8-6

The Aral Sea: An Ecological Disaster

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Executive Summary

The dimension of the human-induced ecological disaster in Central Asia is probably best illustrated in the desiccation of the Aral Sea. In 1960 this water body had a surface area of more than 68,000 square kilometers (km^2) and was the fourth-largest freshwater lake in the world. In 2009 only the "Small Aral," the western part of the "Large Aral," and a little pond from the eastern part of the "Large Aral" remained.

Much has been written and said on the causes and consequences of the vanishing Aral Sea. Numerous donors and international organizations have implemented more than 20 large-scale projects worth about US$500 million in the Aral Sea Basin (ASB). Concurrently, much research has focused on how to reverse the negative trend or mitigate its negative impact on the environment, economy, and health of the people. Nonetheless, the Aral Sea has not been restored. Worse, in the past decade the remnants of the Aral Sea have desiccated even faster than calculations and model simulations predicted. The complete loss of the economical use of the Aral Sea threatens the livelihood and health of the population. The disastrous degradation of the ecosystems has led to the virtual extinction of unique flora and fauna and to a dramatic increase in human illnesses such as respiratory diseases, hepatitis, and anemia. Have all of the research and the efforts to save the Aral Sea been in vain? Can the Aral Sea, or at least part of it, still be saved? Or must the local and global communities focus merely on mitigating the severe environmental and human consequences of the sea's desiccation? And if so, how?

Your assignment is to formulate policy recommendations for the riparian states in Central Asia to deal with the problems identified in this case.

Background

The Aral Sea lies between the two great deserts of Central Asia. Until the 1960s, the Aral Sea was the fourth-largest freshwater inland lake in the world, with a surface of 68,000 km^2 and a volume of 1,056 cubic kilometers (km^3). This water body annually yielded 40,000 metric tons[1] of fish, while the deltas of its major tributaries hosted dozens of smaller lakes and biologically rich marshes and wetlands covering 550,000 hectares (ha). The Aral Sea Basin extends not only to five Central Asian countries, but also to Afghanistan and a small part of Iran (Figure 1). The total area of the ASB is 180 million hectares, of which 7.9 million hectares are irrigated with more than 95 km^3 of water annually (Dukhovny and Sokolov 2003; Kijne 2005; Micklin 2008). Irrigation water is delivered through 323,000 km of canals (Orlovsky, Glantz, and Orlovsky 2000), and water outflow from irrigated fields is channeled through 190,000 km of drainage collectors and drains (Severskiy et al. 2005). Most of the people in the ASB reside within the area drained by the Syr Darya and the Amu Darya, the two rivers that once flowed into the Aral Sea and whose waters originate in the Pamir and Tian Shan mountains in Tajikistan, Kyrgyzstan, and Afghanistan.

Feeding Rivers and Water Supply

The size of the Aral Sea depends largely on the balance between inflows from the two main feeding rivers (Figure 1) and the sea's net evaporation (that is, the difference between evaporation from the sea's surface and precipitation) (Micklin 2008). The ASB is characterized by high evaporation and low precipitation (Jarsjö et al. 2008). For centuries, the freshwater from the two rivers kept the Aral's water and salt at tolerable levels. In the middle of the 20th century the Amu Darya had an average annual flow of 77 km^3 and the Syr Darya had a flow of 34 km^3, whereas water use in the ASB amounted to about 117 km^3 annually (Nandalal and Simonovic 2003). Between 80 and 95 percent of this water was used for irrigated agriculture and hence did not reach the Aral Sea (Kipshakbayev and Sokolov 2002; Horinkova and Dukhovny 2004; Severskiy et al. 2005).

The drive for economic development by the former Soviet Union starting in the second half of the 20th century triggered the expansion of irrigated (cotton) production. Large dams were built in the upper reaches of both feeding rivers,

[1] All tons in this case study are metric tons, unless otherwise noted.

Figure 1: The Aral Sea Basin

Source: Micklin 2008.

and a vast system of feeding canals was constructed to divert water to the most remote regions, mainly to enhance cotton production. The establishment of this impressive irrigation network added millions of hectares for agricultural production in this arid region.

The present water supply to irrigated areas in the ASB includes not only the actual water diverted from the rivers, but also drainage water resulting from agricultural return flow and wastewater. The remarkable increase in cotton production since the 1960s cemented a livelihood for many but depleted water supplies and neglected the preservation of precious natural resources: the entire ASB is at present saddled with a water and environmental crisis. From both a quantity and quality or safety perspective, the ASB now faces one of the world's most critical shortages of water resources, whether for irrigation or for drinking.

