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Aral Sea Basin: A Sea Dies, a Sea Also Rises

The thesis of this article is quite different from many other theses of papers, books, and articles on the Aral Sea. It is meant to purposely highlight the reality of the situation in Central Asia: the Aral Sea that was once a thriving body of water is no more. That sea is dead. What does exist in its place are the Aral seas: there are in essence three bodies of water, one of which is being purposefully restored and its level is rising (the Little Aral), and two others which are still marginally connected, although they continue to decline in level (the Big Aral West and the Big Aral East). In 1960 the level of the sea was about 53 m above sea level. By 2006 the level had dropped by 23 m to 30 m above sea level. This was not a scenario generated by a computer model. It was a process of environmental degradation played out in real life in a matter of a few decades, primarily as a result of human activities. Despite wishes and words to the contrary, it will take a heroic global effort to save what remains of the Big Aral. It would also take a significant degree of sacrifice by people and governments in the region to restore the Big Aral to an acceptable level, given that the annual rate of flow reaching the Amudarya River delta is less than a 10th of what it was several decades ago. Conferring World Heritage status to the Aral Sea(s) could spark restoration efforts for the Big Aral.

BIOGRAPHY OF THE ARAL SEA

The name Aral Sea comes from the Turkic word "aral" meaning island. The sea's name reflects the fact that it is in a vast basin in Central Asia and lies as an island sandwiched between two deserts, the Karakum and the Kyzlkum. The Aral Sea is really a lake by strict definition based on its physical characteristics. It is fed primarily by Central Asia's two major rivers, the Amudarya and the Syrdarya. During the past 35 000 years, its level has varied widely. In 1960 its level was about 53 m above mean sea level. Its salinity was about 4 g L^{-1}, and it was the habitat for several endemic species of fish and wildlife. Today, the levels of what are essentially its three components vary, with the lowest part having dropped by at least 23 m.

The Aral Sea was once the world's fourth-largest inland sea. Its surface area once measured 66 100 km^2 (25 521 square miles). Its problems began in the 1960s and 1970s with the diversion of the main rivers that feed it. In addition, there is a third major river in Central Asia, the Karakum Canal. This is, in essence, a manmade river, much of which is an unlined canal dug out of the desert sands, the construction of which began in the mid-1950s. By 1987, the Aral Sea had lost about 60% of its volume, its depth had dropped by 14 m (45 feet), and its salt concentration had doubled, killing the commercial fishing industry. Wind storms carried toxic dust onto farms a few hundred kilometers downwind, carrying fine grains of pesticide- and herbicide-laden dust that had been deposited for decades on the newly exposed sea floor. Life expectancies in the districts near the sea are significantly lower than in surrounding areas. The sea is now a quarter of the size it was 50 years ago and has broken into several parts, the North Aral Sea and the South Aral Sea (which is nearly separated into two parts). Re-engineering a barrier to separate the Little (North) Aral from the Big Aral has served to retain water in the North Aral Sea.

The region was under the control of the Soviet Union from the mid-1920s until 1991. Borders between the various Central Asian republics were drawn by the Politburo in Moscow. Climate and soils were excellent for cotton production (Fig. 1). Interestingly, since 1908 (Tsarist times) the sea was seen as a useless body of water, except for navigation, that could be exploited for agricultural activities (1). Two decades later, Tsinzerling (2) developed feasible scenarios for sea level drop and its impacts on society based on the various levels of withdrawals from the rivers. In retrospect, his scenarios and concerns about declining sea level proved quite reliable. Considerable opposition to sharply increasing diversions of the rivers' waters was expressed by Soviet geographers as early as the 1970s (3).

ARAL SEA: FROM SCIENCE TO POLICY

The science related to the Aral Sea is actually quite easy to understand, as complex as its components and their interactions might be. Many studies for at least half a century have provided researchers with considerable amounts of data relating to the climate, water, and soils (e.g., 4). The hydrological balance is known, as are the many ways that settlements have interfered with or disrupted it (5). Clearly there has been more water leaving the Aral Sea than entering it (through sea water evaporative processes and water diversion to an adjacent basin). Cotton has been blamed for the demise of the sea and the poisoning of the water and agricultural lands. Fertilizers, herbicides, and pesticides were applied to the cotton fields in great amounts, based on the assumption that if a little amount did some good, then a lot would do even greater good for cotton production. It was revered as a crop and for its high level of production in the region.

Little, if any, political attention was paid, however, to the environmental costs associated with the long-term environmental and societal consequences of cotton production. Quotas set in Moscow drove regional political leaders and collective farm managers to push hard on the workers to meet the unrealistic quotas, quotas that were often met only on paper. There are many documented accounts about how the cotton production statistics were manipulated to please the Politburo thousands of kilometers away from Central Asia.

