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Short Communication

The Salt and Dust of the Aral Sea Could Turn Central Asia into A Second Sahara

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Abstract

The Aral Sea is located in the heart of Asia, in Central Asia, spanning the western part of Kazakhstan and the northwestern part of Uzbekistan. It is a transient lake that emerged in its current location approximately 600–700 years ago. Until the 1960s, the surface level of the Aral Sea continued to rise due to the inflow from the Amu Darya and Syr Darya rivers.

Introduction

Starting in 1913, irrigation-based agriculture was extensively developed in the Aral Sea basin to grow water-intensive cotton crops, primarily to supply Russia's textile industry. By 1960, the area of irrigated land had expanded to 5.2 million hectares, reaching 6.9 million hectares by 1970. As a result, water from the Amu Darya and Syr Darya rivers ceased to flow into the Aral Sea. In response, the Soviet government initiated projects to divert water from Siberian rivers to the Aral basin. The Irtysh-Karaganda Canal was constructed and became operational, and also additional work began on a canal intended to direct water to Central Asia.

However, in 1986, a group of Russian environmentalists succeeded in halting the project to redirect Siberian rivers to Central Asia. They cited potential ecological disruptions in the West Siberian wetlands and significant harm to fisheries in the Ob River as reasons to abandon the plan. The desiccation of the Aral Sea was driven by the demand to supply Russia's textile industry with cotton fiber, ignoring the collapse of the unique fishing ecosystem in the Aral Sea and the hazardous ecological conditions imposed on the local populations that had coexisted there for generations [1-4].

As the Aral Sea dried up, an estimated 11.88 billion tons of salt (based on a salinity of 11% and a water volume of 1080 km^3) were released into the atmosphere. With approximately 10 million tons of salt dispersed annually, this process could persist for 100 years. Textbooks describe how the Aral Sea basin once thrived, containing numerous large and small lakes. The article underscores the necessity of diverting at least 25 km^3 of water from Siberian rivers to the Aral Sea to address this crisis.

In the heart of Asia, there once existed a stunning natural wonder: the Aral Sea. Its vastness was so immense that, from airplanes flying at altitudes of 10 - 11 kilometers, its shores were invisible. For this reason, it was referred to as the "Aral Sea" (Island sea). Spanning an area of 68,000 km^2, with a water volume of 1,080 km^3 and an average depth of 15 meters, it was a bustling hub of maritime activity. Ships navigated its waters, fishing thrived, and the Aral was renowned for its unique fish species.

However, this rare gem in the center of Asia is now gone. The dynamics of the Aral Sea's desiccation are presented in Table 1.

As seen in the table, efforts to mitigate the consequences of the Aral Sea's desiccation have not yielded significant results, and in its place, a desert called "Aralkum" has emerged. Numerous studies have been conducted to examine the aftermath of the Aral disaster and to develop measures to address it. Representatives from many countries have actively participated in and continue to contribute to these efforts. A list of relevant literature published in recent years is provided in [3].

Discussion

The primary cause of the Aral Sea's desiccation is as follows:

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Table 1: Water Inflow to and Consumption in the Aral Sea (km^3).