History of the Aral Sea

Historical, geophysical, and anecdotal evidence suggest that the "drying" of the Aral Sea must have occurred previously. It is argued that millions of years ago the northwestern part of present Uzbekistan and the southern parts of present Kazakhstan were covered by a vast inland sea (Oriental Express Central Asia n.d.). After the gradual receding of the water, a broad plain of highly saline soil became exposed, with a few remaining intermittent water bodies. One remnant of this ancient sea became the Aral Sea.[2] The evidence further shows that in the past 9,000 years the surface has been completely or partly flooded and desiccated at least eight times (Aladin and Plotnikov 1995; Aladin, Micklin, and Plotnikov 2008). At times, the level of the Aral Sea has fluctuated by up to 30–35 meters. All previous episodes of desiccation have been caused by climatic alteration and natural diversions of the feeding rivers away from the sea. The potential role of rainfall variations is unclear, yet there is a consensus that they played a smaller role than the migration of the rivers (Kes and Klyukanova 1990). Anthropogenic contributions to the dying of the sea are also undeniable. Starting about 3,000 years ago, the region's population increased and irrigated agriculture commenced, leading to sizable withdrawals and diversions of river water for irrigation (Micklin 1988).

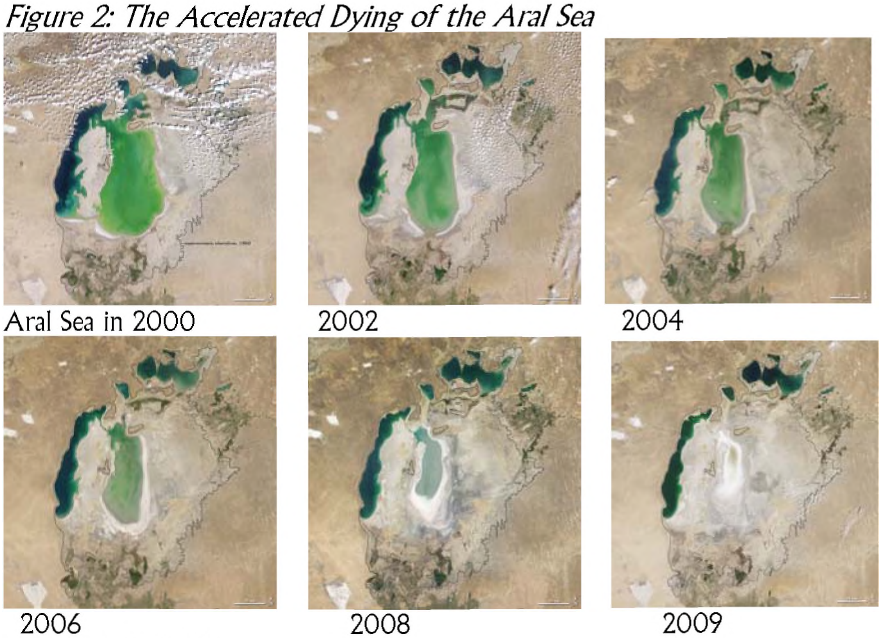
[2] The sea was called the Aral Tengizi ("Sea of Islands" in Kazakh) because it used to contain more than 1,000 islands.

The most recent recession of the Aral Sea, however, dwarfs the previous events. In the past century two short periods of record high flows were offset by three longer dry spells in the 1960s, the mid-1970s, and the early 1980s. Although the most recent desiccation may be partly natural in origin, stemming from droughts or even climate change, it has also resulted from human mismanagement of water and ever-increasing water withdrawals since the 1960s from the Amu Darya and Syr Darya rivers for the production of "white gold"—cotton (Micklin 1988; Brookfield 1999). The combined effects of natural and human causes have provoked the dramatic decline of available water resources, which in turn has resulted in the present shrinkage of the Aral Sea (Saiko and Zonn 2000).

Recent Shrinkage of the Sea

In 2004 the remainder of the Aral Sea's surface amounted to about 17,000 km^2, or 25 percent of its size in 1960. The water volume had decreased by 80 percent, whereas the salt concentration had increased at least five times, eradicating unique flora and fauna and preventing the survival of most of the sea's fish and wildlife. Furthermore, during this process the large sea separated into smaller water bodies: the North or "Small" Aral in Kazakhstan and the "Large" Aral in Uzbekistan, which later became the "West" and "East" Aral (Micklin 2008). The desiccated sea floor created a new desert called the Aralkum Desert. By 2007 the sea's area had further shrunk to only 10 percent of its size in the 1960s, and the salinity of the remaining sea surpassed 100 grams per liter. With continuing water withdrawals from the feeding rivers, the sea was expected to contract even further by the second or third decade of the 21st century, but a changing climate has sped up the drying even further. In 2009 the eastern part of the "Large Aral" turned into a pond (Figure 2) and the western part also shrank considerably. In contrast, concerted efforts by the Kazakh government and international organizations restored the "Small Aral," through the construction in 2005 of the 13–kilometer-long, US$85.5 million Kok-Aral Dam and dike, which presently regulate the flow from the Small into the Large Aral. Underground water discharge from the original sources may find its way to the sea through geological layers. Yet with an estimated 4 km^3 of water per year, this underground inflow will not stop, let alone reverse, the desiccation.