Admittedly, it is easy to sit in an armchair far away from Central Asia and advise the leaders of the Central Asian Republics about the need to break their dependence on cotton or to use water more efficiently. It is also easy to tell them that they must cooperate on issues related to the efficient management and use of basin-wide water resources and water supply. But making the needed drastic changes is much easier said than done.

To be fair to policy makers in these relatively new countries, problems related to the Aral Sea and its environment are not the only ones that they had to face. Recall that the sea had been dropping slowly over time and not changing in notably sharp, step-like increments. While these hardly noticeable changes were underway, leaders also had to contend with many urgent issues. Under "normal" conditions, the five Central Asian Basin states (and Afghanistan) were clearly operating in a multi-

Figure 1. Uzbek stamp from 1957, highlighting the importance of cotton.

stressed political and economic environment. Table 1 lists many of the stressful concerns and is not in order of priority.

THE ARAL SEAS: ETHICS AND EQUITY

It is easy to identify numerous ethical and equity issues that surround the half-century decline in the level of the Aral Sea, in the degradation of the water and soil quality, in the decline in human well-being and health conditions, and in the choices made as to how, what, and why to develop the Central Asian Republics the way that Soviet and post-Soviet leaders have done.

One of the most obvious equity issues centers on upstream versus downstream users of the streamflow of the Amudarya and the Syrdarya. In the Aral basin the upstream users are Tajikistan and Kyrgyzstan. To these, however, Afghanistan must be added even though its demands on water withdrawals from the Amudarya to date have been minimal. Turkmenistan could also be viewed as an upstream country in the sense that its significant withdrawals from the Amudarya via the Karakum Canal start where the river begins its descent toward the sea. Aside from politically feel-good platitudes about sharing water resources in a river, whether in Central Asia or in other parts of the globe, those who are situated downstream are in reality at the mercy of the upstream countries (users) when it comes to access to water quantity and water quality.

This is not just an international transboundary problem, but is a problem within countries as well. In Uzbekistan, for example, Amudarya water flows through much of the Uzbek territory before it reaches Karakalpakstan. It is the Autonomous Republic of Karakalpakstan that suffers most from water shortages and poor water quality (6), as the river water is withdrawn well before it can reach the receding shoreline of the sea. Yusup Kamalov, founder of the Union for the Defense of the Aral Sea and the Amudarya, recently asserted that it was within the rights of the Karakalpak people to have their sea and their livelihoods that were dependent on a healthy sea (7).

Table 1. Stressful considerations for policy makers in the Aral Sea Basin.

Diverted streamflow	Pesticide and fertilizer use
Declining water quantity	Declining water quality
Shortened life expectancy	Ethnic conflicts
Rapid sea level drop	Contaminated aerosols
Loss of biological productivity	Dust storms
Loss of biological diversity	Karakum Canal
Loss of wildlife and forests	5 competing nations
Islamic fundamentalist threat	Terrorist groups
Upstream-downstream issues	Dictatorships
Oil and gas haves and have-nots	Global warming
Hotter summers, colder winters	Loss of cultural heritage

Afghanistan territory accounts for 17% of the Aral basin but does not yet draw much water from the Amudarya. it will divert water for agricultural development, once the wars there end. This will make a bad water situation for the Aral basin even worse.

Equity and ethical concerns also center on intergenerational issues. To what extent should land and water resources be exploited by the present generation of users, if its use impinges in a negative way on the ability of future generations to maintain their livelihoods? To what extent does the concept of "sustainable development" play in the decision-making processes of current leaders in the region? Aside from the human issues of equity, one can ask "Who speaks on behalf of Nature?" Who represents the interests of the sea, the fish, the soils, the rivers, the deltas? It is now clear that the cotton-related Aral Basin development policies were going to destroy the Aral Sea's natural environment and ultimately its productive capabilities.

THE IMPACTS OF SOCIETY ON THE SEA

Society's impacts on the Aral have for the most part been negative. Increasing streamflow diversions during the past five decades have led to a sharp and relatively rapid decline not only in level, but also in societal and ecological well-being. The diversion from the Karakum Canal has contributed to that decline. The drying out of the deltas has caused a loss in wetlands, an increase in salinity, a decrease in biodiversity, and an attendant loss in revenue with the destruction of various economic activities dependent on delta habitats for flora and fauna. The sea recedes from its fishing ports and supporting settlements as its coastline shrinks. The image the world has of this drying sea is conveyed in photos of fishing vessels trapped by desert sands, destined to rust away or to have their metal parts salvaged (Fig. 2).

