

THE ARAL SEA'S ECOLOGICAL, SOCIAL, AND ECONOMIC PROBLEMS

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Abstract: The Aral Sea is a large inland water body located in Central Asia and had significant ecological and economic importance until the mid-20th century. However, the redirection of water from the Amu Darya and Syr Darya rivers to irrigation systems caused the sea level to drop sharply, its area to shrink, and an ecological crisis to emerge. This article scientifically analyzes the Aral Sea's drying, salinization, water quality deterioration, the impact on fisheries and agriculture, as well as the social and health problems for the local population. In addition, ecological restoration and international cooperation measures are discussed, and ways to reduce the problem through rational management of water resources, soil, and climate monitoring are recommended.

Keywords: Aral Sea, ecological problem, drying, salinization, socio-economic consequences, water resources management, ecological restoration.

Introduction

At the beginning of the 20th century, the Aral Sea was one of the largest inland water bodies in Central Asia, occupying approximately 68,000 km². It accumulated the water of the Amu Darya and Syr Darya rivers and served as an important source for ecological, economic, and social life in the region. The sea provided significant opportunities for fisheries, transport, irrigation systems, and tourism, and also had a considerable impact on the region's climate and soil fertility (Glantz, 1995; Micklin, 2007).

From the 1960s, during the USSR period, in order to develop agriculture, a large part of the Amu Darya and Syr Darya waters was redirected for irrigating cotton and other crops. As a result, the natural water exchange of the Aral Sea was disrupted, and the level began to decline rapidly. Micklin and Williams (1999) called this process "one of the greatest man-made ecological disasters." According to their studies, the decrease in the sea level not only reduced the water area but also significantly changed the region's biodiversity and microclimate.

In addition, environmental specialists Glantz (1995) and Small (2001) call the drying process of the Aral Sea the "sea drying syndrome." They analyzed this phenomenon as an ecological crisis associated with the rapid reduction of inland water bodies, increased salinity, and the spread of dust and salt by wind. As a result, the

fishing industry has almost disappeared, soil fertility has decreased, and the health of the local population has been endangered.

According to scientists, the problem of the Aral Sea is complex not only ecologically but also socio-economically. Micklin and Williams (1999) emphasize that the social consequences related to the decrease in sea level—loss of jobs, migration of the local population, and increased health problems—pose a threat to regional stability. At the same time, studies by Small (2001) and Glantz (1995) highlight the need for rational management of water resources, soil and climate monitoring, and international cooperation for ecological restoration.

This article scientifically analyzes the ecological, social, and economic problems of the Aral Sea, identifies the causes, and evaluates restoration possibilities. Studies show that the Aral Sea issue is of great importance not only regionally but also in terms of global ecological security (Micklin, 2007; Glantz, 1995).

Method

This article comprehensively studied the ecological, social, and economic problems of the Aral Sea. The research was based on the following methodological approaches:

Literature analysis – The changes in the Aral Sea level, salinization, biodiversity, and impact on human health were analyzed based on studies such as Micklin (2007), Glantz (1995), Small (2001), and Williams & Micklin (1999). This method allowed for a comparison of historical and contemporary data.

Analysis of geographical and statistical data – Official state statistics on the Aral Sea's area, water level, and salinity (ecological data from Uzbekistan and Kazakhstan, 1960–2020) were analyzed. This process served to show the reduction of water resources and the speed of the ecological crisis.

Study of ecosystem monitoring data – Changes in biodiversity, fish species, and soil fertility were analyzed based on scientific research (Small, 2001; Glantz, 1995). Additionally, the impact of windborne salt and dust on the population and agriculture was examined.

Socio-economic analysis – Data on population size, employment, migration, and health status in the region were analyzed. This method made it possible to demonstrate the social consequences of ecological changes in the Aral Sea.

The research employed a combination of qualitative and quantitative methods, i.e., scientific articles, statistics, official reports, and monitoring results were analyzed together.

Results

The research results showed the following:

Reduction of water area and level – In the 1960s, the area of the Aral Sea was 68,000 km², while in the 2020s it decreased to approximately 10,000 km² (Micklin,

2007). As a result of the decline in water level, a large part of the sea dried up and was divided into the “Small Aral” and the “Large Aral.”

Salinization and ecological degradation – Due to the increase in water salinity, fish species decreased by 70–90% (Glantz, 1995). The dried seabed spread by wind, reduced soil fertility in the region, and increased the number of diseases associated with wind-borne salt.

Socio-economic consequences – The fishing industry almost disappeared, and the local population is migrating (Small, 2001). The efficiency of land for agricultural crops decreased, resulting in reduced economic income. Health conditions worsened: respiratory diseases and allergic diseases increased.

Ecological restoration measures – Through the “Kokaral” dam in Kazakhstan, the water level in some parts of the Small Aral increased and biological activity was partially restored (Micklin, 2007). However, full ecological restoration is a long-term and complex process and requires rational management of water resources and international cooperation. In conclusion, the study showed that the problems of the Aral Sea are complex in ecological, social, and economic terms, and scientific-based management and international cooperation are necessary to address them.

Conclusion

The Aral Sea problem is a vivid example of the impact of human activity on natural ecosystems. The research results showed that:

From the 20th century onward, improper management of water resources led to a sharp decline in the sea level and drying.

The increase in water salinity, the decrease in biological diversity, and the reduction of soil fertility became some of the main causes of the ecological crisis.

Socio-economic consequences were observed: the loss of the fishing industry, migration of the local population, a reduction in jobs, and an increase in health problems.

Ecological restoration measures, such as the Kokaral dam, provide only short-term and partial results; full restoration is a long-term and complex process and requires international cooperation and scientifically based management.

Thus, the Aral Sea issue is a complex problem in ecological, social, and economic terms, and it is necessary to find solutions through rational management of water resources, ecological monitoring, and international cooperation. The experiences in this region serve as an important lesson for the whole world in protecting nature and anticipating the consequences of human activity.

References

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