natural process but the outcome of mistaken production priorities, weak water accounting, and the insufficient weight given to ecological limits in political decisions.

From the 1960s to the late 1980s the Aral Sea rapidly lost its hydrological status. As the level fell, the once-single basin separated into the Small (North) Aral and the Large (South) Aral. On the Uzbek side – especially in the lower Amu Darya and in Karakalpakstan – the problem assumed its most severe form. The port city of Moynaq was left far from the water, fish-processing plants and port infrastructure lost their economic role, and the local population confronted intertwined ecological, public-health, and employment crises (Micklin, 2007:50–55).

The following table sets out the basic cause-and-effect chain of the Aral Sea crisis.

Political–economic decision	Effect on the water system	Consequence for the Aral Sea region
Priority expansion of cotton and irrigated land	A large share of Amu Darya and Syr Darya flow was diverted to fields	Sea level fell, salinity rose, fisheries contracted
Weak water accounting and pricing	Water losses and inefficient irrigation persisted	Soil salinization, drainage problems, declining yields
Late recognition of ecological consequences	No mechanism for environmental flow to the sea was created	Aralkum desert, salt-dust storms, and health risks
Divergent regional water–energy interests	Seasonal mismatch between upstream and downstream needs	The need for transboundary coordination intensified

Table 1. The political-economic causal chain of the Aral Sea crisis.

1960–1991: The dominance of the hydro-technical production model

The years 1960–1991 may be characterized as the period in which a "hydro-technical production model" prevailed in the history of the Aral Sea. Within this model, the principal function of water was to increase agricultural output – above all cotton. River basins were treated not as integrated ecosystems but as technical elements of a large economic network. The ecological value of water resources and the interests of downstream populations were relegated to a secondary position in planning.

In this period the expansion of irrigated land did not merely raise the volume of water withdrawn; it also transformed the culture of water use. Open canals, filtration losses, secondary salinization, and an inadequate drainage system squandered a large share of the water before it could be converted into useful harvest. The problem lay not only in technical obsolescence but in the very objective of water management: the planning system rewarded the fulfilment of quotas rather than the conservation of water. Water-use efficiency thus became an internal problem of the political economy.

One of the most important lessons of the Aral crisis is that when water policy fails to recognize an ecological limit, short-term economic gain is converted into long-term social cost. As the sea contracted, a new desert – the Aralkum – emerged on the former seabed, becoming a source of salt, pesticide residues, and fine dust. Philip Micklin's hydrological figures make the scale of the contraction vivid: the 67,499 km² recorded in 1960 had fallen to 39,734 km² by 1989, and by 2009 the total area of the sea was about 7,146 km² (Micklin et al., 2014:9). In parallel, the volume of the sea fell from roughly 1,093 km³ to under 100 km³, and average annual inflow declined from about 50 km³ to less than 10 km³ (Gaybullaev et al., 2012; Shi et al., 2014).

Desiccation of the Aral Sea, 1960-2010

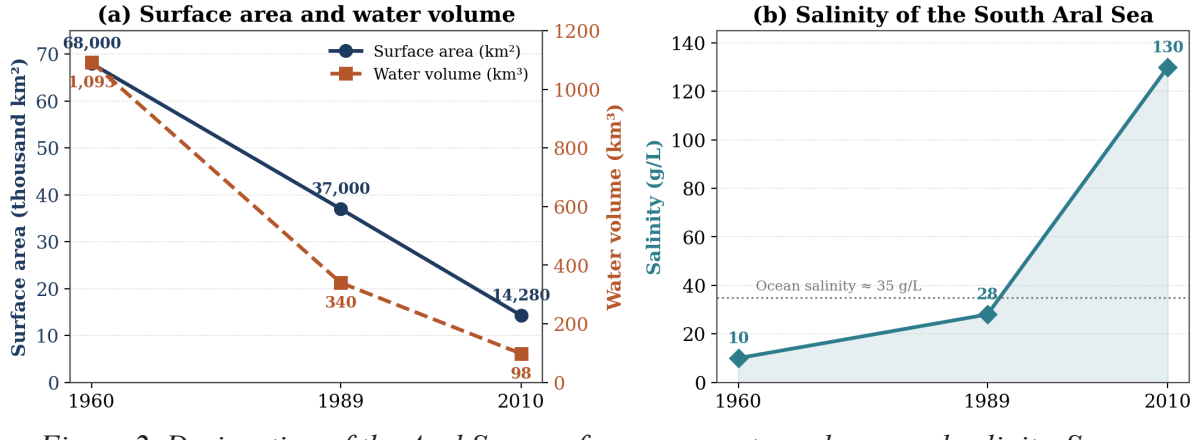

Figure 2. Desiccation of the Aral Sea: surface area, water volume, and salinity. Source: compiled by the authors from Micklin (2007) and Gaybullaev et al. (2012).

