HISTORY OF THE IRRIGATION SYSTEM IN UZBEKISTAN

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Abstract:
This article covers the history of the development of Uzbekistan's irrigation system. Irrigation systems have played an important role in the development of the country's economy and culture since ancient times. The article analyzes, in particular, the changes during the Soviet era and after independence. The major water projects implemented during the Soviet era and their environmental consequences are discussed, as well as the reforms implemented after independence and new water management strategies. The article also examines the main problems in the management of water resources in Uzbekistan today and ways to solve them.

Keywords: Uzbekistan's irrigation system, water resources management, environmental consequences, Soviet water projects, post-independence reforms, water-saving technologies, historical irrigation systems.

Introduction

Archaeological excavations in Uzbekistan have revealed evidence of the history of irrigation dating back to 3000-3200 BC. During this period, waterworks and irrigation systems, including important projects such as the Darghom Canal, were constructed by hand. This article provides detailed information about ancient hydraulic engineering works along the Zarafshan River valley. The Darghom Canal, built using water from the Zarafshan River, was dug in the Bronze Age to improve water supply. Archaeological data show that when digging this canal, hydraulic engineers took into account the geographical and geological features of the land, including relief, to a very high degree. This indicates a high level of scientific and technical thinking at that time[3].

During the Bronze Age, cisterns were built every 35-45 km along the routes of large trade caravans. These cisterns, while serving as a source of water for caravan traders and travelers, were built in a way that was adapted to the natural conditions of the environment. This system indicates the existence of an effective system of water management and distribution at that time.

Uzbekistan's Bronze Age irrigation structures and hydraulic systems, as revealed by archaeological excavations, confirm that advanced methods of water resource use were developed at that time. The Dargum Canal and cisterns along trade routes played an important role in storing and distributing water, which contributed to the economic and cultural

development of the region. These systems had a significant impact not only on irrigation, but also on the lifestyle and activities of the region's population [4].

Literature review

The Soviet government, as part of its development programs, invested heavily in expanding irrigation systems in Uzbekistan. In the process, new water structures, such as reservoirs and canals, were built, which allowed for a significant increase in the area of irrigated land. However, these efforts were mainly aimed at expanding cotton cultivation, which led to the transformation of the republic's economy into a monoculture.

The construction of water structures was carried out in an excessive manner, disregarding the natural conditions and ecological balance of the republic. Along with the construction of numerous reservoirs and canals, water consumption increased sharply, which led to the drying up of natural water sources and the degradation of the Aral Sea. The ecological crisis around the Aral Sea, including the decline in sea level and the increase in salinity, has had a negative impact on biodiversity in the region and has intensified salt dust storms, which are harmful to agriculture.

Research Methodology

analysis of scientific literature, advanced foreign and local experiences, and comparative methods were used.

During the 1920s and 1930s, hydraulic structures were built manually, and by the 1950s and 1960s, this process was more efficient due to large-scale mechanization. Thanks to large-scale irrigation projects implemented during the former Soviet Union, from the 1960s, the waters of the Amu Darya and Syr Darya rivers began to be diverted to the deserts in order to expand the irrigated area by developing the deserts. As a result of this process, Uzbekistan currently manages 4.3 million hectares of irrigated land. These newly irrigated areas are of great importance in ensuring the food security of the country's population, which now numbers 34 million, compared to 6.2 million in 1950[1].

During this process, special attention was paid to cotton cultivation, which led to excessive and inefficient use of water resources. This, in turn, had a negative impact on the natural environment. In particular, the groundwater level rose sharply, which led to the near drying up of the Aral Sea. Nevertheless, although the newly developed 3.0 million hectares of land contributed to the increase in total green areas, there is still a lack of clear analysis of the contribution of this area to the cleanliness of the air in the atmosphere. The research and results of this work in this regard may play an important role in the development of this sector in the future.

Analysis and results

After Uzbekistan gained independence, water consumption in our country decreased by about 20 percent compared to the 1980s due to a sharp reduction in the area of water-intensive crops such as cotton and rice, changes in administrative and economic management methods of water resources, as well as global climate change and problems of transboundary water relations. This situation indicates the need to adopt new approaches to water resources management.

Global climate change is also causing water scarcity in the Central Asian region. The severity of this problem is highlighted by the frequent occurrence of droughts in the region. While until the 1970s, water scarcity years were observed on average once every 10-12 years, over the past 40 years, the frequency of such events has increased to once every 4-6 years [5]. These changes require a review of water resources management strategies in the region and increase the need for research and development, including the introduction of water-saving technologies and enhanced cooperation in transboundary water resources management.

As revealed by the research conducted at the Institute of Soil Science of the Former Union Academy of Sciences, after the initial sharp decrease in the number of microorganisms during irrigation, their number increases after 1-2 days and reaches its peak by 4-5 days. This indicates the processes of restoring the biological activity and fertility of the soil.

The method of irrigation is carried out by trapping snowmelt and river flood waters in cisterns in early spring. This method involves one-time irrigation and is mainly used in semi-arid regions, including the Volga region, the North Caucasus, the desert regions of Western and Eastern Siberia, Ukraine and Kazakhstan. In these regions, summer precipitation is sufficient to meet the water needs of plants.

