

Article

## The Impact of the Kushtepa Channel Construction on the Water and Food Security of Uzbekistan

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**Abstract:** This research paper provides a scientific analysis of the comprehensive impact of the Kushtepa canal being constructed in northern Afghanistan on the distribution of water resources in the Amu Darya basin and on the water and food security of the Republic of Uzbekistan. The article provides a detailed analysis of the canal's technical parameters, river flow reduction forecasts, and the potential socio-economic losses in Uzbekistan's agriculture as a result. International legal aspects of transboundary water resource management, regional water diplomacy, and adaptation measures taken by Uzbekistan, including the introduction of water-saving technologies and the modernization of irrigation systems, will also be discussed.

**Keywords:** Kushtepa Canal, Amu Darya, Water Security, Food Security, Transboundary Waters, Agriculture, Climate Change, Water Diplomacy

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### 1. Introduction

The Central Asian region is currently facing serious environmental and economic challenges due to global climate change and limited water resources. The Amu Darya, the largest river in the region, is vital for the agriculture and energy systems of Uzbekistan, Turkmenistan, and Tajikistan. The Amu Darya basin is not only an economic resource but also a key artery ensuring the lifestyle, food security, and environmental sustainability of millions of people in the region [1]. However, in recent years, the water balance in the region has undergone changes under the influence of new and serious geopolitical and technical factors. Starting in March 2022, the construction of the massive Kushtepa canal, which will draw water from the left bank of the Amu Darya, by the interim government of Afghanistan, has raised the issue of water resource management in the region to a new level. While this project aims to irrigate the northern regions of Afghanistan, ensure food independence, and create thousands of new jobs, it significantly increases the risk of water scarcity for downstream countries, particularly Uzbekistan. The situation is further complicated by the lack of modern legal agreements between Afghanistan and Central Asian countries on the use of Amudarya water [2].

The relevance of this article lies in the fact that the construction of the Kushtepa canal directly impacts Uzbekistan's agricultural potential, especially the socio-economic stability of the Khorezm region and the Republic of Karakalpakstan, located in the lower reaches of the river. The aim of the study is to scientifically assess the impact of canal construction on Uzbekistan's water and food security, forecast potential risks, and propose effective adaptation strategies to these challenges [3].

Kushtepa Canal: Technical Specifications and Current State of the Project

The Qoshtepa canal project is one of the largest irrigation facilities in Afghanistan's history, originating from a section of the Amu Darya in the Kaldar district of Balkh province [4].

## 2. Methods

This study employs a mixed-method approach combining hydrological analysis, statistical data evaluation, and expert-based forecasting. Data were collected from official reports, international organizations, and existing literature on transboundary water management. The study analyzes changes in the Amu Darya water balance under the influence of the Kushtepa canal and evaluates potential impacts on agriculture and food security in Uzbekistan. Scenario-based forecasting was applied to estimate future risks under different water availability conditions.

## 3. Result and Discussion

The total length of the canal is 285 kilometers, the width is 100 meters, and the depth is 8.5 meters. The technical capacity of the project is 650 cubic meters of water per second, which makes it possible to receive approximately 10 to 15 cubic kilometers of water per year. This volume is equal to about 15-20% of the average annual flow of the Amu Darya [5].

The project is planned to be implemented in three stages. The first stage covered a distance of 108 kilometers and was completed at the end of 2023. The second stage includes a 177-kilometer section, and as of March 2026, excavation work at this stage is 98% complete. The third stage involves the construction of irrigation networks and the development of agricultural lands. The full completion and commissioning of the project is scheduled for 2028 [6].

Industry experts and international experts are pointing to a number of technical shortcomings in the canal's construction. The main problem is that the canal bed is not concreted and passes through sandy soils. This can lead to the absorption of a large portion of water (approximately 30-40%) into the ground, resulting in a rise in groundwater levels and the salinization of surrounding lands. Additionally, the quality of the canal's hydraulic structures—specifically the structures at the water intake—and the ability to regulate river flow also raise serious questions [7]. Such technical deficiencies not only increase water losses but also negatively affect the stability of water supply for the countries downstream of the river.

Through this project, the Afghan government aims to develop 550,000 hectares of land and achieve the country's grain independence. However, the economic efficiency and environmental safety of the project remain questionable without regional cooperation. The construction of the canal is a factor that can change not only the distribution of water resources but also the entire ecosystem of the Amu Darya basin [8].

