The Aral Apocalypse

Snehasini Maddhichetty Antonious
101294169

Carleton University
Department of Engineering Practice
Masters in Software Engineering
ECMP 5007_Climate Change and Sustainability

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Project Report

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Executive Summary

The Aral Sea Crisis represents one of the most significant cases of anthropogenic environmental degradation in recent history. Once the world's fourth-largest inland lake, the Aral Sea has declined by over 85% since the 1960s, primarily due to Soviet-era irrigation policies aimed at expanding cotton production. The diversion of the Amu Darya and Syr Darya rivers led to major ecological disruptions, including lakebed desiccation, biodiversity loss, and regional climate shifts. Local communities continue to face respiratory illnesses, water shortages, economic decline, and displacement (WHO, 2011; UNEP, 2019). While the Kok-Aral Dam has enabled partial recovery in the North Aral Sea, the southern basin remains a stark symbol of irreversible environmental mismanagement.

The crisis serves as a cautionary tale, especially in the context of climate change-driven water insecurity. Today, similar pressures are mounting in vital water systems globally—from the Great Lakes in North America, facing eutrophication and fluctuating water levels, to the Colorado River Basin, which is drying under the strain of overuse and rising temperatures.

This report uses the Aral Sea as a lens to explore broader themes of sustainable engineering, water ethics, and international environmental governance. It underscores the urgency for climate-resilient infrastructure, transboundary water cooperation, and community-driven adaptation strategies, particularly as global warming intensifies competition over finite freshwater resources. In the age of climate change, the Aral Sea is not just a regional tragedy—it is a global warning.

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1
Introduction

The Aral Sea crisis exemplifies the dangers posed by the overexploitation and mismanagement of freshwater resources. Human activity, driven by agricultural needs, political goals, and economic pressures, has significantly diminished global water supplies, especially in arid and semi-arid regions. The Aral Sea—technically a lake but historically referred to as a *'sea'* due to its vast size and saline water—is now a desert, having faced one of the most extreme cases of environmental degradation, stemming from poor governance, unsustainable irrigation practices, and the failure to consider the complex interactions between water management and climate variability.[1] Climate change further exacerbates these challenges by increasing evaporation rates, reducing precipitation, and intensifying water scarcity. As global freshwater systems are increasingly threatened, the lessons from the Aral Sea serve as a stark warning of how unsustainable water management can lead to irreversible ecological and socioeconomic impacts. This report delves into the causes, consequences, and restoration efforts of the Aral Sea disaster, offering insights into how better water management practices could have mitigated this crisis and can inform global water governance today.

2

Historical Context: The Rise and Fall of the Aral Sea

The Aral Sea, once one of the largest inland bodies of water in the world, was a defining geographical feature of Central Asia. By 1960, it spanned approximately 68,000 km^2, making it the fourth-largest lake globally [2]. Fed primarily by the Amu Darya and Syr Darya rivers, it straddled the borders of Kazakhstan and Uzbekistan as seen in Figure 2.1. The name originates from the Kyrgyz term *Aral-denghiz*, meaning *'Sea of Islands'*, referring to the presence of over 1,000 islands, each exceeding one hectare (*2.5 acres*) in area [2]. For centuries, the Aral Sea supported a rich ecosystem, providing crucial resources such as fresh water, fish, and a stable climate for the surrounding agricultural communities. The lake's waters served as a vital lifeline for the local population, enabling sustainable fishing industries and agriculture.

However, the Aral Sea's decline began in the mid-20^{th} century, driven largely by human intervention. Figure 2.2 illustrates the rapid shrinking of the Aral Lake through satellite images. The most significant factor contributing to its desiccation was the Soviet Union's aggressive irrigation policies, which diverted vast amounts of water from the two primary rivers that fed the lake to support agricultural expansion [3]. By the early 2000s, the Aral Sea had shrunk by approximately 90% in volume, leading to a dramatic loss of biodiversity and a collapse of the local fishing industry [4]. What was once a thriving body of water became a symbol of ecological devastation. The Aral Sea's loss highlights the complex interplay between industrial development, resource mismanagement, and environmental sustainability. Annexure A depicts the current state of the Aral lake.

Figure 2.1: *Geography of the Aral Lake*

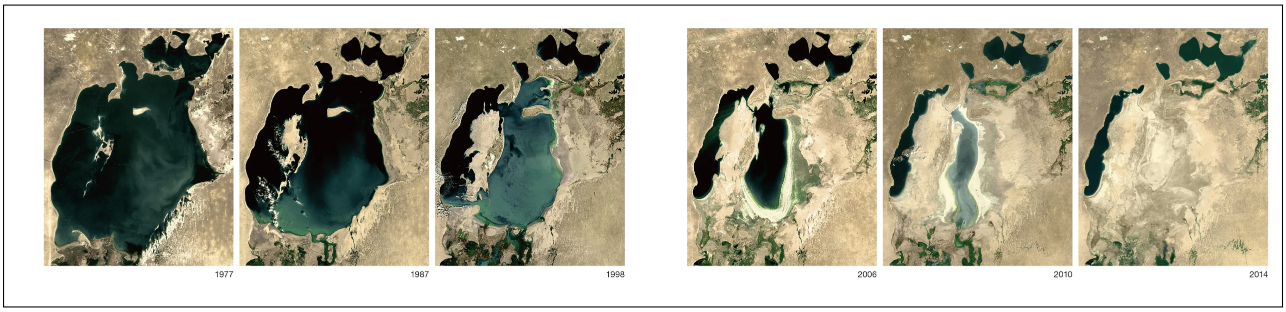

Figure 2.2: *Satellite images of the Aral Lake over the years*

3
Cotton Production and the Soviet Irrigation Plan

In the 1960s, the Soviet Union embarked on an ambitious plan to increase cotton production in Central Asia, transforming the region's desert landscapes into highly productive agricultural zones.[5] Cotton, referred to as 'White Gold', was considered an essential export for the USSR, and the government's drive to increase yields led to the implementation of large-scale irrigation systems that diverted water from the Amu Darya and Syr Darya rivers, which were the primary sources feeding the Aral Sea [6]. The Soviet authorities constructed an extensive network of canals to facilitate this massive irrigation effort. However, the system was riddled with inefficiencies. Around 60% of the diverted water was lost due to poorly designed and unlined canals that leaked or evaporated before reaching the fields [6][7]. Despite these inefficiencies, cotton production in the region surged. By the 1980s, the Soviet Union had transformed Central Asia into one of the world's leading cotton-producing regions [8].