Figure 2: The Accelerated Dying of the Aral Sea



Source: NASA 2010.

Drastic Consequences

The Aral Sea crisis has reached international dimensions, and the environmental costs of the drying of the Aral Sea are enormous. The receding of the water line has exposed previously deposited salts, pesticides, and toxic substances (Micklin 2008) that are picked up by swirling winds and transported over unknown distances. The return of the polluted drainage water to the rivers has degraded the livelihoods, health, and living habitats of people in the ASB. The Aralkum Desert has become a source of toxin-laden dust storms, and inhabitants in the vicinity of the Aral Sea have experienced a dramatic rise in respiratory diseases, hepatitis, and anemia (Micklin 2008). The delta ecosystems have deteriorated considerably: by 1990 more than 95 percent of the marshes and wetlands had given way to sandy deserts, and more than 50 delta lakes, covering 60,000 ha, had dried up. Overgrazing and unsustainable agricultural practices contributed to this dismal situation.

In the past, the Aral Sea regulated or mitigated the cold north winds from Siberia and reduced the summer heat. The drying of the vast Aral Sea has thus resulted in climate changes—dryer, shorter summers and longer, colder winters. The effective growing season has been reduced from about 220 to 170 days; pasture productivity has decreased by half; the destruction of vegetation has decreased meadow productivity by a factor of 10 (Kumar 2002; Abdulkasimov, Alibekova, and Vakhabov 2003).

The falling water level and increasing water salinity have decimated the once-flourishing fishing industry that supported the local population. Millions of inhabitants have emigrated, unable to cope with the loss in jobs and increasing poverty. The accumulated annual losses from the decline in economic activities were estimated at US$115 million, in addition to annual social losses estimated at about US$28.8 million over the past two decades (CAWATER n.d.).

The population in the ASB now faces critical challenges, such as ecological and economic instability, uncertainties related to ongoing climate change, and degradation of land and water resources, all leading to a worsening of livelihood conditions. To arrest or alleviate these negative trends, the region needs to implement a sustainable development strategy that departs from the present situation. But what should be the basis of such a concept? Can the sea be refilled and its economic, social, and ecological services reclaimed? If so, at what cost and financed by whom? Or should concerted efforts of the global community focus instead on adapting to the consequences of the crisis? Such an approach may be easier to finance, but would it be sufficient from an ecological viewpoint?

Policy Issues

"If everyone who came to study the Aral Sea had brought a bucket of water, the sea would be full by now"—this is the cynical comment made by people in the vicinity of what is left of the Aral Sea. This comment reflects their perspective on recent research efforts, which have been mainly short term in nature and of little benefit.

Starting in the 1970s, several Soviet government commissions carried out reclamation measures to prevent a further lowering of the sea level or at least to mitigate the social, economic, and ecological impacts. Water management and coordination tasks were assigned to specially established river basin organizations of the Amu Darya and Syr Darya Rivers, to an organization called Aralvodstroy mandated to conduct scientific and technical research and undertake measures for improving ecological and sanitary conditions in the Aral Sea area, and to the Aral Consortium, consisting of the governments of Uzbekistan and Karakalpakstan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and the regional (local) authorities of the Aral Sea area (Schutter and Dukhovny 2003). By the end of the 1980s, various projects in the Amu Darya delta had been implemented, including the creation of reservoirs like the seven-square-kilometer Tuyamuyun. Following the collapse of the Soviet Union, however, water management in the ASB became more complicated because there was no formal system for resolving conflicts among the five newly independent Central Asian states. The breakdown of the former Soviet Union also ended the specially developed "water-energy nexus" between up- and downstream countries in Central Asia. Since independence in 1991 in particular, the upstream countries have pursued self-sufficiency in energy based on hydropower. To satisfy their domestic energy demands, these countries have released large quantities of water in winter, which in turn decreased the irrigation water supply during the growing season in the downstream countries. Interstate disputes over water allocation between the riparian countries recur annually, despite the acceptance of a Framework Agreement for the Sry Darya River in 1998 that recognized the water-energy nexus (Horinkova and Dukhovny 2004).

