



Constructing the Karakum Canal: The Urbanization of Soviet Turkmenistan and the Aral Sea Crisis

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Abstract

The collapse of the Aral Sea ecosystem is regarded as one of the most devastating environmental tragedies in history. Primarily driven by Soviet-era irrigation practices aimed at expanding agriculture in Central Asia's arid regions, the catastrophe has had lasting ecological and socioeconomic consequences. To address the repercussions of past actions, it is essential to move beyond perceiving water as a "national" resource: It cannot be fully comprehended or effectively managed within national borders. An ecosystem-based approach can help divert from a technologically and economically based mono-functional value system, promoting possibilities for sustainable development in the region.

Policy Recommendations

- Stakeholders should be educated about how water management can damage the environment. Understanding its impact is essential for addressing and mitigating ecological problems.
- Ecosystem thinking is necessary to manage the current problems. Water should be understood as a transboundary asset, and neighboring countries of the Aral Sea basin should work toward shared management of cross-border water resources while also considering intangible water heritage and practices.
- To solve complex problems, governance based on mono-functional water use should be substituted by policies addressing multifaceted challenges.

KEYWORDS

irrigation system
ecosystem thinking
USSR
Turkmenistan
cross-border governance

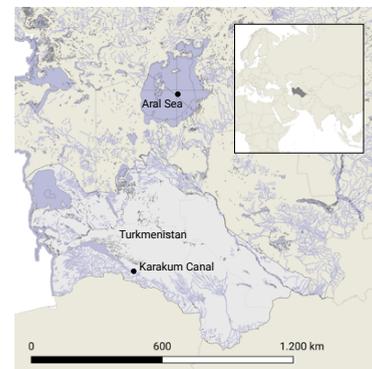
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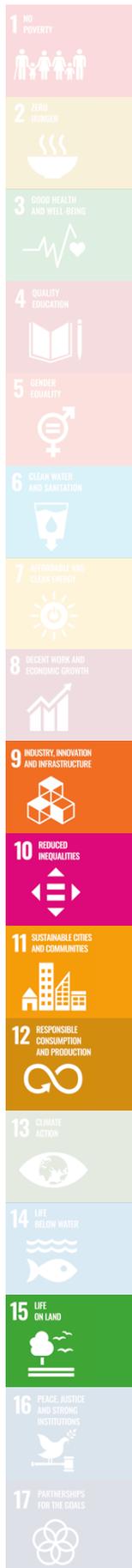
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BWh: Hot desert climate



< Fig. 1 Graveyard of Ships (Aral Sea) (Source: Mirfayzbek Abdullayev, 2025. CC0 1.0, via Wikimedia Commons).



Introduction

Today, the Aral Sea, located between Kazakhstan and Uzbekistan, contains 10 percent of its original volume of water (fig. 2). The region's economy has been destroyed, and its landscape is heavily polluted due to a tenfold increase in the water body's salt concentration. The water and soil are contaminated by fertilizers, pesticides and heavy metals, and the area is experiencing frequent dust storms (fig. 3). Many of its inhabitants suffer from devastating illnesses, such as respiratory, heart and kidney diseases (Wæhler and Dietrichs 2017). The demise of the Aral Sea, a lake that once covered a land area one-half as big as the Netherlands, has been closely linked to the irrigation practices of the Soviet Union and the construction of the Karakum Canal (Brite 2018; Obertreis 2017; Peterson 2019).

This article examines current challenges and emphasizes the importance of adopting an ecosystem thinking, which underscores the need for value-driven decisions on water governance, enabling multi-functional, holistic water use. Such a perspective aligns with the work of researchers who have proposed including social, cultural and environmental aspects in the long-term perspectives and development (D'Agostino and Hein 2024; Ghaderian 2022; Maria et al. 2022).