1991–2016: Independence, regional institutionalization, and crisis mitigation

After 1991 the Aral Sea basin ceased to be an administrative matter internal to a single state. The basins of the Amu Darya and the Syr Darya became an issue of transboundary water governance among newly independent states. This historic turn made water policy considerably more complex: for upstream states water was primarily an energy resource, while for downstream states it remained a resource for irrigation and food security. New institutions and agreements were therefore required.

The 1992 Almaty Agreement became one of the first political-legal foundations for the joint management, use, and protection of the region's shared water resources, and in 1993 the International Fund for Saving the Aral Sea (IFAS) was established. IFAS and the Interstate Commission for Water Coordination (ICWC) served as important platforms for regional coordination, water allocation, donor cooperation, and the promotion of Aral region programmes (Interstate Commission for Water Coordination of Central Asia, 1992; Glantz, 1999).

Nevertheless, the years 1991–2016 cannot be assessed as a period of full success. Although regional institutions existed, the economic incentives for efficient water use, the mechanisms for mandatory environmental flows, a unified data base, and investment discipline did not develop sufficiently. The FAO AQUASTAT survey likewise records the complexity of reconciling water and energy interests in the Syr Darya basin, the operating regime of the Toktogul reservoir, and the needs of downstream states (Food and Agriculture Organization, 2013:136, 151).

The most tangible counter-example came from Kazakhstan. Having concluded that restoring the whole sea was infeasible, the World Bank and the Kazakh government stabilized the North Aral through the Kok-Aral dam, completed in 2005; the northern lake's level rose, its salinity fell several-fold, and commercial fish stocks recovered (Eurasianet, 2010). For Uzbekistan, whose territory abuts the more heavily depleted southern remnant, this demonstrated that recovery would be partial and zonal, and that policy would have to address the consequences of a desiccated seabed rather than its reversal.

The principal institutional lesson of this period is that the Aral crisis cannot be resolved by national policy alone. Water flow is transboundary, climate risk is regional, and social consequences are local. Effective governance must therefore operate simultaneously at three levels: the basin, the national-policy level, and local communities.

2017–2025: Water security, human security, and the modernization model

The period after 2017 inaugurated a qualitatively new stage in Uzbek water policy. In this stage the Aral question came to be framed not only as an ecological problem but as a matter of human security, poverty reduction, the green economy, international cooperation, and climate adaptation. The establishment in 2018, under United Nations auspices, of the Multi-Partner Human Security Trust Fund for the Aral Sea Region was the international expression of this approach (United Nations Multi-Partner Human Security Trust Fund for the Aral Sea Region, 2018).

A second element was the strategic planning of the water sector. By Presidential Decree of 10 July 2020, the Concept for the Development of the Water Sector of the Republic of Uzbekistan for 2020–2030 was approved, defining water management not as an isolated technical branch but as a strategic sector linked to the economy, ecology, food security, and climate adaptation (President of the Republic of Uzbekistan, 2020).

A third element was the transition to water-saving technologies and digital monitoring. According to data published on the government portal in 2025, in 2020–2024 some 60 trillion soum of budgetary funds and 622 million U.S. dollars of foreign investment were directed to the water sector, and the area under water-saving technologies was expected to rise from 4 percent in 2020 to 50 percent in 2025 (Government Portal of the Republic of Uzbekistan, 2025). These indicators signal a shift toward a resource-conserving policy model. Figure 3 illustrates the distribution of the principal water-saving technologies.