Following independence in 1991, the Central Asian states inherited the agricultural production systems developed during the Soviet era, including the intensive irrigation network. But the legacy also included a rather fragile and degraded landscape. Outdated Soviet principles of water allocation and management (UNESCO 2000) were transferred to the newly established Interstate Commission for Water Coordination (ICWC). The ICWC was tasked with regulating water distribution in the ASB and consolidating country positions on a regional water strategy with the support of international organizations and bilateral agencies. In time, various structures were set up for the management of the ASB water resources—the Interstate Council on the Aral Sea Problems (ICAS), a high-level body charged with recommending actions to the governments of the riparian states; the Executive Committee of the ICAS; and the International Fund for the Aral Sea (IFAS), a high-level body in charge of the financing of the ICAS (FAO 1998; Roll et al. 2004). In 1997 the ICAS and the IFAS were merged into a restructured IFAS—International Fund for Saving the Aral Sea—which has a hierarchical structure (see the Annex) and is charged with making decisions on water and the environment in the ASB.

Despite the concerted efforts and the progress achieved in regional cooperation in the ASB, and despite agreements and conventions and established institutions, the impact of interstate cooperation cannot yet be seen on the ground. It is now recognized that effective interstate cooperation requires an understanding of the roles of riparian states, the elaboration of a comprehensive and multilevel legal and institutional framework for intergovernmental cooperation, and the development of a political process in support of cooperation based on the principle "regional cooperation interests are above the national interests" (Roll et al. 2004, 8). Successful interstate cooperation will require involving not only the national administrations, but also various other stakeholders: national stakeholders, international stakeholders, research organizations and researchers, and the regional population.

Stakeholders

National Stakeholders

Stakeholders at the national level include the prime decision makers in the countries within the ASB, including Afghanistan (the latter currently diverts hardly any water, but existing agreements concluded during the Soviet period foresee a certain share of total water use for Afghanistan).

Certain lower-level authorities in the Central Asian countries are stakeholders with regard to water allocation and distribution: agricultural ministries, river basin organizations, water users associations, and nongovernmental organizations (NGOs), especially in Kazakhstan and Uzbekistan, focusing on education, health, and awareness building among the ASB population.

International Stakeholders

Stakeholders at the international level in the ASB are represented by the IFAS as well as donor agencies and the international projects they support. These agencies include the Regional Environmental Center for Central Asia, which receives support from international agencies to implement NGO development, environmental management, and environmental education (Roll et al. 2004). The Central Asian Global Water Partnership (GWP) has a mandate to initiate multistakeholder cooperation in the region. It is developing a regional network for sharing information and knowledge and for involving stakeholders—NGOs, representatives of economic sectors, researchers, and others—in water cooperation.

Researchers and Research Organizations

Research organizations are crucial for increasing understanding and awareness and developing sustainable strategy options for coping with the Aral Sea problem, water management, and transboundary cooperation in the ASB. These organizations have garnered support from international finance institutions (the World Bank, the Asian Development Bank, the U.S. Agency for International

Development), multilateral organizations (the United Nations Educational, Scientific, and Cultural Organization [UNESCO], the United Nations Children's Fund [UNICEF], the United Nations Development Programme, the North Atlantic Treaty Organization [NATO], the European Union's Technical Assistance to the Commonwealth of Independent States [TACIS] programme), and the governments of individual countries (Finland, Japan, the Netherlands, Sweden, and Switzerland). In addition, the German Ministry for Education (BMBF) has supported research on policy so that scientists and involved stakeholders can together design and implement a sound management plan for the ASB and its transboundary waters.

The Population of the Aral Sea Area

A crucial group of stakeholders is obviously the population living in the vicinity of the remnants of the Aral Sea, including Karakalpakstan and the Khorezm region in Uzbekistan, and south Kazakhstan. The population directly affected by the Aral Sea crisis is estimated at about 5 million people, of whom about 70 percent live in rural areas. These rural people include fishers who depended on the sea for income and farmers who depend heavily on the rivers for irrigation. The fishing industry was ruined by the drying of the sea, but the rivers still contain enough water to allow farming activities.

Lessons Learned

International institutions (such as the World Bank, the Asian Development Bank, the United Nations Development Programme, and UNESCO) and others have launched various initiatives and provided financial support to assess the problems of the Aral Sea region and to seek solutions. Nevertheless, after years of rescue missions, the Aral Sea remains the worst human-caused ecological disaster in the world. It is a classic case of too many stakeholders, many of whom have entered too late with scarce resources. At the same time, the many interests represented do not necessarily include environmental concerns.

Cooperation among stakeholders and donors has been only modestly successful because of their diverse political agendas and interests. Stakeholders and donor agencies must better coordinate and streamline their efforts (Roll et al. 2004). Since the late 1990s, numerous donors have come to this "disaster epicenter," with more than 20 large-scale projects ongoing or in the pipeline with a total portfolio of about US$500 million. These projects focus on technical assistance and give less priority to changing the general mindset, creating awareness, and developing institutional frameworks for integrated interstate water cooperation and management. Thus, the changes that have taken place in the ASB have not led to reduced water consumption or stopped the ongoing disappearance of the Aral Sea. Although at present it hardly seems possible to reverse the ecological crisis in the ASB, legal, administrative, and economic reforms would be prerequisites for any feasible options for action (Martius et al. 2004).