Years	Water Level (m)	Volume (km^3)	Precipitation (km^3)	Evaporation (km^3)	Salinity (g/L)	Surface Area (thousand km^2)	River Inflow to the Sea (km^3)		Total
							From Syr Darya	From Amu Darya	
1	2	3	4	5	6	7	8	9	10
1960	53.4	1083	9.41	71.1	9.93	68.9	21.1	43.0	64.1
1961	53.3	1079	9.59	70.4	9.97	68.5	4.0	30.9	34.9
1962	53.0	1060	8.63	70.9	10.8	65.9	5.8	27.6	33.4
1963	52.6	1038	11.6	70.6	10.6	64.3	10.6	33.1	43.7
1964	52.5	1030	8.12	64.0	10.1	64.8	15.0	38.3	53.3
1965	52.3	1019	8.48	66.3	10.8	63.1	4.7	25.5	30.2
1966	51.9	993	6.64	71.1	11.8	61.7	9.6	33.1	42.7
1967	51.6	974	7.51	57.8	11.0	60.9	8.7	27.0	35.7
1968	51.2	952	6.03	67.3	11.5	60.1	7.3	28.0	35.3
1969	51.3	955	9.06	52.3	10.9	60.2	17.5	55.5	73.0
1970	51.4	964	7.22	62.0	11.2	60.3	9.8	28.0	37.8
1971	51.1	940	5.81	59.8	11.4	59.7	8.2	15.8	24.0
1972	50.5	909	5.78	55.3	11.9	58.9	7.0	13.2	20.2
1973	50.2	891	8.95	56.4	11.9	58.4	8.9	31.2	40.1
1974	49.8	870	4.75	60.2	13.0	57.9	1.9	6.3	8.2
1975	49.0	822	4.43	60.0	13.4	56.7	0.61	10.6	11.2
1976	48.3	779	5.79	51.1	14.6	55.7	0.57	11.1	11.7
1977	47.6	742	5.04	45.7	15.4	54.6	0.48	9.0	9.5
1978	47.1	713	6.42	52.5	15.0	53.9	0.78	21.3	22.1
1979	46.4	680	4.87	52.1	15.1	52.9	3.2	11.1	14.3
1980	45.7	644	9.73	50.2	16.8	51.7	2.5	8.6	11.1
1981	51.1	616	11.9	47.1	17.7	50.7	7.4	6.3	13.7
1982	50.5	574	8.52	38.5	18.8	49.3	1.7	0.54	2.2
1983	50.2	532	4.51	47.6	20.3	47.7	0.94	2.3	3.2
1984	49.8	499	5.99	44.3	21.9	46.2	0.60	8.0	8.6
1985	49.0	466	7.19	42.5	22.9	44.6	0.68	2.4	3.1
1986	41.1	432	6.22	39.4	22.9	42.8	0.51	0.44	0.95
1987	40.3	401	5.68	37.3	23.9	41.1	1.6	8.2	9.8
1988	39.7	380	5.10	35.8	25.0	39.9	6.9	16.4	23.3
1989	39.1	354	6.85	36.7	28.0	38.4	4.4	1.0	5.4
1990	38.2	323	5.34	34.9	30.0	36.4	3.5	9.0	12.5
1991	37.6	299	5.60	34.6	32.0	31.8	4.0	12.5	16.5
1992	37.2	286	4.61	35.6	34.0	33.9	4.6	28.9	33.5
1993	36.9	278	4.15	32.7	35.0	33.2	7.9	18.8	26.7
1994	36.6	266	3.62	31.1	36.0	32.3	8.9	21.7	30.6
1995	36.1	250	4.73	33.6	37.0	31.3	5.2	5.1	10.3
1996	35.5	230	4.31	28.9	42.0	29.7	5.1	7.5	12.6
1997	34.8	210	3.57	27.2	43.5	28.0	4.6	2.2	6.8
1998	34.2	194	4.30	21.0	49.8	25.5	7.6	23.9	31.5
1999	33.8	181	4.80	19.7	50.6	23.7	5.5	6.4	11.9
2000	33.3	169	4.27	17.3	55.8	22.9	2.9	2.6	5.5
2001	32.2	143	1.35	15.8	58.6	21.2	2.8	0.40	3.2
2002	30.9	110	1.17	15.3	60.1	18.7	6.4	6.7	13.1
2003	30.6	100	3.38	17.8	62.4	17.3	9.2	11.4	20.6
2004	30.3	93.5	3.30	17.6	68.0	16.4	9.86	5.92	15.8
2005	30.0	89	1.16	15.3	72.3	15.8	-	-	-
2006	29.3	81	0.91	14.8	79.7	14.5	-	-	-
2007	28.6	78	0.78	12.1	88.3	14.3	-	-	-
2008	28.0	74	0.57	10.8	98.7	14.0	-	-	-
2009	27.6	70	0.45	11.3	113.7	13.5	-	-	-
2010	27.1	67	0.38	12.5	119.8	12.8	-	-	-
2011	26.4	64	0.41	13.1	129.4	12.0	-	-	-

Note: The table is compiled based on available sources [1,3].

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At the beginning of the last century, Russia's textile industry relied on cotton fiber purchased from the United States. The agreement between Russia and the US regarding this sector expired in 1913. As a result, Russia began cultivating its cotton. Efforts to do this were made in Ukraine and the North Caucasus, but cotton cultivation did not develop in these regions due to the labor-intensive nature of the process. Consequently, the Russian Empire's government began developing irrigation-based cotton farming in the arid region of Central Asia. These efforts continued during the Soviet era, with the construction of numerous canals and large water reservoirs. By 1962, 5.2 million hectares of land were converted to irrigated farmland.