The top-down approach and dominant view of water as a strictly economic asset is one of the main causes of environmental degradation. Until the 1950s, a thriving fishing industry brought prosperity to the region of the Aral Sea; however, during the last years of Stalin's rule, the Soviet government emphasized irrigation and agricultural development. Soviet officials recognized Central Asia's hot desert lands as suitable for large-scale cotton growing, which had not

been attempted previously due to limited water availability. The officials viewed this natural obstacle as something to overcome, leading to the development of one of the largest irrigation infrastructures in history – the Karakum Canal.

In the 1970s, the water level of the Aral Sea began to drop, and the construction of the canal was acknowledged as one of the main factors in the collapse of the Aral Sea ecosystem (Brite 2018; Obertreis 2017; Peterson 2019), as it draws 15–30 per cent of the flow of the Amu Darya River, one of the primary inflows for the Aral Sea. Due to the Aral Sea being an inland lake with a closed basin, the water withdrawals have been pinpointed as the cause of an extreme decrease in the lake's volume (Peterson 2019). Although more than 700 km away, the cities of Southern Turkmenistan are linked to the Aral Sea by the Karakum Canal, highlighting the interdependence of urban and ecological systems.

Turkmen Cities in Response to Water

Before the canal's construction, due to limited water resources, Turkmen cities were confined mainly to oasis areas (Cvilikovska 2025). Following the development of the Karakum Canal, many Turkmen cities, like Balkanabat, Mary, Gyzylarbat and Tejen, have been expanded and organized in a way that makes them greatly dependent on the canal's water supply. The country's capital, Ashgabat, was devastated by an earthquake in 1948. It then became the focus of an experiment in Soviet urban planning. Rebuilding was facilitated by the arrival of canal water in 1962, which increased per capita water availability fivefold and enabled the construction of entire neighborhoods where the canal became the primary water source (Korzuna 1982).