Policy Options

Responses to the destruction of the sea can be divided in two categories: (1) refilling and restoring the sea; and (2) taking no action and letting "nature" run its course.

Refill or Restore the Sea

One solution is to increase the flow of water into the sea. Restoring the sea to its size of 1960—53 meters above sea level—would require at least 73 km^3 of water to be discharged to the Aral Sea annually for a period of at least 20 years. Kienzler (2005) estimated that this period would be 24 years, assuming that only Amu Darya River water would enter the sea and that Uzbekistan would withdraw no water for irrigation, household, and industry uses. Refilling the Aral Sea to its volume of the 1980s would require a ban on water withdrawal from the Amu Darya River for 6–10 years (Kienzler 2005). But the current combination of low water flow into the Aral Sea and high evaporation precludes filling the Aral Sea to any volume registered in the past.

Restoring the sea to the size of 41,000 km^2, as in 1987, would require a river inflow into the sea of around 30 km^3 annually. Some observers consider this level of inflow feasible if irrigation withdrawals from the feeding rivers are markedly reduced. Practical solutions, varying in feasibility and cost, range from lining canals to adopting water- and soil-conserving agricultural cultivation methods. Improved irrigation techniques, improved and more targeted water management, and the cultivation of crops that require less water have all been suggested. These options for action can be grouped into four clusters: (1) technical solutions; (2) diversion from elsewhere; (3) institutional solutions; and (4) political solutions.

Technical solutions. Because irrigated agriculture consumes about 80–95 percent of all water resources (Kipshakbayev and Sokolov 2002; Horinkova and Dukhovny 2004; Severskiy et al. 2005), efforts to improve water management must predominantly address agriculture in the ASB. Irrigated agriculture is the lifeline for the region's population and essential for the economies of all riparian states. Most of the water from the two feeding rivers is diverted to agriculture through an extensive irrigation network. Most of these canals are, however, poorly built, and 70 percent of them are unlined (Kijne 2005). In Uzbekistan alone, only 12 percent of irrigation canals are "waterproofed" and much irrigation water just seeps out and adds to groundwater stock. At the same time, the average efficiency of irrigation systems (the ratio of water used productively in fields to headwork withdrawals) in the ASB remains low (Kijne 2005; Bekchanov, Lamers, and Martius 2010). Only about one third of water withdrawn from rivers for irrigation reaches farmers' fields directly.

Some experts consider upgrading the irrigation system to be a better investment than restoring the Aral Sea. They estimate that 10–22 km^3 of water a year could be saved by rehabilitating and renovating irrigation systems and lining canals with concrete (Micklin 1988). Yet these actions are not easy to achieve. Lining the many kilometers of the canal system with concrete would require enormous human resources and cost an estimated US$16 billion (Micklin 2002). Alternatively, cutting river water withdrawals could be achieved by reducing the scale of irrigated agriculture, improving watershed management, introducing water-wise technologies such as drip or subsoil irrigation, or eliminating water-intensive, low-margin crops.

A recent in-depth study by the Center for Development Research (ZEF) of Bonn University, Germany, examined the potential benefits of using water-wise technologies in the Khorezm region of northwest Uzbekistan. All water-wise options can contribute to reducing irrigation water demand. The study estimated that these technologies could save 1.5–3.0 km^3 (or 7–16 percent of total water consumption) in this region of 270,000 ha (Bekchanov, Lamers, and Martius 2010). Yet the application of water-wise technologies will not automatically increase profits because it may require additional investments and labor costs. For example, farmers could achieve potentially high water savings by switching from paddy rice to maize and aerobic rice, but at the same time, these changes could substantially decrease farmers' incomes because the new crops have lower yields than paddy rice. Applying animal manure to cotton, wheat, and potatoes has the potential to conserve more than 1 percent of the water presently applied and increase profits through higher yields. Improved ways of applying irrigation water, such as double-sided furrow irrigation,[3] alternate dry furrows, and shorter furrows, were estimated to save at least 0.4–0.9 percent of the total water applied, with relatively low investments required. The application of drip irrigation could reduce water inputs by up to 70 percent. This technology is financially attractive for cash crops but not for staples. Consequently it is feasible for less than 1 percent of land area and would lower water demand by about 0.13–0.18 percent. Laser-guided land leveling can reduce surface and flood irrigation applications in the field by up to 30 percent (Egamberdiev et al. 2008).

Results from an analysis of the cotton value chain in the Khorezm region (Rudenko, Grote, and Lamers 2008) showed that there is potential to reduce water use in agriculture by introducing agroprocessing facilities that would, for example, manufacture cotton into ready-made garments. By shifting from merely producing cotton to processing textile products, the region could secure the same export revenue from the cotton value chain while reducing its production of cotton. This approach would release 69 percent of land currently used for cotton production in Khorezm while demanding about 0.5 km^3 less water for irrigation annually and reducing the need for subsidies by US$14 million annually (Rudenko, Grote, and Lamers 2008).