In a last-ditch effort to save the livelihoods of the workers at fish processing factories, fish were shipped into the region for processing from the Pacific Ocean and from Baltic seaports in the early 1990s (Fig. 3).

All of the above adversely affected settlements in Karakalpakstan, especially livelihoods and human health. As Lindgren (8) has noted, maternal mortality and respiratory and diarrhea diseases are worse there than in the rest of the region. The tuberculosis level is the highest in Europe as well as in the former Soviet Union, and anemia levels are among the highest in the world. Other adverse health effects in the Karakalpak Republic include hepatitis, malnutrition, high infant mortality, kidney dysfunction, neurological disorder, and cancer.

IS THERE A WAY FORWARD?

The Aral Sea situation is a perfect example of the consequences of the disregard of precaution, of a blind faith in the ability of

Figure 2. Rusting hull of a ship in Uzbekistan. Photo: M. Glantz.

Figure 3. Workers pondering their future in a dying industry in Nukus, Uzbekistan, 1995. Photo: M. Glantz.

science and engineering to extract on demand Nature's bounty and of how short-term gains can have deleterious impacts if they are pursued without consideration of or care for the adverse impacts in the long term.

All is not lost, however. The government of Kazakhstan has moved forward to restore the Little Aral Sea. After several attempts to build earthen barriers to arrest the flow from the Little Aral to the Big Aral, a concrete wall now helps to retain water in the Little Aral. Its level has steadily risen, as the government assures a steady flow of Syrdarya water into its delta. The fishing industry, too, has been resurrected in this region (9).

It is time now to consider partially restoring the Big Aral Sea and maintaining it as a partially restored inland body of water. This would serve to show future generations what can happen if one does not respect the limits to the exploitation of nature. It also demonstrates what happens when one has a blind faith that whatever is done to the environment can be undone by human ingenuity and science and technology. A partial restoration of the Aral Sea to a previous higher sea level also has tangible positive aspects. Some aspects include, but are not limited to, the following:

- Maintaining international interest in a unique feature of nature in the region
- Improving health conditions
- Restoring delta productivity and restores wetlands ecosystems
- Improving interethnic relationships
- Encouraging Siberian River diversions only for drinking water
- By making it a World Heritage site, governments would be encouraged to take stronger interest in a partial restoration of the sea
- Encouraging tourism
- Encouraging additional international development support
- Demonstrating government commitment to a healthy Karakalpak and other people living in the Aral Sea's disaster zone

Table 2 suggests examples of impacts and benefits of attempts to restore the Big Aral Sea.

WORLD HERITAGE AND THE ARAL SEAS

About a decade ago a colleague and I proposed that the Aral Sea be considered by UNESCO as a World Heritage Site (10). Needless to say, the idea was not considered seriously, if at all. However, we continue to believe that conferring World Heritage Status can serve several positive purposes for the sea and for the people in the settlements around it.

The criteria for World Heritage status (11) is the following, as noted in Article 2 of the World Heritage Convention:

Table 2. Level of the restoration of the Big Aral.

Impacts	Seas disappear	Save seas partially	Restore seas to 1960 level
Global community level	Failure to stop problem (human failure)	Reverse Siberian rivers to the sea	In theory: YES
	Human interest worldwide wanes	Meter irrigation water	
	Biodiversity loss: flora/ fauna loss	Gas/oil exploration to fund sea restoration to a partially restored level	In practice: NO
Regional government level: requires government initiatives	Poverty increases	Hard decisions	Allow river water to get to sea in large annual amounts
	Loss of biodiversity	Save Amudarya delta	Requires a long-term perspective
	Out-migration	Money needed for restoration	Requires a change in cotton economy
	Declining health services	Cleaning water	
	Increase in dust storms	Restock fishery	
	Change in regional climate	Monitor/meter/enforce water use	
	Impact on glaciers	Little Aral as positive example	
Individual and group level	Emigration (environmental refugees)	Jobs	Restore and preserve culture of Karakalpak
	Degraded health statistics	Improved health	
	Destruction of culture	Some job restoration	
	High unemployment	Ecotourism increases	

Figure 4. Student demonstration to "Save the Aral Sea" in Nukus, 1995. Photo: M. Glantz.

i) Natural features ... of outstanding universal value (OUV) from the aesthetic or scientific view;
ii) Geological and physiographical formations ... which constitute the habitat of threatened species of animals and plants of OUV from ... view of science or conservation;
iii) Natural sites or ... areas of OUV from ... view of science, conservation or natural beauty.

