The Aral Sea Disaster

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The Aral Sea is one of the worst ecological disasters on our planet. What was once the world's 4th largest inland sea, the Aral Sea has lost over 60% of its surface area, 2/3 of its volume, declined 40 m in depth, and has fallen to the eighth largest inland body of water in the world.

The cause of this disaster is attributable to a vast expansion of irrigation in the central Asian Republics beginning in the 1950's, which greatly reduced inflows to the Sea. The diversion of water for massive irrigation development was done deliberately by Soviet Union officials, unconcerned about the consequences of their actions.

The environmental, social and economic damage has been immense. Winds pick up dust from the dry seabed and deposit it over a large populated area. The dust likely contains pesticide and chemical residues that are blamed for the serious rise in mortality and health problems in the region. The Aral Sea, and the now exposed dry seabed, may also be contaminated by runoff from a former Soviet military base and a biological weapons laboratory. The ecosystem of the Aral Sea has collapsed, and climate changes in the Aral Sea Basin have been documented.

Hundreds of agreements have been signed since the 1980's on programs designed to address the "Aral Sea Problem" which, to date, have not been effective at preventing the continuing shrinking of the sea.

The Aral Sea Basin

The Aral Sea is located in Central Asia and lies between Uzbekistan and Kazakhstan in a vast geological depression called the Turan lowlands, in the Kyzylkum and Karakum Deserts. In the 1950's, the sea covered 66,000 km^2, contained about 1090 km^3 of water, and had a maximum depth of about 70 m. The Aral Sea supported vast fisheries and shipping industries. At that time the sea was fed by two rivers, the Amu Darya and the Syr Darya, which originate in the mountain ranges of central Asia and flow through the 5 republics of Uzbekistan, Kazakhstan, Kyrgyzstan, Tajikistan, and Turkmenistan.

The two rivers provide most of the fresh water used in Central Asia. In the last 50 years, about 20 dams and reservoirs and 60 major irrigation schemes have been constructed. Approximately 82% of river diversions are for agricultural use and 14% are for municipal and industrial use (Table 1).

Water demand continues to increase due to population growth and industrial expansion (Table 2). Since 1960, the population of the Central Asian republics has increased 140% and totals over 50 million. Likewise, industrial production using large amounts of water

has also increased. Examples include steel production, which rose 200%, cement production by 170% and electricity generation by a factor of 12.

The total inflows to the Aral Sea began decreasing rapidly in the 1960's, and by 1990 the storage volume of the sea had decreased by 600 km^3 (Table 3). As the water level fell, salinity levels tripled, rising from about 1000 ppm to just under 3000 ppm today. By the 1980's, the Aral Sea problem became well know in the Soviet Union, and government officials proposed ambitious projects to divert water from other rivers, including ones in southern Russia and Siberia, to be transported to the Aral Sea in massive canals. However, these plans died with the breakup of the Soviet Union in 1991.

The decrease in the water level of the Aral Sea has now split it into two separate water bodies: the Small and Large Aral Seas (Maloe More and Bol'shiye More), each separately fed by the Syr Darya and the AmuDarya, respectively. The once vast Amu Darya delta, which covered 550,000 hectares has now shrunk to less than 20,000 hectares.

Irrigation and Cotton

For thousands of years, Central Asian farmers diverted water from the Amu Darya and Syr Darya Rivers, transforming desert into green oases and supporting great civilizations. Historically, irrigation water use was conducted at a sustainable level. However, the creation of the Soviet Union and the collectivization of farmlands resulted in the end of traditional agricultural practices. Beginning as early as 1918, Soviet leaders began expanding irrigated land in Central Asia for export and hard currency. Cotton was known as "white gold." The USSR became a net exporter of cotton by the 1930's, and by the 1980's was ranked fourth in the world in cotton production.

The policy of emphasizing cotton production was accelerated in the 1950's as Central Asia's irrigated agriculture was expanded and mechanized. In 1956, the Kara Kum Canal was opened, diverting 1/3 of the flow in the Amu Darya to new cultivated areas in the deserts of Uzbekistan and Turkmenistan. The year 1960 represents the critical junction when the Aral Sea began to drop. Irrigated cotton production and water diversions continued to be expanded until the break-up of the Soviet Union (Table 4).