Realizing changes in water use in the field will require supporting measures, such as effective and extended consulting as well as financial support and

[3] Double-sided furrow irrigation involves applying irrigation water from both sides of the furrow at the same time, leading to more uniform application of water over the length of the furrow.

advisory services for farmers to disseminate knowledge. It will also require improving access to credit so that farmers can invest in water-wise technologies, and this will in turn require improvements in the banking system. All riparian states will need to exhibit strong political will and commitment to reducing irrigated areas or switching to less water-demanding—and less profitable—crops.

Diversion of water from elsewhere. One alternative to maintaining or increasing water availability in the rivers that feed the Aral Sea is to import water from other regions. In the 1970s and early 1980s, Soviet research institutes proposed transferring part of the flow of the northern Volga and Ob-Irtysh Rivers from Siberia about 2,500 km south to the Amu Darya River and the Aral Sea (Figure 3).

Both rivers are far larger than the Amu Darya and Syr Darya. The Volga, which flows into the Caspian Sea, has a flow of about 240 km^3 of water a year. The Ob-Irtysh, with a flow of around 385 km^3 a year, flows north into the Arctic Ocean. Because water in these rivers exceeds the water needs of Siberia, it was suggested that 10 percent of their flows be diverted to the Aral Sea annually (Ring 2004).

The project's first stage, aimed at providing 27 km^3 of water annually, was scheduled for implementation by the late 1980s and 1990s and included the construction of a system of low dams, pumping stations, and a huge "Sibaral" canal. But in 1986 construction and design work ceased, primarily because of high costs, but also because of the protests of Soviet scientists and intellectuals, who argued that the project would cause severe ecological and cultural damage. With the breakup of the Soviet Union, the plan was shelved, although the idea has recently been reassessed by various stakeholders. In the view of opponents, monetary costs and, more important, environmental costs and risks are high. The diversion of massive amounts of water (60–100 km^3 annually) from Siberian rivers for 30 years (the amount of time required to fill the Aral Sea) was estimated to cost US$30 billion (Temirov 2003) to US$50 billion (Ring 2004), plus

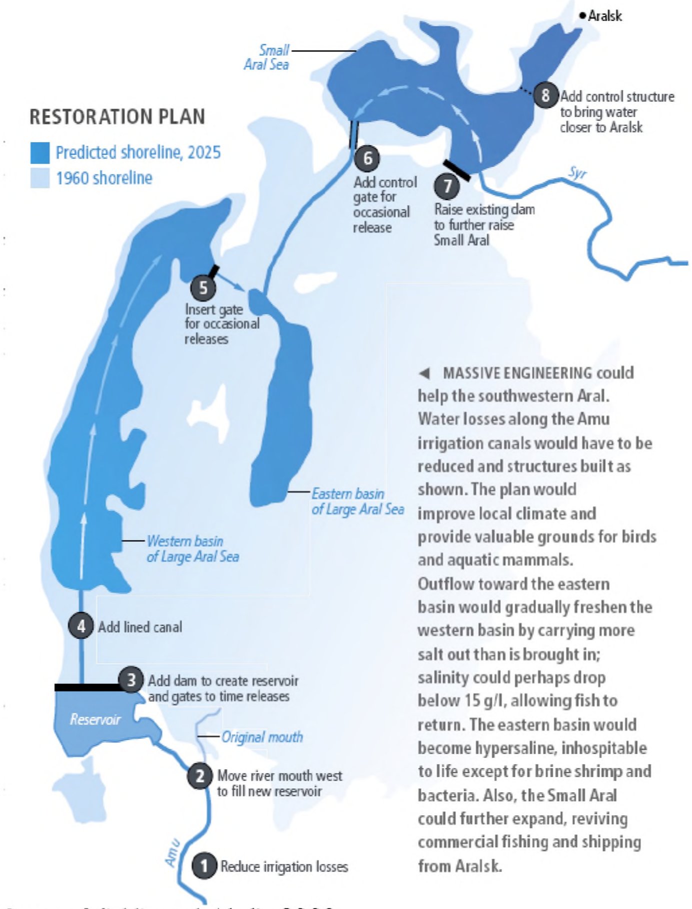
Figure 3: Options for Diverting Water from the Volga and Ob Rivers to the Aral Sea

Source: Ring 2004.
Note: Yellow areas = elevation over 200 meters.

a mammoth amount of energy.[4] This energy would have to be generated with nuclear power unless highly efficient transmission lines could be built to import electricity. A nuclear power plant for the pumps could cost up to an additional US$5 billion. Even aside from the potential threats of a nuclear plant in the ASB, the environmental costs of changing natural river flows and the impact on the ecology of the Siberian plain cannot really be predicted. In addition, it is not clear that sufficient funds could be accumulated from riparian states and international funding organizations to sponsor this plan. Still, supporters of this option point to positive environmental effects: the ASB would be turned into a region suitable for fishing, agriculture, and forestry in about 25–50 years (Ring 2004). In addition, the banks of the Caspian Sea, which are presently threatened by inundation that endangers centuries-old cities, could be saved from the rising waters of an overabundant Volga River. Finally, as fresh water is removed from the Arctic Ocean (from Ob-Irtysh River), the gulfstream current could be preserved (Ring 2004).