It would be impossible to refill the Aral to the level of the 1960s without crippling economic development prospects and without considerable regional sacrifice. Even if the political and humanitarian will to do so were there, the regional economies are linked so strongly to the production of cotton that water would have to be found elsewhere to "save the seas." However, it would be possible to refill and stabilize it at an intermediary level by letting predetermined amounts of Amudarya streamflow reach the sea each year for the next several decades. Restoring both seas would help to improve the living conditions in the pre-Aral region and would help to improve regional human as well as ecological health. In addition, a partially restored Big Aral would serve as an example of how creeping (seemingly insignificant but cumulative) local and regional environmental changes can lead to major national catastrophes in a relatively short period of time.

A partially restored sea could serve both as a symbolic result for present and future generations regarding the lack of understanding of the interactions between humans and nature and as a symbol of human capabilities to restore with time parts of nature that society had destroyed (Fig. 4). As an example, arresting the continued decline in sea level in the Big Aral and embarking on a program of partial restoration of the sea could serve to restore faith in learning from experience. Perhaps more to the point is my feeling that if the Big Aral Sea were to disappear, global humanitarian interest in the sea and in the region would dissipate sharply and quickly. In other words, humanitarian aspects for getting involved in efforts to "save the sea" would likely dry up.

THE ARAL SEA AS AN ENVIRONMENTAL "HOTSPOT"

Environmental degradation has a starting point. One can represent the process in pyramid form in which the base of the pyramid represents a pristine environment. Humans enter the scene and begin to transform nature to meet their needs. The process of change begins, as suggested in Figure 5.

Soon relatively harmless changes to the environment become areas of concern to observers, especially to local affected inhabitants. With time, degradation becomes increasingly visible: too many trees harvested on mountain slopes, too many livestock grazing the rangelands, too many fish being caught, and too many natural habitats being destroyed in the name of progress (e.g., coastal mangrove destruction to set up shrimp ponds). Soon, areas of concern, if left unaddressed, can evolve into locations where the human activities are destroying the ecosystems on which they depend for their livelihood and for sustainable development prospects, beyond their ability to recover without serious intervention by society, e.g., hotspots.

If the hotspots continue to be neglected, the degradation becomes so severe that it becomes prohibitively costly to repair, which means that many people would have to learn to live within the new ecological boundary conditions created by that

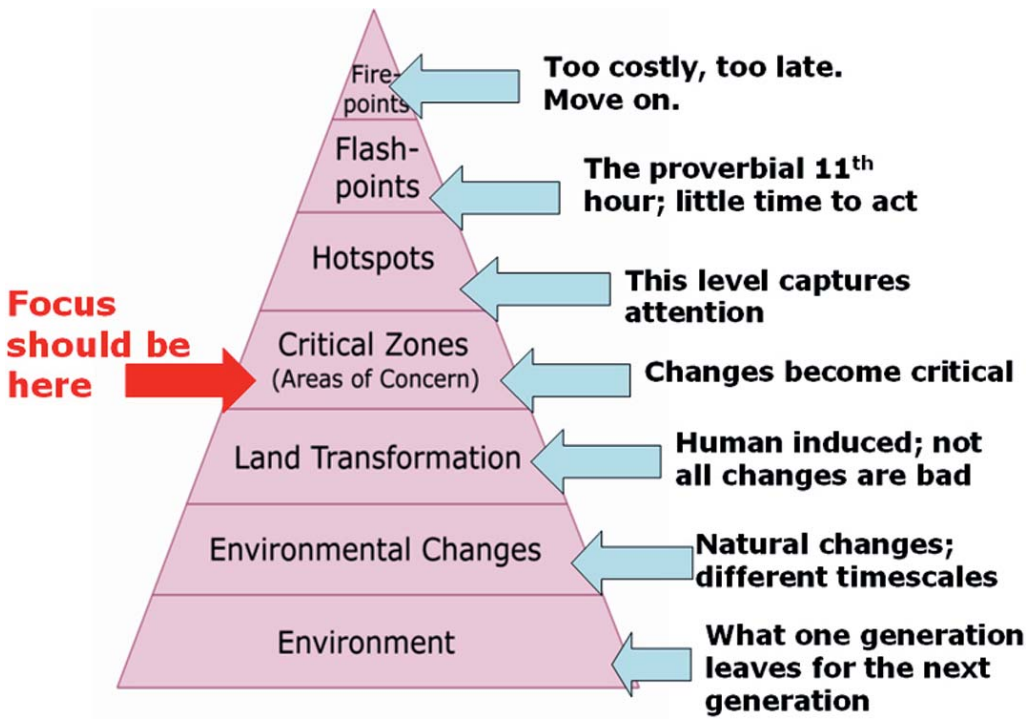

Figure 5. Hotspots pyramid of environmental change.