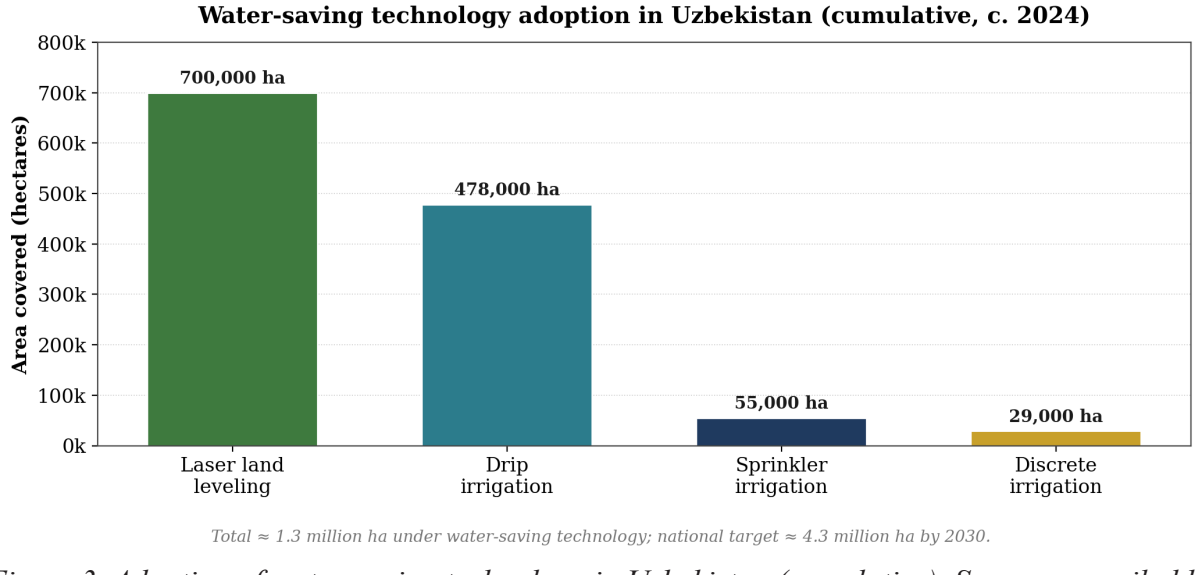

Figure 3. Adoption of water-saving technology in Uzbekistan (cumulative). Source: compiled by the authors from national reporting.

A fourth element was ecological restoration on the dried bed of the Aral Sea. UNDP's "Green Aral Sea" initiative and Uzbekistan's planting of saxaul and other desert species became a new practical direction of Aral policy (United Nations Development Programme, 2025). The objective is not to return the sea to its former state but to reduce salt-dust storms, support biodiversity, soften the local microclimate, and create a safer ecological environment for the population.

The Program for Water Resources Management and Development of the Irrigation Sector, approved in 2025, further strengthened the practical phase of this transformation. The program sets tasks including the reconstruction of irrigation networks, the expansion of water-saving technologies, improved energy efficiency at pumping stations, the automation of water accounting, and the introduction of digital control systems. It envisages the reconstruction of about 2,551 km of irrigation networks, the introduction of water-saving technologies on some 1.4 million hectares, and water savings of up to 14 billion m^3 by 2028 (President of the Republic of Uzbekistan, 2025).

ANALYSIS

The evolution of Uzbek water policy across 1960–2025 can be explained through three broad models. The first is a production-centred model, in which the chief function of water was to grow cotton for the planned economy. The second is a crisis-mitigation model, which after independence relied on social assistance, drinking water, grant projects, and regional institutions for the population of the Aral region. The third is a water-security and efficiency model, which strengthened markedly in 2017–2025, when water saving, digitalization, international investment, ecological restoration, and climate adaptation entered a single policy agenda.

Period	Policy model	Main objective	Principal weakness	Transformation outcome
1960–1991	Hydro-technical production	Expand cotton and irrigation volume	Ecological limits unrecognized	Aral water balance destroyed
1991–2016	Crisis mitigation and regional institutions	IFAS/ICWC, grants, social aid	Weak incentives and data systems	Impacts eased, but systemic saving slow
2017–2025	Water/human security and modernization	Water saving, digital monitoring, restoration	Financing and monitoring discipline still weak	Shift to an ecology–economy–climate nexus

Table 2. Three models of water policy in Uzbekistan, 1960–2025.

The table shows that the transformation was not merely an exchange of documents; it was a change in the political conception of water itself. Whereas in the 1960s water was a free input to production, by 2025 it was treated as a strategic, finite resource that demands accountability. In the scholarly literature this is interpreted as a transition to a "water-security" paradigm.

According to World Bank data, agriculture accounts for roughly 90 percent of water consumption in Uzbekistan, and irrigation is the backbone infrastructure of the country's agriculture and food system. Real results in water policy are therefore inseparable from agricultural policy: market mechanisms in cotton and grain production, clusters, crop diversification, subsidies, and the financial model of water-saving technologies form an indivisible process (World Bank, 2025). Yet water-saving technology alone does not solve the problem. If water accounting is not transparent, if there is no economic responsibility for water, if farmers' access to technology is unequal, or if the freedom to choose crops is insufficient, even drip irrigation can become merely a statistical indicator. Technological modernization must therefore proceed together with institutional modernization.