Now, estimates are that over of 80% of the workforce in the Amu Darya Basin is employed in agriculture. The main agricultural crops in the basin are cotton (6.4 million ha), forage (1.7 million ha), rice (0.4 million ha), and tree crops (0.4 million ha).

Some Central Asian irrigation experts estimate that only 20 to 25% of the water diverted from the rivers is actually used by the crops, the rest being lost in the canals that transport the water to the fields and in inefficient on-farm irrigation practices. It is believed that over the past decade, adequate maintenance, repair, and renovation of the irrigation infrastructure was not performed at a meaningful level, and water losses from deteriorating canals, gates and other facilities have increased.

Most irrigated land is under furrow irrigation, with drip irrigation accounting for about 5% of irrigated cropland (used primarily on orchard crops), and sprinkler irrigation accounting for about 3%. Even though the water saving benefits of gated pipe are well known in the region, less than $1/6^{th}$ of the farms use this technology. Reasons may include cost and product availability. Most farms follow the centuries-old practice of cutting earthen canals with shovels in order to divert water into the field. The volume of water available in these ditches is not sufficient to provide an even distribution of water over the field. As a result, water logging and soil salinity now affects about 40% of all the cultivated land in the region.

Muynak and Aralsk

Of all the villages affected by the drying of the Aral Sea, Muynak is the best known. Historically, Muynak was located on an island of the vast Aral Sea delta at the mouth of the Amu Darya River in Karakalpakstan (a semi-autonomist republic in Uzbekistan). In 1962, the island became a peninsula, and by 1970 the former seaport was 10 kilometers from the sea. The retreat of the Aral Sea continued to accelerate, and the town was 40 kilometers from the sea by 1980, 70 kilometers in 1995, and close to 100 kilometers today.

Over 3000 fishermen once worked the abundant waters around Muynak, which supported 22 different commercial species of fish. In 1957, Muyank fishermen harvested 26,000 tons of fish, about half of the total catch that year taken from the Aral Sea. Muyank also produced 1.1 million farmed muskrat skins, which were used to produce coats and hats.

The Kazakh city of Aralsk, was once located on the northern edge of the Aral Sea, and like Muyank, had major fisheries and commercial industries. A major shipping and transport industry existed between these two cities. As the Aral Sea shrank, Aralsk found itself farther and farther from the shore, which had retreated nearly 129 km by the 1980's. In the early 1990's, a dam was built just to the south of the mouth of the Syr Darya, to protect the northern part of the Aral Sea, letting the southern portion evaporate. Although only 10% of the water in the Syr Darya River reaches the northern part of the Aral Sea, the Little Aral has risen 3 meters since the construction of the dam, and the shoreline has again crept to within 16 km of the town.

Environmental Problems

The Aral Sea is an unfortunate example of an old Uzbek proverb: "at the beginning you drink water, at the end you drink poison." As the Amu Darya and Syr Darya rivers flow through cultivated areas, they pick up fertilizers, pesticides, and salts from runoff, drainage water, and groundwater flow. In the 1960's, it was common for about 550 kg/ha of chemicals to be applied to cotton fields in Central Asia, compared to an average of 25 kg/ha used for other crops in the Soviet Union. Residues of these chemicals are now found on the dry seabed. Estimates are that millions of tons of dust and chemical residues are picked up from the seabed and distributed over the Aral Sea region.

The Sea may have been contaminated from runoff from by two former USSR military installations in the area. A chemical weapons testing facility, closed in the mid 1980's, was located on the Ust-Jurt Plateau (north shore). Renaissance Island (Vorzrozhdeniya Island), located in the central Aral Sea, was the site of the former USSR Government's Microbiological Warfare Group, which produced the deadly Anthrax virus. Some scientists believe that containers holding the virus were not properly stored or destroyed. As the Aral Sea continues to dry and water levels recede, the ever-expanding island will soon connect to the surrounding land. Scientists fear that reptiles, including snakes that have been exposed to the various viruses, will move onto the surrounding land and possibly infect the humans living around the shores of the Aral Sea.