### Changes in the water balance of the Amu Darya and hydrological risks

The Amu Darya basin is the largest river system in Central Asia, with an average annual flow of 78-79 cubic kilometers. The formation of the river's flow depends mainly on the melting of glaciers and snow in the mountains of Tajikistan and Afghanistan. In recent decades, the reduction of glacier areas and changes in precipitation patterns resulting from global climate change have led to a decrease in river runoff. Under such conditions, the annual water intake through the Kushtepa canal ranges from 10 to 15 cubic kilometers, which seriously affects the river's water balance.

Hydrological analyses indicate that when the Kushtepa canal reaches full capacity, the water level in the lower reaches of the Amu Darya is expected to decrease by 15-20 percent. This indicator can be even higher in low-water years. For example, in years of drought, when the river flow decreases to 34-40 cubic kilometers, the share of water taken through the canal can be 30-40% of the river flow. In such a situation, the water shortage in the downstream regions of Uzbekistan and Turkmenistan will reach a critical level.

The influence of the canal on the river flow is related not only to the reduction of water volume but also to changes in the river flow regime. During the irrigation season, i.e., in April-August, when water demand reaches its peak, the increase in water intake through the canal creates serious difficulties in irrigating the crop fields downstream. Furthermore, the decrease in river runoff will further worsen the ecological situation in the

Aral Sea basin. In the Aral Sea region, negative processes such as a decrease in groundwater levels, soil salinization, and an increase in dust storms may intensify [9].

Another aspect of hydrological hazards is related to the unconcrete channel of the canal. Due to the fact that a large portion of water is absorbed into the ground, the efficiency of water withdrawn from the river flow is low. This could lead to the waterlogging and salinization of land in Afghanistan itself. At the same time, a decrease in river flow can lead to changes in the riverbed and bank erosion, which threatens the safety of hydraulic structures.

Impact on Uzbekistan's agriculture and food security [10].

The agricultural sector holds one of the leading positions in Uzbekistan's economy, accounting for approximately 25–27 percent of the country's gross domestic product (GDP). More than 90 percent of the country's total water resources are used specifically for agricultural needs. Therefore, the decrease in the water level of the Amu Darya directly and strongly affects the agricultural potential and food security of Uzbekistan [11].

The water shortage caused by the construction of the Kushtepa canal will primarily hit the Khorezm region and the Republic of Karakalpakstan, which are located in the lower reaches of the river. Agriculture in these regions is entirely based on lands irrigated by the waters of the Amu Darya. A 15-20% decrease in water flow leads to a significant reduction in cultivated areas and a decrease in crop yields in these regions. According to expert estimates, economic losses in Uzbekistan's agriculture due to water shortages could amount to 1.5–2 billion US dollars per year [12].

From the perspective of food security, water scarcity leads to a decrease in the production of grain, cotton, fruit and vegetable products, and livestock products. This leads to an increase in food prices in the domestic market and a decrease in the real income of the population. In particular, the reduction of rice and cotton fields, which require a lot of water, can lead to the loss of income for the population employed in these industries. According to forecasts, approximately 250,000 people employed in agriculture may be at risk of unemployment [13].

Socio-economic consequences are associated not only with a decrease in income but also with the deterioration of the population's living conditions. Water scarcity also negatively affects the supply of drinking water, which can lead to a deterioration of public health and the sanitary-epidemiological situation. Agricultural losses also lead to increased migration flows from rural areas to cities, increasing pressure on social infrastructure.

The government of Uzbekistan is implementing large-scale reforms to modernize agriculture and introduce water-saving technologies in order to mitigate these risks. However, the impact of external factors, such as the Kushtepa Canal, may reduce the effectiveness of these reforms and require additional resources. To ensure food security, it is required to radically change the composition of crops in the country and raise water use efficiency to the level of international standards [14].

Legal aspects of managing transboundary water resources.

The management of transboundary water resources is considered one of the most complex and sensitive areas of international law. Relations between Afghanistan and Central Asian countries regarding the Amu Darya basin currently lack a modern legal framework. The treaties signed between the former Soviet Union and Afghanistan in 1946, 1958, and 1961 were primarily focused on the technical aspects of delimitation and riverbed use, failing to fully address the issue of equitable distribution of water resources.