These options for refilling the Aral Sea require not only huge financial and labor resources, but also a change in people's mindsets and perceptions of the natural flow of things. Micklin and Aladin (2008) recently proposed an expensive but easier plan to rescue the western part of Large Aral rather than trying to refill the whole sea. According to this plan, water losses along the Amu Darya River would have to be reduced through irrigation improvements. Increased water flow then would be directed through an artificial channel to the west and collected in a reservoir for further controllable release to the western Large Aral (Figure 4). Micklin and Aladin (2008) suggested that the plan would improve local climate and provide valuable grounds for birds and aquatic mammals. In addition, water salinity would drop below 15 grams per liter, allowing fish to return.

Figure 4: Restoration of the Western Large Aral Sea



Source: Micklin and Aladin 2008.

Institutional solutions. Water use could be reduced through a system of incentives based, for example, on the introduction of water rights and water fees both at the user level (farmers) and at a higher level (governments of riparian states). Currently, irrigation water in the ASB is delivered to farmers without direct fees but with low indirect fees not associated with its use. Introducing water charges and creating a water market in riparian states may lead to more efficient water use by farmers for irrigation and could help save more water at the regional level.

[4] Every km³ of water lifted 300 meters will require giant pumps and pipes and 124 megawatts of power year-round.

Another solution is to reduce or even abolish irrigated agriculture in the ASB, at least for a period of time, to allow water from the two feeding rivers to flow to the sea. No agricultural crops could then be produced to feed people or generate income for the rural population, so the international community, for example, would have to compensate farmers for not cultivating. Compensating rice and cotton farmers in the ASB for not cultivating their crops has been calculated to cost US$30 million annually for a rather long period. They could use these compensation payments to buy or import food crops, such as rice. This option would release enough water to double the present annual flow into the Aral Sea. The funding could come, for example, from the major environmental organizations, which spend many times that amount of money each year on marketing and legal fees, or from the corporate world, which could be convinced to spend US$30 million annually for environmental considerations (Ring 2004).

Political solutions. Political options could also be used to achieve more efficient monitoring and controlling of agreements on water use by all riparian countries. Existing agreements do not ensure proper water use and control. Water flows to the sea are not ensured, and emergency conditions are created (Nandalal and Simonovic 2003). Yet riparian countries do understand the urgent need to collaborate as partners to solve water management issues and cope with the Aral Sea problem. These countries have drawn up several water-sharing agreements on sustainable use of available resources, improvement of water quality, and avoidance of harm to the well-being of the countries because of water policy. But on several points these agreements are still ambiguous. Furthermore, the political and economic interests of the countries often differ greatly from each other and from the agreements' objectives. Clear identification of water rights among the countries and an assurance of adherence to agreements can help. Also, the introduction of defined water quality standards or of a "polluter" tax may significantly affect water use. But finding a strategy for cost recovery requires a willingness of water users to pay; taxes tend to exhibit high price elasticity (so people tend not to pay if taxes are too high) and farmers do not always see the corresponding benefits in the short run.

Take No Action

A second group recommends taking no action to refill the Aral Sea, but rather easing the consequences. Many ASB residents, especially the elderly and the religious, believe based on historical evidence that the present demise of the sea is a recurrent event and that no active interventions are needed to refill it. They favor letting "nature" follow its course. Certain actions appear necessary, however, to help the inhabitants of the ASB cope with the degraded environment (climate, air, water, and soil), health problems, and poor livelihood and income-generating possibilities. This group advocates using huge financial resources to improve present-day life rather than investing in the uncertain future of the sea. Regional organizations and international donors have already devoted substantial funds to programs to improve the health and welfare of the local population. Attempts to mitigate the effects of desertification include afforestation of the newly exposed seabed. At the same time, coping strategies should be financially feasible and doable. They could have a major impact in the region.

Some researchers argue that instead of spending enormous amounts of energy, research, and funds on the long-term and potentially unsuccessful restoration of the sea, it would make more sense to improve the ecosystem in the ASB by rehabilitating wetlands and numerous smaller water bodies. This effort would preserve what is left of the Amu Darya and Syr Darya deltas, as well as strengthen ecosystems and biodiversity, as was achieved by the Sudoche Lake Rehabilitation Project initiated in 1989.