The Area Sea once supported a complex ecosystem, an oasis in the vast desert. Karakalpakstan scientists believe that a total of about 100 species of fish and animals that once flourished in the region are now extinct, as are many unique plant species.

Residents believe that there is a direct correlation between the drying of the sea and changes in climate of the Aral Sea Basin. The moderating effect of the sea has diminished and temperatures are now about 2.5 ºC higher in the summer and lower in the winter. Rainfall in the already arid basin has also decreased by about 20 mm.

The Human Tragedy

Over the last fifty years, there has been a large increase in mortality rates, illnesses, and poor health in the region. Some estimate that 70 to 90% of the population of Karakalpakstan suffer some an environmentally-induced malady. Tuberculosis is rampant; hardest hit are women and children. Other common health problems include kidney diseases, thyroid dysfunctions, anemia, bronchitis, and cancers.

The Future

Since 1984, hundreds of international agreements have been signed to address Aral Sea problem. The early agreements had the goal of stabilizing the sea and then slowly increasing flows to restore its ecosystem. In 1992, the Interstate Commission for Water Coordination was formed by the 5 central Asian republics, which also accepted, in principle, to adhere to the limits on water diversion set during the Soviet era from 1984 to 1987. To date, however, no progress has been made on stabilizing or reversing the declining inflows. With no water reaching the Aral Sea from the Amur Darya, scientists predict that this portion of the sea (the Large Aral Sea) will disappear by 2020.

Suggested Websites (CITE THESE REFERENCES WITHIN THE TEXT)

The Aral Sea Homepage: http://www.dfd.dlr.de/app/land/aralsee/

Requiem for a dying sea: http://www.oneworld.org/patp/pap_aral.html/

Disappearance of the Aral Sea: http://www.grida.no/aral/maps/aral.htm

Earth from Space: http://earth.jsc.nasa.gov/categories.html

Figure Caption (sent by separate email)

This NASA photograph (STS085-503-119) was taken in August 1997 and looks towards the Southeast. The Amu Darya River is visible to the right and the Syr Darya on the left. The Aral Sea is now separated into the Small Aral to the north and the Large Aral to the South. Shown are the approximate extent of the Aral Sea in 1957 before a massive expansion of irrigation diversions from the rivers.

Tables

Table 1. Average Water Supply and Demand in the Aral Sea Basin.		
Total Water Available	**km^3**	**%**
Amu Darya Basin	84.3	64
Syr Darya Basin	47.8	36
TOTAL	**132.1**	**100**

Table 2. Water Demand		
Water Demand	**km^3**	**%**
Agriculture:		
Amur Darya Basin	44.8	81.6
Syr Darya Basin	34.6	
Municipal Water:		
Amur Darya	3	6.5
Syr Darya	3.3	
Industry:		
Amu Darya	3	8.2
Syr Darya	5	
Livestock:		
Amu Darya	0.2	0.2
Syr Darya	0	
Fishery:		
Amu Darya	2.6	3.5
Syr Darya	0.8	
TOTAL	**97.3**	**100**

Table 3. Decline of the Aral Sea during the 1980's and total estimated inflows from the Amu Darya and Syr Darya rivers.			
Year	**Inflows, km^3**	**Aral Sea**	
		Volume km^3	**Surface Area km^2**
1911-1960	56.0	1064	66100
1981	6.0	618	50500

1982	0.04	583	49300
1983	2.3	539	47700
1984	7.9	501	46100
1986	0.0	424	41100
1987	9.0		
1988	23.0		41000
1989		300	30000

Table 4. Cultivated land along the Amu Darya and Syr Darya rivers				
	Before 1917	**1960**	**1980**	**1992**
Millions of Hectares	5.2	10	15	18.3

Table 5. General Statistics of the Aral Sea Basin Countries in 1995.					
	Kazakstan	**Uzbekistan**	**Turkmenistan**	**Kyrgyzstan**	**Tajikistan**
Area, km^2	2,717,300	447,400	488,100	198,500	143,100
Irrigated land, km^2	23,080	41,500	12,450	10,320	6.940
Poplulation	17,376,615	23,089,261	4,075,316	4,769,877	6,155,474
Pop. Growth rate, %	0.62	2.08	2.5	1.5	2.6