Climate change makes the transformation still more urgent. The World Bank reports that water availability in some basins may decline by 30–40 percent by 2050, while irrigation demand may rise by about 5 percent by 2030 and 7–10 percent by 2050 (World Bank, 2023:38). This means that future water policy is not only a matter of allocating existing water but of increasing the adaptive capacity of the economy under conditions of diminishing supply.

The strength of current Aral policy is its attempt to combine ecological restoration with human security. Saxaul planting, green cover, international funds, local infrastructure, and job-creation programmes can be mutually reinforcing. The social and health dimensions, concentrated in Karakalpakstan, remain central: the health literature documents elevated rates of respiratory disease, anaemia, and adverse reproductive outcomes among the exposed population (Small et al., 2001; Crighton et al., 2003), and researchers have emphasized how tightly ecological and social well-being are coupled in the basin (White, 2013). The weakness, however, is that results are often judged by "input indicators" – area planted, funds allocated, or facilities built – whereas genuine impact must be measured by "outcome indicators" such as reduced

dust storms, stabilized soils, drinking-water quality, population health, incomes, and migration pressure.

RESULTS

The analysis indicates that the Aral crisis changed Uzbek water policy along at least five dimensions. First, the water question shifted from an ecological problem to a matter of national security and development. Second, the modernization of irrigation infrastructure became a permanent priority of state policy. Third, transboundary cooperation became an inseparable part of Uzbek water policy. Fourth, the Aral region took shape as a distinct geographic field for international cooperation, donor activity, and human-security projects. Fifth, water-saving technology, digital monitoring, and climate adaptation became central elements of policy by 2025.

The analysis also shows that the root of the Aral crisis lay not in water scarcity as such but in the governance model that produced that scarcity. Today's transformation must therefore not be confined to new canals, pumps, or drip-irrigation equipment. The central task is to strengthen the institutional system for planning, accounting, pricing, monitoring, and balancing water against ecological needs.

As a practical conclusion, the article proposes the following five directions.

Recommendation	Content	Expected outcome
1. Basin-level data integration	Maintain flow, consumption, drainage, and quality data for the Amu Darya and Syr Darya on a single digital platform	Decisions rest on real data; allocation becomes more transparent
2. Link water saving to outcomes	Tie subsidies to actual water saved and to yields, not only to installed equipment	Technology delivers economic rather than merely statistical gains
3. Ecological monitoring in the Aral region	Track dust-storm, soil-stability, and biodiversity indicators on afforested areas	Restoration results become measurable
4. Protect downstream interests	Connect drinking-water, drainage, health, and employment programmes for the lower Amu Darya to water policy	Water policy is harmonized with social justice
5. Strengthen regional diplomacy	Renew water–energy exchange, data sharing, and climate-risk arrangements within IFAS and ICWC	Transboundary trust and forward planning increase

Table 3. Five practical directions for Uzbek water policy in the Aral region.

CONCLUSION

The Aral Sea crisis was one of the gravest ecological and social trials in the history of Uzbekistan. Its causes have deep historical roots: the subordination of water resources to the interests of the economic plan, cotton monoculture, the orientation of large irrigation systems toward volume rather than efficiency, and the belated recognition of ecological consequences. The model that took shape in 1960–1991 destroyed the natural balance of the Aral Sea and turned the Aral region into a zone of ecological risk.

In the period after 1991 regional institutions emerged, structures such as IFAS and ICWC were created, and international donor and social-assistance projects expanded. Yet this stage was one of mitigating the consequences of the crisis rather than resolving it. The most important change came after 2017, when water policy became a complex agenda linked to ecological restoration, human security, digitalization, water saving, and climate adaptation.

The 2020–2030 water-sector concept and the 2025–2028 program represent a new stage of water policy in Uzbekistan. The principal task is no longer to restore the Aral Sea to its historical volume but to convert the Aral region into a territory that is sustainable from the standpoint of habitation, production, and ecological security. This requires the simultaneous expansion of water-saving technologies, the digitalization of water accounting, the adaptation of crop structures, the protection of downstream interests, and the strengthening of regional water diplomacy.

The overall conclusion is that, if the Aral crisis was a policy error of the past, the new water policy that had taken shape by 2025 is an opportunity to convert the lessons of that error into practical governance. To seize this opportunity, water policy must become a system that accounts for the ecological, economic, and social value of every cubic metre of water.

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