However, this growth came at a severe environmental cost. The diversion of water to irrigate cotton fields meant that less water flowed into the Aral Sea, causing its water levels to plummet. By the 1990s, the Aral Sea had lost over 90% of its volume, triggering a cascade of ecological and social consequences [9]. The rising salinity in the remaining water rendered the lake increasingly inhospitable to aquatic life [10]. The pursuit of *'white gold'*, ultimately decimated the Aral Sea, exposing the unsustainable nature of the Soviet irrigation plan.

4
Environmental Impacts of Lake Depletion

The depletion of the Aral Sea has resulted in profound and far-reaching environmental consequences, transforming the previously flourishing ecosystem into a barren and inhospitable landscape. The extensive loss of water from the lake, driven by Soviet irrigation practices, has left a devastating legacy.

4.1 Exposed Lakebed and Desertification

As the water levels of the Aral Sea plummeted, vast stretches of the former lakebed became exposed, giving rise to dry, salt-encrusted terrain highly susceptible to erosion and toxic dust dispersion (Figure 4.1). What was once a vital aquatic ecosystem quickly became a desert, with salt and toxic residues left behind. The exposed lakebed, now known as the Aralkum Desert (Figure 4.2), spans thousands of square kilometers and is a direct result of the lake's shrinking. This transformation has not only altered the physical landscape but also contributed to the release of hazardous chemicals, such as pesticides, fertilizers, and heavy metals, into the environment [11]. These substances, once trapped in the lake water, have been carried by wind and dust storms across the region, further deteriorating the environment.

4.2 Microclimate Disruptions

The disappearance of the Aral Sea has also led to significant changes in the local climate. The lake had previously played a critical role in moderating the temperature of the region, creating a stabilizing effect on the surrounding microclimate. As the lake's surface area shrank, the region experienced more extreme weather conditions [12]. Summers became hotter, and winters colder, due to the loss of the lake's ability to absorb and release heat. In addition, precipitation levels began to decline, exacerbating the already arid conditions. These changes in climate have not only disrupted the natural environment but also negatively impacted the agricultural productivity of the surrounding areas [13].

Figure 4.1: *The exposed lakebed*

Figure 4.2: *The Aralkum Desert*

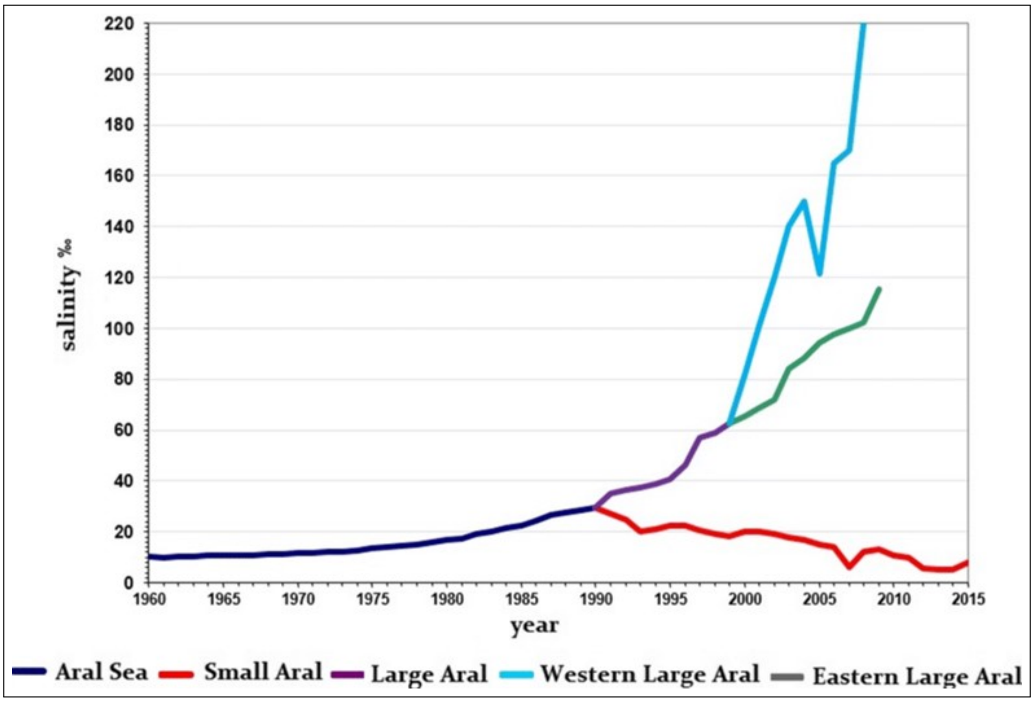

Figure 4.3: *Salinity rise in Aral*

4.3 Biodiversity and Habitat Loss

The dramatic ecological transformation of the Aral Sea has resulted in a profound loss of biodiversity and critical habitats. Once home to 24 native fish species, the lake experienced a sharp increase in salinity—from approximately 10 g/L to over 100 g/L in some regions—caused by the diversion of inflowing rivers for irrigation [14]. This rendered the aquatic environment uninhabitable for most freshwater species, leading to the complete collapse of the fish population by the late 1990s (Figure 4.3) [15][16]. Annexure B contains few such endangered or extinct fish species endemic to the Aral Region.