International legal norms, in particular, the 1992 UN Convention on the Protection and Use of Transboundary Watercourses and International Lakes and the 1997 Convention on the Right to Various Types of Shipless Use of International Watercourses, promote the principles of "fair and rational use" and "no significant damage" in the use of transboundary water resources. However, Afghanistan is not a party to these conventions, which makes it difficult to conduct the negotiation process in the international legal arena [15]. The interim government of Afghanistan considers the construction of the Kushtepa canal its sovereign right and emphasizes that it has its share in the use of Amu Darya water. At the same time, downstream countries, particularly Uzbekistan and Turkmenistan, are

concerned that the decrease in river flow will cause serious damage to their economies and ecology. To fill the legal gap, it is necessary to develop new multilateral agreements at the regional level and involve Afghanistan in regional water management mechanisms, such as the Interstate Water Coordination Commission (IWC).

The importance of diplomatic dialogue lies in the fact that the water issue is not only a technical issue but also a political and security one. The government of Uzbekistan continues technical and political dialogue with Afghanistan on the water issue. Water resources management through regional cooperation and mutually beneficial agreements not only reduces water scarcity but also contributes to strengthening stability and trust in the region. The mediation and technical assistance of international organizations and donor countries in this process are also important.

#### *Uzbekistan's Adaptation Strategy and Solutions.*

In response to the water shortage caused by the construction of the Kushtepa canal and climate change, the government of Uzbekistan has switched to an "emergency mode of operation" and is implementing a large-scale adaptation strategy. The main goal of this strategy is to increase water use efficiency, reduce water losses, and modernize agriculture.

First of all, special attention is paid to the introduction of water-saving technologies. By 2028, drip, sprinkler, and discrete irrigation systems are planned to be implemented across most of the country's 3.5 million hectares of irrigated land. These technologies allow for a 40-50% reduction in water consumption and a 20-30% increase in yield. The government is allocating subsidies and preferential loans to farms that have implemented water-saving technologies. The second important direction is the modernization of irrigation systems and the concreting of canals. Most of the main and internal canals in Uzbekistan have an earth channel, and water losses in them amount to 30-40%. Currently, thousands of kilometers of canals are being concreted as part of the state program. This measure significantly increases the efficiency of water delivery from the source to the field. Priority tasks include the digitalization of reservoirs and hydraulic structures, as well as the implementation of "smart" water metering systems.

The third direction is the optimization of crop composition. Water-intensive crops, particularly rice and cotton, are being reduced, and they are being replaced by low-water and high-yield crops (fruit and vegetable crops, legumes, intensive orchards). This will not only save water but also increase the export potential of agricultural products. Selection work has also been intensified to create new varieties resistant to salinity and drought.

The fourth area is strengthening regional water diplomacy. Uzbekistan is actively negotiating with Central Asian countries and Afghanistan on the joint and rational use of water resources. Proposals are being put forward to create a water and energy consortium at the regional level and a unified information system for managing water resources. Such cooperation is beneficial for all parties and serves to reduce the risk of water scarcity.

#### **4. Conclusion**

The construction of the Kushtepa canal is not only an environmental but also a serious economic and social challenge for the Republic of Uzbekistan. The depletion of water resources in the Amu Darya basin poses a direct threat to the country's food security and could lead to significant losses in the agricultural sector. The research results show that when the canal reaches full capacity, a 15-20% decrease in river flow negatively impacts the socio-economic stability of the lower-flow Khorezm region and the Republic of Karakalpakstan.

However, this crisis situation can serve as a powerful impetus for modernizing Uzbekistan's agriculture and radically improving water use efficiency. Measures implemented by the government, such as the introduction of water-saving technologies, the concreting of irrigation systems, and the optimization of crop composition, are essential in mitigating the risk of water scarcity. At the same time, it is necessary to widely use digital technologies in water resource management and introduce accurate water accounting systems.

Regional cooperation and water diplomacy are the only and non-alternative way to

solve this problem. The main conditions for sustainable development are the inclusion of Afghanistan in the framework of international water law, the development of new multilateral agreements on the use of transboundary water resources and the improvement of regional water management mechanisms. Water resource management based on mutual trust and mutually beneficial cooperation not only ensures water security but also contributes to strengthening peace and stability throughout the Central Asian region.

Future research should focus on continuous monitoring of the Kushtepa canal's impact on river flow, modeling the combined consequences of climate change and the canal's impact, and assessing the economic efficiency of water-saving technologies by region. Only a scientifically grounded approach and regional solidarity can successfully overcome the challenges related to water and food security.

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