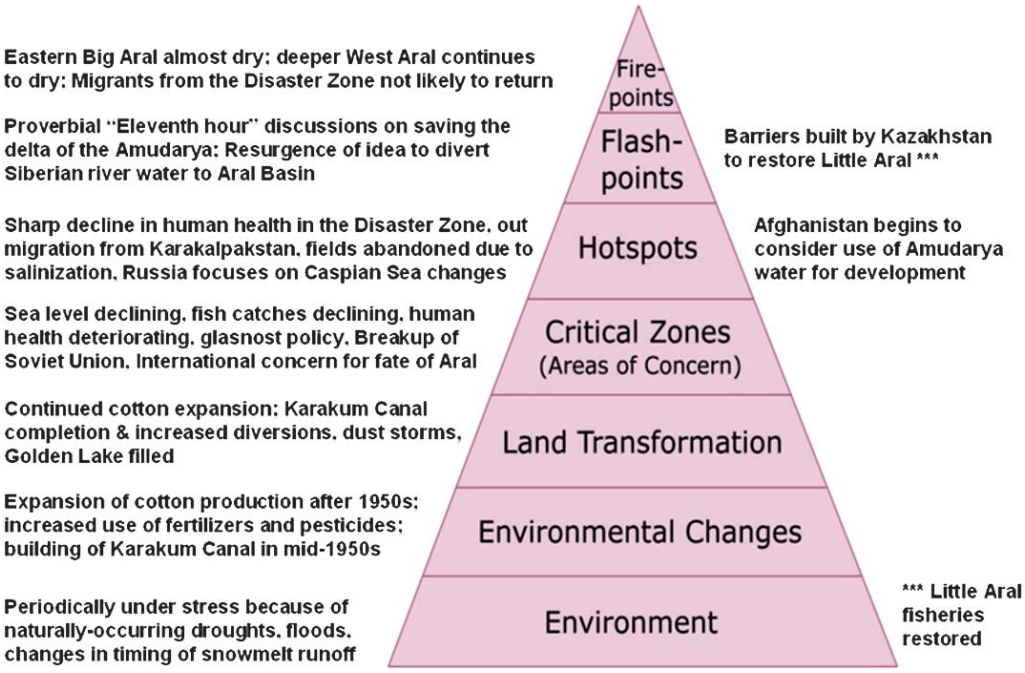

Figure 6. Hotspots pyramid applied to the Aral Sea situation.

degradation. The environment is then considered to be at a "flashpoint," the proverbial "11th hour." This would leave very little time for a society to act to avoid reaching the final stage of degradation and human responses to it, the stage labeled "firepoint." Firepoint is the point of no return. The situation requires an abandonment of the land or perhaps just the end of the exploitation of the resources used for industrial, agricultural, and societal metabolism.

While there is considerable interest in and fascination with the hotspots, the focus of societies, especially governments, should be on "areas of concern." Environmental changes related to the Aral Sea have become so severe that they are at the flashpoint stage for some locations and at the firepoint for others. Figure 6 suggests the levels of creeping change in an Aral Sea context.

CONCLUDING COMMENTS

The Aral Sea's impacts on ecosystems and societies have been positive over time. With regard to ecosystems it has produced a rich environment for a range of flora and fauna, terrestrial and aquatic. The region's two major rivers produced two highly productive inland deltas. The stream ecosystems were also abundant in species of aquatic life at different stretches of the river. The sea in the past had a steady supply of water each spring from the melting glaciers in the nearby mountains.

The positive aspects of the sea for society include the availability of abundant river water for human settlement and economic development purposes and a restoration of biodiversity in the delta as well as the sea. There had been, until recently, a sustainable balance in the Aral Basin's hydrological cycle; that is, before human intervention disrupted that cycle.

Providing the Aral Sea with World Heritage Status can serve to encourage governments in the region to seek ways to restore the sea to a usable level. Bringing back healthy deltas can restore biodiversity. It can restore a level of fishing and other economic activities and, therefore, livelihoods. It can provide a modicum of hope for the future for the Karakalpak people who have been left with little hope and few options short of migrating to other parts of Uzbekistan. There are examples of heritage sites that serve as memorials to sad experiences in human history. The Aral Sea, once the world's fourth largest inland sea and now not even on the list, deserves Heritage Status as well as restoration. It will take a long time to accomplish this task. Better, then, to get started now.

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