Simultaneously, the shrinking shoreline of the Aral Sea led to the disappearance of extensive wetlands that had once bordered the lake and served as vital habitats for a wide variety of migratory bird species [17]. These wetlands provided essential breeding and feeding grounds for ducks, swans, pelicans, cormorants, and many other bird species (refer to Annexure C) migrating through Central Asia. As these ecosystems disappeared, countless migratory birds were forced to abandon the region, struggling to find alternative habitats. This disruption triggered a severe decline in both regional and migratory biodiversity, with species such as muskrats and deer, which had depended on the wetlands, also becoming increasingly scarce [18]. This dual collapse of aquatic and avian life highlights the extensive ecological damage caused by the desiccation of the Aral Sea.

5
Socioeconomic and Health Consequences

The environmental collapse of the Aral Sea has had severe socioeconomic and health impacts on the surrounding communities, with lasting consequences for the people who depended on the lake for their livelihoods.

5.1 Loss of Jobs in the Fishing Industry

One of the most immediate and dramatic impacts of the Aral Sea's depletion was the collapse of the local fishing industry. Prior to the crisis, the lake supported one of the largest fisheries in the Soviet Union, with more than 60,000 people employed in fishing and related industries [10]. Annexure Dshows evidence of a successful fishing industry that once existed. However, as the water became increasingly saline and the fish population collapsed, these jobs were lost. Many families found themselves without work, leading to widespread poverty in the affected region [19].

5.2 The Decline of Port Towns

The environmental degradation of the Aral Sea has led to the near-total collapse of port towns that once played a crucial role in the region's economy. Moynaq, formerly a prominent fishing center in Uzbekistan, lay approximately 150 kilometers from the nearest body of water in 2023 [20]. The population of Moynaq (see Annexure E) has sharply decreased, with an estimated 100,000 residents migrating due to the environmental collapse, leaving behind roughly 18,000 people who face health challenges and extreme living conditions [21]. The retreat of the sea has rendered the port obsolete, resulting in the abandonment of infrastructure and the loss of livelihoods. This trend is observed in other settlements along the former coastline, where the depletion of the Aral Sea has caused significant depopulation and the collapse of local economies. The Aral Ship Graveyard (Figure 5.1), located near Moynaq, further illustrates the scale of environmental change, as abandoned ships now lie stranded in the desert, marking the extent of the region's transformation.

Figure 5.1: *Aral Ship Graveyard*

5.3 Toxic Dust Storms and Health Issues

Perhaps the most insidious consequence of the Aral Sea's desiccation is the health impact of toxic dust storms referred to as *'black blizzards'* [22]. As the exposed lakebed dried, it became a source of hazardous dust and chemicals. Winds carried this dust across the surrounding regions, and it often contained toxic pesticides and heavy metals from the agricultural runoff. These dust storms have been linked to a sharp increase in respiratory diseases, including asthma, bronchitis, and other chronic illnesses. Additionally, the presence of pesticides and industrial pollutants has contributed to a rise in cancers and birth defects in the affected populations [23].

5.4 Decline in Agricultural Productivity

The degradation of the Aral Sea has also had a severe impact on local agriculture. As the lake receded, soil salinization increased, making it more difficult for farmers to grow crops. The irrigation systems that had been used to divert water from the rivers also led to a build-up of salts in the soil, further reducing its fertility. As a result, agricultural productivity in the surrounding areas plummeted, and many farmers have been forced to abandon their fields. Between 1987 and 2019, approximately 3,129 km^2 of farmland in the Aral Sea region was abandoned due to salinization and desertification [24]. The scarcity of fresh water, combined with poor soil conditions, has further exacerbated the economic hardships faced by the region's agricultural workers [18].

5.5 Long-term Public Health Crisis

The long-term health impacts of the Aral Sea crisis continue to affect the population today. The toxic environment, combined with the lack of economic opportunities, has created a public health crisis in the region. Diseases related to poor water quality, such as kidney and liver disease, have become increasingly common. Furthermore, the psychological toll of the crisis, which has seen entire communities devastated, has led to increased mental health problems, including depression and anxiety [25].

6
Restoration Efforts: The Kok-Aral Dam

In 2005, Kazakhstan constructed the Kok-Aral Dam across the Syr Darya River to address the dire state of the North Aral Sea (Figure 6.1). This project aimed to restore water levels, reduce salinity, and improve local ecosystems. By retaining more water within the northern basin, the dam has improved water quality, supported the recovery of aquatic life, and promoted the reappearance of wetland habitats. While the South Aral Sea remains beyond recovery, the dam has brought significant benefits to the northern basin [26].

6.1 Successes of the Kok-Aral Dam

The primary achievement of the Kok-Aral Dam was the rise in water levels of the North Aral Sea, which increased by about 3 meters [26]. This helped restore local ecosystems and reduce the salinity, which had previously risen to harmful levels. As a result, fish populations, including the native bream, pike-perch and roach, returned to the region, providing some revival for the fishing industry. Wetlands also reappeared, offering habitat for migratory birds that had previously abandoned the area [27].

6.2 Challenges for the South Aral Sea

Despite the successes in the North Aral Sea, the South Aral Sea remains largely beyond recovery. The southern basin continues to suffer from severe ecological degradation, with its waters having retreated significantly, leaving behind a toxic desert. The scale of this deterioration and the lack of resources for large-scale restoration mean that the South Aral Sea is unlikely to recover in the near future [27].

6.3 The Way Forward

The success of the Kok-Aral Dam underscores the potential of localized restoration efforts, but it also highlights the need for regional cooperation. While Kazakhstan has made progress, sustained recovery of the Aral Sea region will require collective action from all stakeholders to address inef-

Figure 6.1: *Kok-Aral Dam*

ficient water management and unsustainable agriculture, ultimately restoring ecological balance [28].