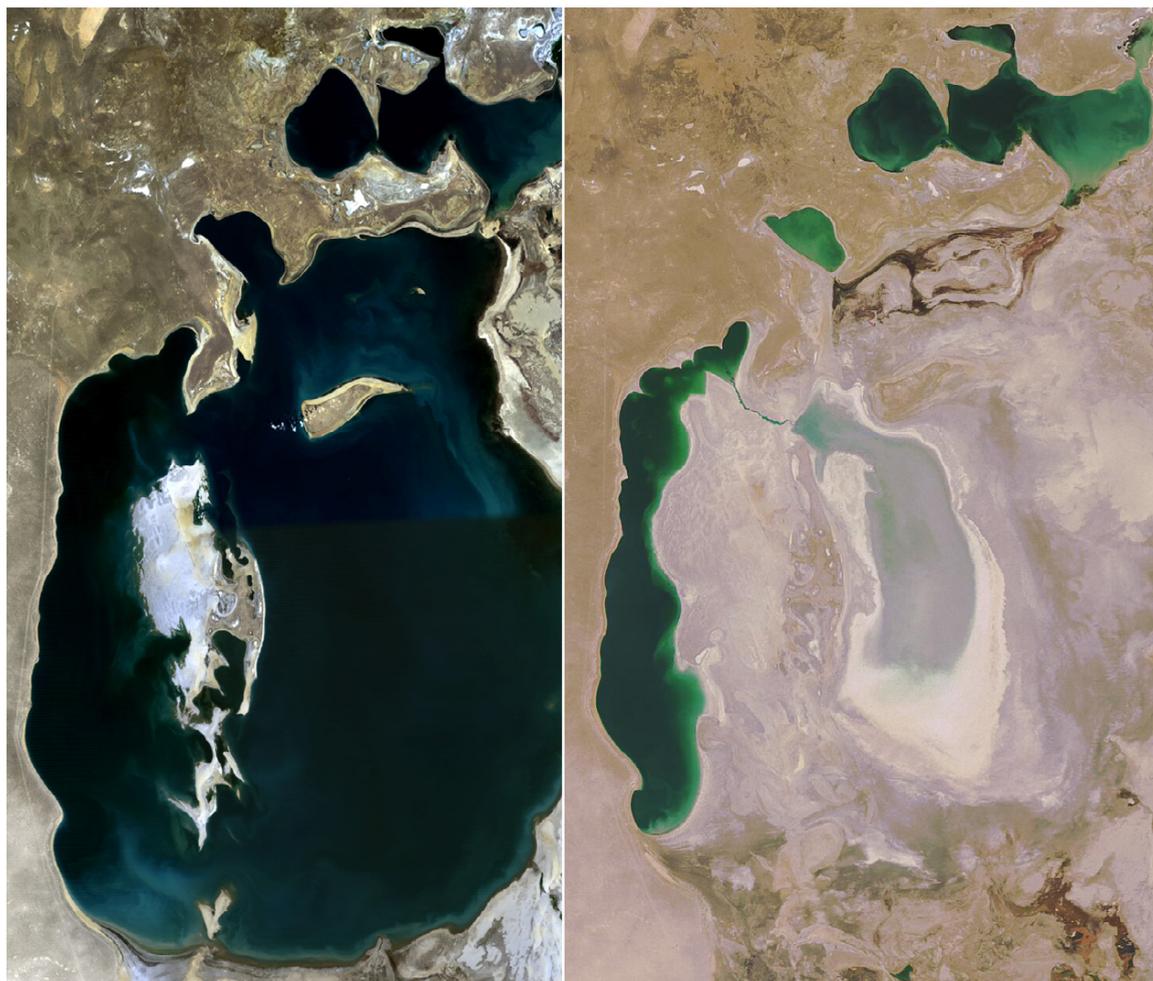


^ Fig. 2 The Location of the Aral Sea. The Historical Borders of the Aral Sea (hatched) and the Aral Sea in 2008 (solid color) (Source: Aplaice, 2021. CC-SA 4.0, via Wikimedia Commons).

Water from the canal made it possible for urban areas to expand into the irrigated lands that once surrounded them, extending new street networks into the desert. Soviet urban planners viewed large green spaces and bodies of water as essential for mitigating the harsh desert climate. This approach was reflected in Ashgabat's design, earning it nicknames like the "Green Pearl" and the "City of Gardens" (Liepa 1981). The cityscape featured expansive parks, interconnected boulevards and numerous fountains designed to be aesthetically appealing and to enhance living conditions (fig. 4). However, landscape design began to face problems with sustainability in the early 1970s, as many water-demanding foreign species were planted in hot and dry environments (Kachelson 1987).

Despite threats of water scarcity, Soviet planners continued to expand Ashgabat's green infrastructure throughout the twentieth century.

An example of this ambition is the Central Esplanade, created as the city's focal point. Symbolizing state authority, the Esplanade served as a stage for military parades and offered locals and visitors alike a place to stroll. It housed significant buildings like the Karl Marx Library, designed by Abdula Akhmedov, surrounded by lush gardens and fountains, showcasing monumental architecture integrated with natural elements. Water features and greenery in public spaces reflected a commitment to enhancing the urban environment through landscaping and urban design. Decorative water infrastructures, such as fountains and cascades, were constructed in front of most public buildings, sculpturally and functionally creating united ensembles with their surroundings and often extending to shaded inner courtyards. However, the romanticized vision portrayed in Soviet propaganda often diverged from reality. Ashgabat's climate posed significant challenges to maintaining the vast



^ Fig. 3 USSR propaganda poster "We'll conquer drought, too" (Source: Viktor Ivanovich Govorkov, 1949).