However, the demand for cotton fiber grew increasingly stronger, which in turn required the cultivation of new land. Another 1.7 million hectares of land were brought under irrigation. As the cotton fields expanded, the surface area of the Aral Sea began to decline rapidly. Concerned about this, local authorities and the population began requesting action. In response, efforts were initiated to divert part of the water from Siberian rivers to Central Asia to address water shortages. Under the leadership of the "Soyuz Giprovodkhoz," a special project was organized for the search and implementation of solutions. A substantial amount of funds were spent, and construction work began. The Irtysh-Karaganda Canal, 459 km long, 40 meters wide, and 7–10 meters deep, was put into operation. The first section of the canal, 170 km long, was nearing completion and would supply water to Central Asia.

However, by 1986, after the majority of the Aral Sea's water had evaporated, and at the request of several Russian environmentalists, these projects were halted. The primary reason for halting the projects was the ecological consequences, such as the disruption of the ecology of the West Siberian wetlands and the decline in fishing in the Ob River. The drying up of the Aral Sea, the salinization of half of the cultivated land, and the severe pollution of the atmosphere were overlooked by Russian ecologists, scientists, and leaders of the former USSR government.

It is important to note that the monocultural cotton cultivation was primarily aimed at supplying Russia's textile industry. Between 1976 and 1990, the bulk of the 2.2 - 2.5 million tons of cotton fiber produced annually in Central Asia was used by Russian textile industries, with 700,000 - 800,000 tons being exported. The Aral Sea water was used for this purpose, causing the sea to nearly dry up. In its dried-up bed, 11.88 billion tons of salt (from an average salinity of 11‰ and a water volume of 1080 km^3) mixed with sand particles. According to textbooks, this region, which once had a rich natural landscape with large and small lakes, now resembles the initial appearance of what later became the Sahara desert, following the gross violation of nature's usage rules. Therefore, it can be concluded that Central Asia could potentially turn into a second Sahara Desert.

As evidence of this, the case of the Kara-Bogaz-Gol is also notable. In 1984, a dam was built to reduce evaporation from the Caspian Sea and to utilize the salt accumulated in Kara-Bogaz-Gol. However, the wind began to carry the salt particles in all directions, even contaminating the air in Azerbaijan. As a result, in 1992, the dam separating Kara-Bogaz-Gol from the Caspian Sea was dismantled after significant funds had been invested in its construction.

It is evident from the above that such an ecological disaster poses a threat to the lives of more than 60 million people in Central Asia. Moreover, the increasing amounts of dust and salt particles in the air could sharply reduce precipitation. This has already led to a reduction in the water flow in nearby rivers. For example, from 1990 to 2020, the trend in the annual flow of the Chodaksoy River in northern Fergana Valley was -0.012 $m^3/s/year$, Kosonsoy River was -0.036 $m^3/s/year$, and G'ovasoy River was -0.011 $m^3/s/year$, indicating a decreasing water flow.

Author's perspective

It is well-known that in the era of climate warming, rising air temperatures increase the air's moisture capacity, which in turn strengthens circulatory movements and increases precipitation. The reduction in river water flow could be exacerbated by the impact of Aral dust and salt. As the reduction in precipitation continues, the flow of mountain rivers may further decrease, severely affecting the living conditions of the Central Asian population. This situation requires immediate action. Therefore, it is crucial to restore the Aral Sea by replenishing it with water. However, this cannot be achieved with the waters of the Amu Darya and Syr Darya alone. Thus, to prevent Central Asia from turning into a second Sahara, it would be most effective to restore the Aral Sea by diverting 25 - 50 km^3 of water from Siberian rivers. Since the primary reason for the drying of the Aral Sea was to supply cotton fiber for Russia's textile industry, the Russian government should be the main leader in this effort. International community assistance may also be necessary.

Conclusion

The development of the textile industry in Russia increased the demand for cotton fiber. This was achieved by expanding irrigated farming in the arid region of Central Asia. As a result, the flow of water from the Amu Darya and Syr Darya to the Aral Sea decreased and eventually stopped altogether. The drying up of the Aral Sea created a significant ecological disaster in its basin. In its dried-up bed, 11.88 billion tons of salt, mixed with sand, is polluting the air, affecting even the mountainous regions. This reminds us of the early stages of desertification similar to the Sahara Desert. To prevent Central Asia from becoming a second Sahara, it is necessary to redirect part of the water from Siberian rivers to refill the

Aral Sea. This must be done with the cooperation of Russia, Uzbekistan, Kazakhstan, and Turkmenistan, with the help of international organizations.

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