7 Missed Opportunities: What Could Have Been Done?

The Aral Sea disaster highlights several missed opportunities where alternative strategies could have minimized the environmental and socioeconomic impacts. A more sustainable approach might have included:

7.1 Efficient Irrigation Techniques

The inefficient, unlined irrigation canals used by the Soviet Union resulted in significant water loss through evaporation and seepage. In contrast, drip irrigation is a more efficient method that delivers water directly to the plant roots, minimizing evaporation and runoff [29]. This precision watering technique would have been particularly beneficial for cotton cultivation, which requires a substantial amount of water but is sensitive to over-irrigation [30]. Drip irrigation not only conserves water but also ensures that water is used more efficiently, directly supporting crop growth and improving yields without overburdening the water supply.

7.2 Climate-Appropriate Crops

The extensive focus on cotton, a highly water-intensive crop, placed unsustainable pressure on the Amu Darya and Syr Darya rivers. Shifting to drought-resistant, climate-appropriate crops such as wheat, barley, or sorghum would have reduced water consumption while better aligning with the region's arid conditions [31][32]. These crops require less water and are more resilient to extreme weather conditions, improving both soil health and long-term agricultural productivity. By diversifying crop choices, the region could have reduced its dependence on water-intensive monocultures, mitigating the environmental impact on the rivers and ensuring more sustainable agricultural practices [33].

7.3 Environmental Impact Assessments (EIAs)

Despite the implementation of EIAs in the Aral Sea region, the findings were not adequately integrated into policy decisions, which led to the underestimation of the long-term environmental consequences of water diversion projects [34]. A more rigorous and action-oriented application of EIAs could have highlighted critical risks such as soil salinization, declining biodiversity, and the irreversible shrinking of the Aral Sea. These assessments should have been used not only to identify risks but also to actively inform water management strategies that prioritized ecosystem health. Had the EIAs been employed to their full potential, they could have provided a blueprint for sustainable agricultural practices and water usage, which would have alleviated many of the adverse environmental effects observed today.

7.4 Adaptive Water Governance

The centralized and rigid water management system adopted by the Soviet Union lacked the flexibility required to adapt to changing environmental conditions. This inflexibility led to a systematic over-allocation of water to agriculture, without taking into account the long-term ecological limits of the river systems. In contrast, adaptive water governance—characterized by continuous monitoring, data-driven decision-making, and the flexibility to adjust policies as conditions evolve, could have provided a mechanism for managing fluctuating water resources while safeguarding ecological health. Such an approach would have enabled the region to better absorb environmental shocks, ensuring that water resources were allocated efficiently across agricultural, ecological, and human needs, thus preventing the devastating ecological decline seen in the Aral Sea [35].

7.5 Gradual Scaling with Community Engagement

The large-scale, top-down implementation of irrigation projects without adequate local involvement or phased planning led to significant ecological and social disruptions. A more gradual, community-centered approach to water management would have allowed for better integration of local knowledge and environmental feedback, ensuring that water usage patterns were sustainable. Engaging local communities in decision-making would have fostered greater accountability and allowed for the adoption of water-conserving practices that aligned with local agricultural traditions. Moreover, scaling irrigation projects gradually would have provided the flexibility to assess ecological impacts at each stage and make necessary adjustments to minimize adverse effects, ultimately leading to more sustainable water resource management [36].

Had these strategies been implemented early on, they could have preserved both the region's ecosystem and its agricultural productivity, leading to a more sustainable future.

8
A Global Reflection: The Great Lakes and Water Insecurity

The Great Lakes (Figure 8.1), comprising five large bodies of freshwater — Superior, Michigan, Huron, Erie, and Ontario—form the largest surface freshwater system on Earth, accounting for approximately 20% of the world's total supply [37]. Situated on the border between Canada and the United States, they play a critical role in supporting biodiversity, regional economies, and drinking water supplies. However, these vital water resources are increasingly threatened by both environmental and anthropogenic factors [38]. These challenges not only compromise the ecological health of the lakes but also reflect broader global concerns about water security. Several key factors contribute to the escalating risks facing this essential freshwater system:

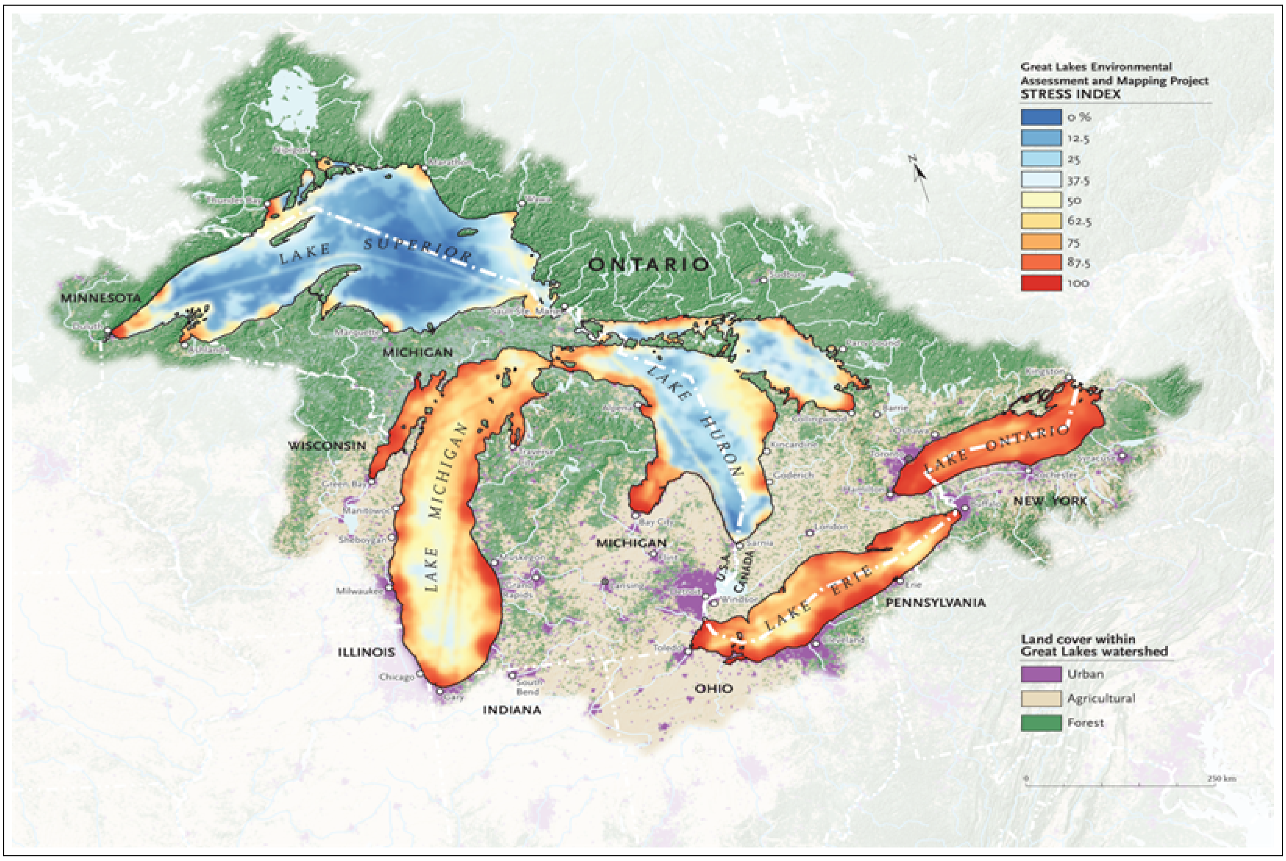

Figure 8.1: *The Great Lakes*

8.1 Drought and Water Diversion Pressures

Persistent droughts in the western United States have renewed interest in diverting Great Lakes water to support agricultural and municipal demands. Although the Great Lakes Compact (2008) prohibits most diversions, the approval of Waukesha, Wisconsin's request under a special exemption has raised concerns [39][40]. This decision could establish a precedent for future diversion claims, particularly as climate change intensifies drought severity across North America.

8.2 Invasive Species Disruption

Over 200 invasive species, including goby fishes, zebra and quagga mussels (see Annexure F), have been introduced to the Great Lakes through ballast water discharge (as seen in Annexure G) from international shipping [41]. These species alter nutrient cycles, outcompete native fauna, and destabilize food webs, leading to ecological imbalances that affect water quality and biodiversity. Their continued spread presents significant management challenges for maintaining ecosystem resilience.

8.3 Avian Botulism and Wildlife Health

Shifts in water chemistry and food web dynamics, driven by invasive species and algal blooms, have created favorable conditions for avian botulism outbreaks [41]. The botulinum toxin accumulates in fish and waterfowl, resulting in widespread bird mortality each year and further threatening the region's vulnerable wildlife. This phenomenon underscores the complex and cascading impacts of ecosystem disruption caused by human activities.

8.4 Climate Change and Extreme Weather Events

Rising temperatures are altering thermal dynamics in the Great Lakes, leading to reduced ice cover, increased evaporation, and more frequent water level fluctuations [42]. These changes contribute to heavier precipitation events, flooding, and shoreline erosion, stressing infrastructure and ecosystems alike. Climate-induced variability adds to the difficulty of maintaining water quality and sustainable lake management.

The struggles of the Great Lakes highlight the global water security crisis, where invasive species, climate change, and conflicts over water access intersect. Similar patterns are observed in other large freshwater systems worldwide, driven by transboundary pollution, shipping practices, and increasing demand for limited water resources [43]. The experience of the Great Lakes emphasizes the need for proactive governance, international cooperation, and the integration of ecological sustainability into freshwater policy planning.

9
Global Parallels in Water Mismanagement

The Aral Sea crisis is part of a global pattern of water mismanagement, driven by over-extraction, poor planning, and climate change. Several prominent water bodies around the world are facing similar declines (see Annexure H), illustrating the widespread risks of neglecting sustainable water management.

9.1 Colorado River (U.S./Mexico)

The Colorado River, a critical water source for millions, is over-allocated, leading to historically low water levels in reservoirs like Lake Mead and Lake Powell. Its depletion, worsened by climate change and reduced snowpack, has caused ecological damage and water security risks for the southwestern U.S. and Mexico [44].

9.2 Lake Chad (Africa)

Lake Chad has shrunk by over 90% since the 1960s due to excessive irrigation, population growth, and climate change. These factors have led to severe water scarcity, affecting millions and contributing to socio-economic instability and conflict [45][46].

9.3 Lake Urmia (Iran)

Once the largest saltwater lake in the Middle East, Lake Urmia has drastically shrunk due to dam construction, water diversion for agriculture, and poor water management. The environmental and socio-economic consequences have been devastating for local communities [47].

9.4 The Ganges, Nile, and Yangtze Rivers

These iconic rivers are under severe stress:

- Ganges: Over-extraction, pollution, and glacial melting threaten water availability for millions in India and Bangladesh [48][49].
- Nile: Tensions over the Grand Ethiopian Renaissance Dam and climate change exacerbate water scarcity, threatening food security in northeastern Africa [50][51].

- Yangtze: Over-extraction, pollution, and the impacts of large-scale dams threaten the river's ecosystem and millions of livelihoods [52].

These global parallels highlight the urgent need for sustainable, integrated water management practices to prevent further environmental and human suffering.

10
Key Takeaways and Policy Recommendations

The Aral Sea crisis and the global parallels discussed in this report underscore the urgent need for proactive, long-term approaches to protect vulnerable freshwater systems. The following recommendations outline key strategies to improve water governance, environmental resilience, and equitable resource management in the face of increasing ecological pressures.

10.1 Plan with Ecosystems in Mind

Ensure water management policies are guided by the long-term sustainability of freshwater ecosystems. Short-term development goals should not outweigh the ecological balance necessary to sustain regional livelihoods and biodiversity.

10.2 Data Before Diversion

Implement real-time environmental monitoring and predictive modeling to guide water allocation and infrastructure decisions. Using accurate data can help minimize ecological damage and inform timely interventions.