One more issue guiding the supporters of the "take no action" plan is the recently discovered large deposits of gas and oil in the Aralkum. Extraction of these resources would render Uzbekistan among the major players in the global power sector in the coming years. Hence Uzbekistan shows little interest in reducing the diversion of the Amu Darya River for irrigated agriculture, but instead intends to explore for oil in the drying South Aral seabed (Fletcher 2007). Not refilling the sea will make the extraction of gas or oil for Uzbekistan less expensive and less labor- and technology-intensive than it would be on a refilled seabed. It is far from clear, however, what the consequences of oil and gas exploitation would be for the Aral Sea.

Assignment

Your assignment is to formulate policy recommendations for the riparian states in Central Asia to deal with the problems identified in this case.

Additional Readings

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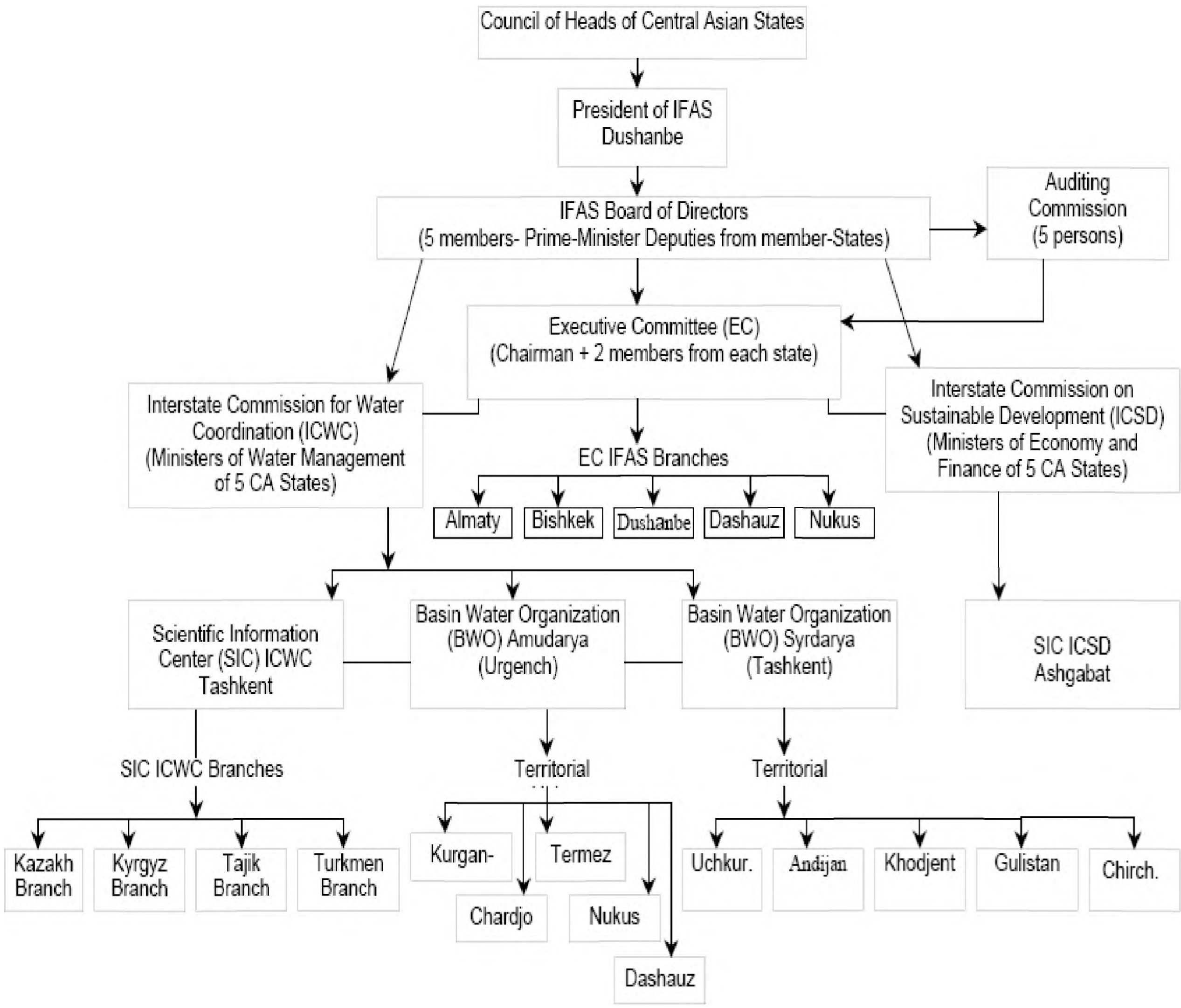
Annex.

The Structure of the International Fund for Saving the Aral Sea (IFAS)



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