In the plain regions of Uzbekistan, groundwater is located deep, which leads to a sharp decrease in the moisture content of the upper layers of the soil after the end of the irrigation season, especially in the summer in fields where wheat, ryegrass and other perennial grasses grow. This situation complicates tillage: the soil is not plowed to the specified depth, clods are displaced, and gentle plowing is not achieved. Therefore, water is supplied through temporary irrigation networks to meet the water needs of plants before summer and autumn plowing. The yield of cotton and other crops depends on how effectively autumn plowing is carried out. Under optimal conditions, soil moisture should be at the level of 70-75% (40-60% relative to TNS) relative to the total crop water consumption standards (CHDNS). Irrigation standards are determined by providing 700-800 m3/ha of water on light soils, 900-1000 m3/ha on medium soils, and 1000-1200 m3/ha on heavy soils.

In 1960-1962, as a result of the deterioration of the functioning of the collector-drainage networks in the Gulistan and Syrdarya districts of the Syrdarya region, the level of runoff water increased from 1 to 1.5 meters in the summer. This process led to soil salinization, which led to the thinning of crops from year to year, deterioration of their growth and development,

and a decrease in productivity. In particular, cotton productivity in some farms decreased threefold from 1954 to 1962.

From 1960 to 1990, the Soviet Union implemented large-scale land reclamation programs in the Aral Sea basin, doubling the area of irrigated land and water abstraction. These large-scale programs also caused economic losses related to climate change, with the degradation of more than 4 million hectares of land in the region costing billions of dollars per year.

In 1960, the total water withdrawal from the Aral Sea basin was 60,610 million m3, and by 1990 this figure had increased by 1.8 times, reaching 109,098 million m3. During this period, the population of the Aral Sea basin increased by 2.7 times, the area of irrigated land by 1.7 times, agricultural production by 3 times, and gross national product by almost 6 times[6]. These increases have played an important role in the management of water resources and economic development in the region, but have also created serious difficulties in maintaining ecological and economic balance.

During the years of independence, significant changes have occurred in the water resources management system in the Republic of Uzbekistan. This system has been significantly improved as part of the reforms being implemented in various sectors of the country's economy. In particular, in accordance with the Decree of the President of the Republic of Uzbekistan No. PF-3226 dated March 24, 2003 "On the most important directions of deepening reforms in agriculture", the following significant changes were made[1]:

The process of abolishing the forms of joint-stock and state-owned enterprises and establishing farms in cotton farming has been fully completed. This step was taken to increase the independence of farmers in the cotton sector and improve economic efficiency.

The water resources management system has been changed from administrative-territorial management to the basin principle. This change will help increase the efficiency of water resource use and reduce environmental impact.

Water users have been actively involved in the decision-making process, and some of the state's powers have been transferred to public organizations. These organizations are called Automated Authorized Point Licensing Agencies (AAPLAs). They play an important role in ensuring the rational use of water resources, as they allow local residents and farmers to directly manage the use of water resources.

The average annual water resources of Uzbekistan's inland rivers are about 11.5 km³ per year, which corresponds to about 18% of the country's total water demand. The country's total water consumption is mainly covered, about 82%, by the transboundary Amu Darya and Syrdarya rivers, whose annual surface runoff is estimated at 123.08 km³. Based on these indicators, water consumption restrictions are set within the framework of an intergovernmental agreement between the Aral Sea basin states and the distribution of water resources between the countries of the region is carried out.

The water management system of Uzbekistan includes 250 irrigation systems, which are equipped with modern water intake facilities, and the total length of irrigation networks is 182.8 thousand km. Among these networks, there are more than 26.1 thousand km of inter-farm canals. The collector-drainage network has a total length of 138.8 thousand km, of which 38.2 thousand km are closed horizontal networks. This extensive system plays an important role in ensuring the efficient use of water resources and serves the sustainable development of the country's agriculture.

The water management infrastructure in the Republic of Uzbekistan is very developed, and currently a total of 5047 units are installed at 1602 pumping stations throughout the country. In addition, 3366 vertical drainage wells are operating. These systems allow for effective management of water resources and land reclamation, which plays an important role in reducing the problem of water shortage in agricultural sectors[2].

There are more than 50 reservoirs in the republic with a total capacity of 17.8 billion cubic meters. These reservoirs are of crucial importance in the country's water supply system, as they allow for water storage, distribution, and use during periods of water shortage. Reservoirs play a key role not only in meeting agricultural needs, but also in hydropower generation and environmental protection.

Conclusion

Although the expansion of irrigation systems in Uzbekistan during the Soviet era served to boost the economy of the republic, these processes undermined ecological sustainability and created a number of problems. Today, this historical experience provides valuable lessons about the need to maintain sustainability and ecological balance in water resource management. Uzbekistan's current water policy seeks to learn from past mistakes and change its approach to the environment, which is an important step towards sustainable development for future generations.

The water management system of Uzbekistan is also provided with a developed road infrastructure, power lines and communication networks. This allows for further optimization of the water resources management process and ensures reliable and uninterrupted operation of water management facilities. With the help of this infrastructure, water distribution can be carried out accurately and efficiently, which has a positive impact on the economic and social development of the country.

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