10.3 Promote Climate-Smart Agricultural Practices

Adopt water-efficient irrigation techniques and prioritize crops that align with regional climate and water availability. This balanced approach supports agricultural productivity while mitigating stress on freshwater sources.

10.4 Prevention Over Restoration

Preventing ecosystem collapse through timely regulation and sustainable practices is more effective and economical than post-crisis restoration. Once water bodies degrade beyond a threshold, recovery is often slow, uncertain, and resource-intensive.

10.5 Integrate Climate Adaptation into Water Policy

Water management must account for shifting climate patterns, including rising temperatures and erratic precipitation. Infrastructure and policy frameworks should be designed to adapt to these changes and ensure water security in a warming world.

10.6 Human - Centered Water Policies

Incorporate the social impacts of water depletion such as health risks, livelihood disruption, and forced migration—into planning. Policies should aim to protect vulnerable communities and prioritize equitable access to water.

10.7 Unify Engineering, Governance, and Community Action

Technical solutions like reservoirs or canals must be supported by transparent governance and strong community engagement. Sustainable water management requires a collaborative model that combines infrastructure with inclusive policymaking and local participation.

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Annexes

A
Aral - Now

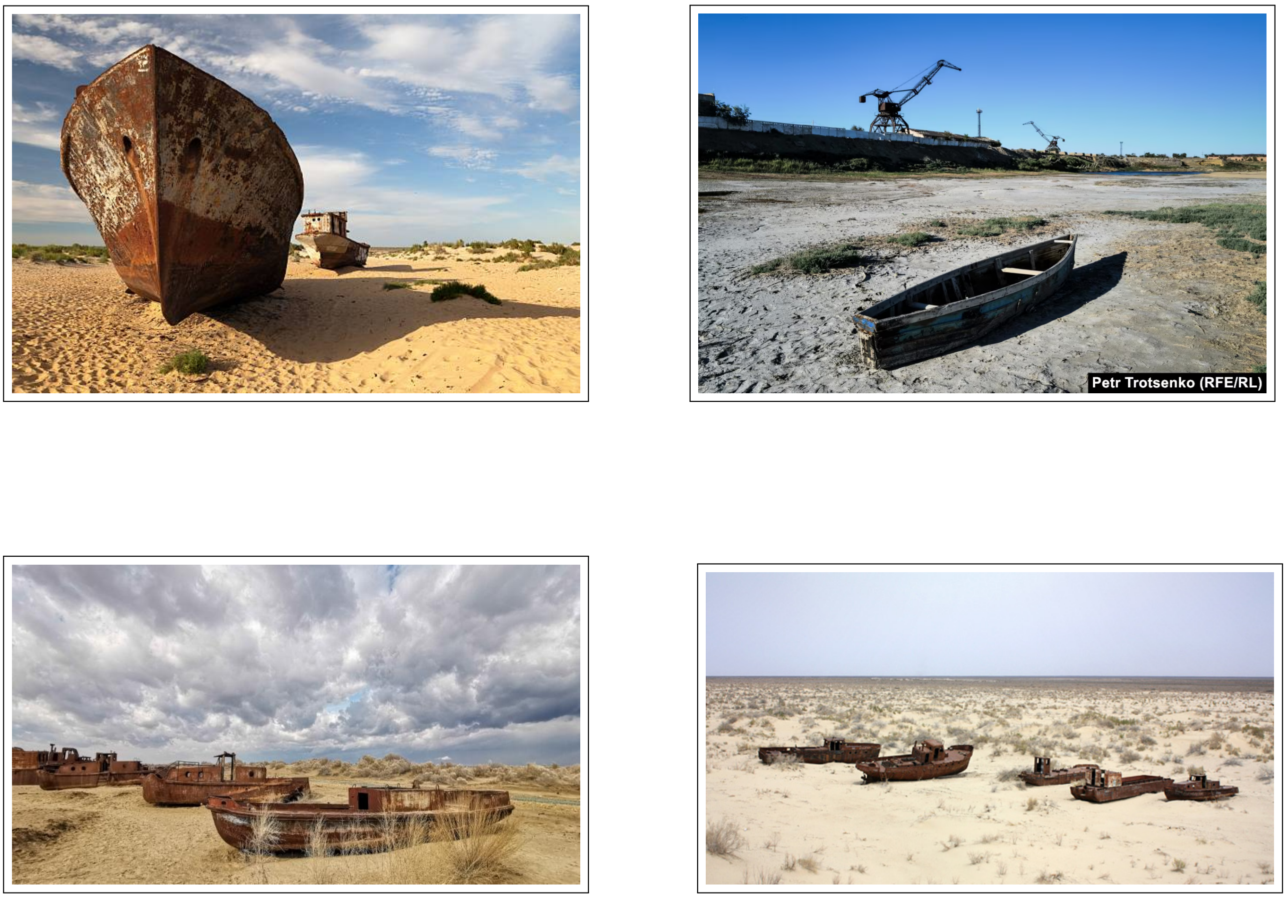

Figure A.1: *Abandoned vessels of the Aral Sea*

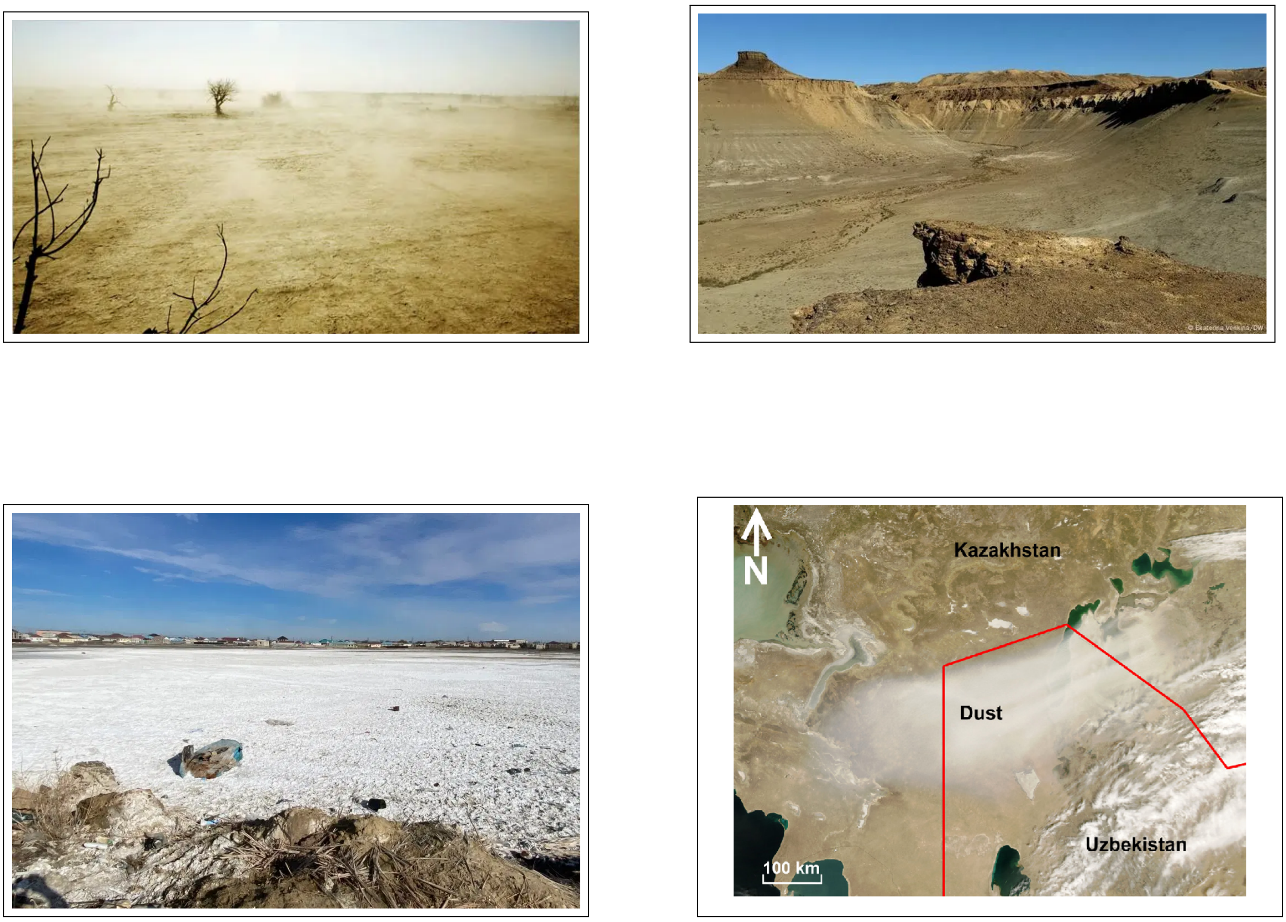

Figure A.2: *Current state of the Aral Sea, showing desiccated landscapes.*

B

Aral fish species that are now extinct or endangered

Figure B.1: *Three-spined Stickleback*