areas of greenery, as the temperature frequently exceeded 45 degrees Celsius. Despite efforts to create shaded areas and increase humidity through evaporative water bodies, photos from 1980s often depict dried lawns next to fountains (Kachelson 1987), evidence of the struggle to sustain greenery in extreme heat (fig. 5). The construction of the Karakum Canal, while integral to urban development, also produced socioeconomic disparities within the capital and among cities. Soviet newspapers mentioned that the canal's proximity to Ashgabat facilitated leisure activities and recreation

along its banks (Sein 1962). However, access to the canal was often restricted by fences, limiting direct interaction between city dwellers and the water. Meanwhile, peripheral neighborhoods faced challenges such as water supply interruptions and inadequate infrastructure maintenance (Kachelson 1987). The canal's impact on urban life varied across Turkmen cities. Cities like Mary featured private residential structures along the canal, with roads running parallel to it but with no public amenities or recreational spaces. In certain instances, access to the Karakum canal was privatized



^ Fig. 4 Boys playing in water, Ashgabat, Turkmenistan (Source: Hammond, 1964. CC-SA 4.0, via Wikimedia Commons).

and limited exclusively to the property owners along its banks. In the areas that did not contribute to Turkmenistan's national image, little to no attention was given to the appearance or amenities of the waterfront.

Future Water Insecurities

Soviet urban planning traditions persist in the twenty-first century, Turkmenistan planted half a million trees in 2023 despite many places in Ashgabat not being able to sustain greenery (fig. 6) and severe water stress that has been noted by the United Nations (Sheraz 2022). The unsustainable practices are even more evident in cities like Balkanabat, where green spaces were developed with water sourced through a 270 km underground piping network connect-

ed to the Karakum Canal. The extensive irrigation created 30 m² of greenery per inhabitant by 1970 (Üdresole 1977). However, this reliance has intensified water insecurity, and in 2015 Balkanabat faced a three-day water shortage (Jardine 2015).

Soviet urban planners, while creating elaborate green spaces and water features in Turkmen cities like Ashgabat, appeared unconcerned with the environmental impact of unsustainable resource extraction. Although already in the 1980s legislators were emphasizing the need for carefully planned interventions and urbanization in desert environments (Kachelson 1987), many Turkmen cities face water shortages today. This contrasts sharply with the lavish use of water for decorative purposes in Soviet urban planning and highlights the



^ Fig. 5 Withering grass in front of Ashgabat Airport (Source: Hughes, 2024. CC-SA 4.0, via Wikimedia Commons).



^ Fig. 6 Thousands of newly planted trees in Ashgabat. The grass is only sustainable in certain places (Source: Kalpak Travel, 2018. CC-SA 4.0, via Wikimedia Commons).

disconnection between planning ideals and environmental realities exacerbated by global warming.

Compared to other states in the Aral Sea basin, Turkmenistan appears to be the most conservative in implementing inclusive and sustainable water reforms. While efforts have been made to promote transboundary cooperation in water management, many attempts have proved unsuccessful. Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan have incorporated integrated water resource management in their policies, but these initiatives are frequently hindered by conflicting interests and implementation difficulties (Harriman 2015; Yakubov 2021).

Conclusion

The demise of the Aral Sea, starting in the 1970s, has been linked to the increase of irrigated lands in Central Asia, but has rarely been connected to the expansion and landscaping of Turkmen cities. However, its deterioration is closely tied to both urban and agricultural expansion, driven by water management policies that have failed to adapt to changing environmental conditions, intensifying water scarcity and worsening the ecological crisis.

The exorbitant use of water without considering future scenarios and its display as a part of nation-building may appear increasingly problematic as water scarcity becomes more frequent in Turkmenistan. The present regime continues the Soviet legacy by expanding green areas, even though, in recent decades, the vegetation has been dying at an increasing rate. The urban spaces developed during the Soviet era depict the shaping of space with no regard for sustainability, as many amenities are

only possible with excessive water use. In recent decades, withering trees and empty fountains have appeared as precursors of a gloomy future. Due to the complexity of the problems and their causes, sustainable development can only be achieved by rethinking the governance of water heritage and collaborating with other countries in the Aral Sea basin.

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