Figure B.2: *Amu Darya Sturgeon*

Figure B.3: *Aral Bream*

Figure B.4: *Albino Aral Barbel*

Figure B.5: *Shovelnose sturgeon*

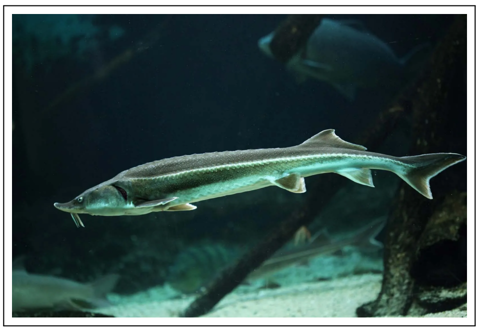

Figure B.6: *Sterlet Sturgeon*

C
Migratory birds stopped visiting Aral

Figure C.1: *Aral Phalarope*

Figure C.2: *Grey Heron*

Figure C.3: *Caspian Plover*

Figure C.4: *Dalmation Pelican*

Figure C.5: *Whooper Swan*

Figure C.6: *Little Grebe*

Table C.1: *Migratory breeding bird species and rare winter visitors*

Group	Species
Wetland-dependent birds	Mute swan (*Cygnus olor*)
	Mallard (*Anas platyrhynchos*)
	Gadwall (*Anas strepera*)
	Caspian gull (*Larus cachinnans*)
Coastal and island plain inhabitants	Black-bellied sandgrouse (*Pterocles orientalis*)
	Pallas's sandgrouse (*Syrrhaptes paradoxus*)
	Lesser short-toed lark (*Calandrella rufescens*)
	Calandra lark (*Melanocorypha calandra*)
	Shore lark (*Eremophila alpestris*)
Coastal and island outcrop inhabitants	Ruddy shelduck (*Tadorna ferruginea*)
	Shelduck (*Tadorna tadorna*)
	Jackdaw (*Corvus monedula*)
	Rock sparrow (*Petronia petronia*)

Table C.2: *Resident breeding bird species*

Group	Species
Plain inhabitants	Gray partridge (*Perdix perdix*)
	Crested lark (*Galerida cristata*)
	Pander's ground jay (*Podoces panderi*)
Riparian forest inhabitants	Common pheasant (*Phasianus colchicus turcestanicus*)
	White-winged woodpecker (*Dendrocopos leucopterus*)
	Magpie (*Pica pica*)
	Turkestan tit (*Parus bokharensis*)
Coastal outcrop inhabitants	Golden eagle (*Aquila chrysaetos*)
	Barbary falcon (*Falco pelegrinoides babylonica*)
	Eagle owl (*Bubo bubo*)
	Little owl (*Athene noctua*)
	Raven (*Corvus corax*)
Inhabitants of settlements	Rock dove (*Columba livia*)
	Collared dove (*Streptopelia decaocto*)
	Laughing dove (*Streptopelia senegalensis*)
	House sparrow (*Passer domesticus*)
	Tree sparrow (*Passer montanus*)

D
Fishing in Aral before the shrinkage

Figure D.1: *Fishing activities on the Aral Sea before its shrinkage, showing fishermen, boats, and typical catches.*

E
Moynaq

Figure E.1: *Landmark of Uzbekistan's infamous disaster-tourism destination*

Figure E.2: *Moynaq ship cemetery*

F
Invasive Species in the Great Lakes

Figure F.1: *Zebra mussels*

Figure F.2: *Quagga Mussels*

Figure F.3: *Round Goby*

Figure F.4: *Avian Botulism*

G
Ballast water discharge from ships

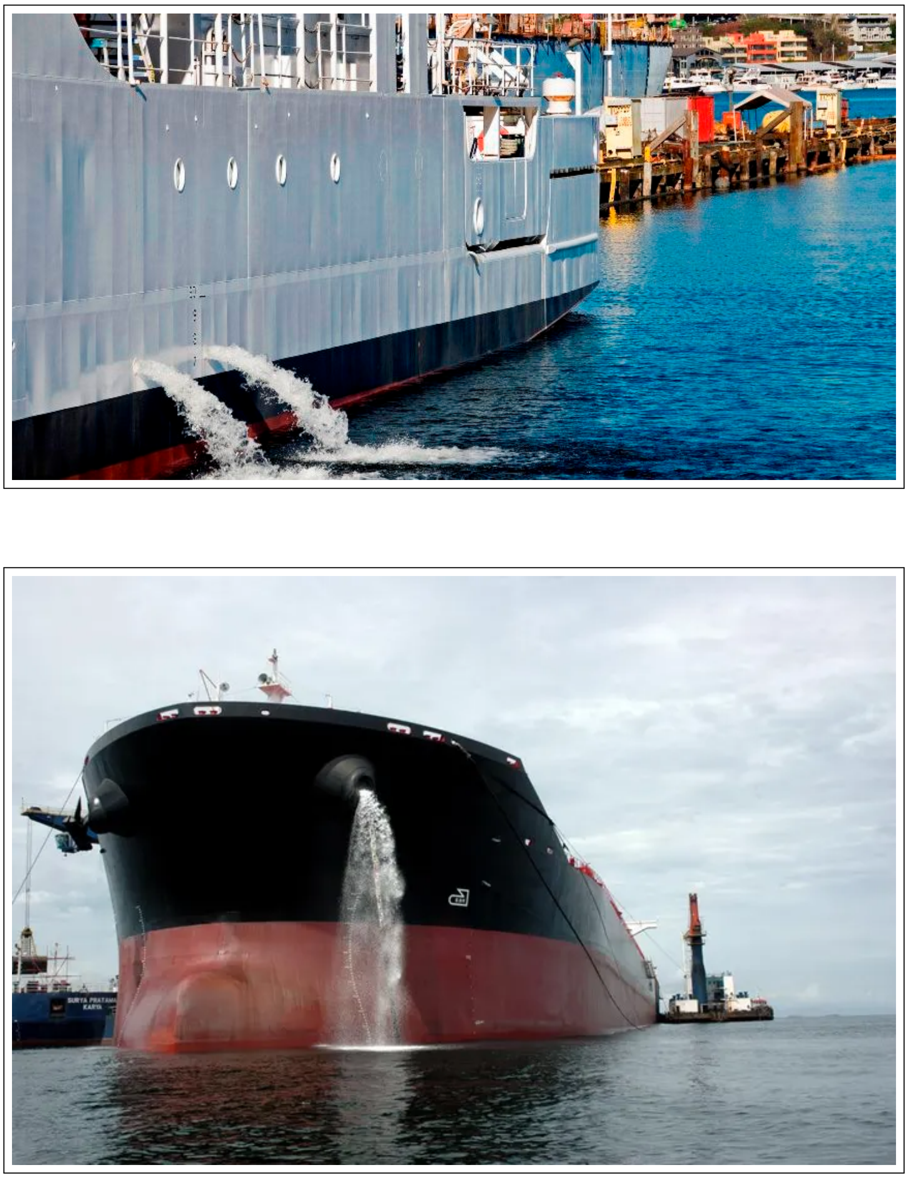

Figure G.1: *Ballast water discharge from ships during port operations.*

H
Lakes in distress

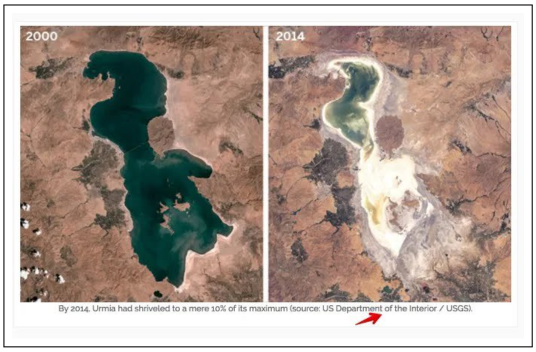

Figure H.1: *Lake Urmia*

Figure H.2: *Lake Yangtze Pollution*

Figure H.3: *Lake Chad*

Figure H.4: *Lake Powell*

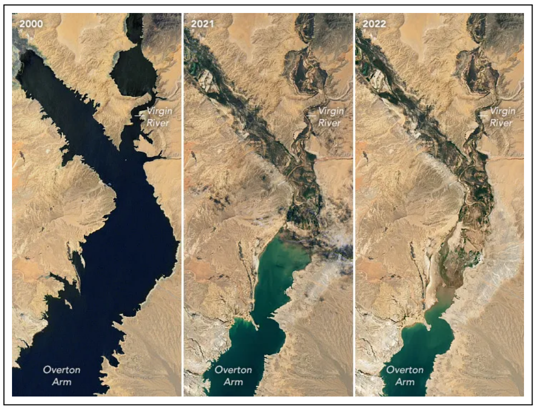

Figure H.5: *Lake Mead Shrinkage*

Figure H.6: *Grand Ethiopian Renaissance Dam*

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