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WATER SCARCITY PERSPECTIVES IN UZBEKISTAN: DRIVERS, IMPACTS, AND SUSTAINABLE SOLUTIONS

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Abstract: Uzbekistan is among the most water-stressed countries in Central Asia, largely due to its arid climate, heavy dependence on trans-boundary rivers, inefficient agricultural water use, and accelerating climate change. Nearly 80 percent of the country's surface water originates outside its borders, primarily from the Amudarya and Syrdarya rivers. This paper examines the major drivers of water insufficiency in Uzbekistan, including upstream water withdrawals by neighboring countries, glacier retreat in mountainous regions, infrastructure losses, and agricultural inefficiencies. It further analyzes socio-economic and environmental impacts and proposes realistic, policy-relevant solutions aimed at ensuring long-term water security.

Keywords: Uzbekistan, water scarcity, trans-boundary rivers, climate change, irrigation efficiency, Central Asia

Introduction

Water scarcity has emerged as one of the most critical development challenges facing Uzbekistan. As a downstream country in the Amudarya and Syrdarya river basins, Uzbekistan relies heavily on water flows originating in upstream states such as Tajikistan, Kyrgyzstan, and Afghanistan. At the same time, rising temperatures, declining glacier mass, and outdated water management systems exacerbate water stress. Given that agriculture accounts for approximately 90 percent of total water consumption, inefficient irrigation practices amplify the vulnerability of the national water system [1].

This paper aims to provide a comprehensive academic assessment of Uzbekistan's water scarcity by identifying key drivers, evaluating current and future risks, and outlining feasible solutions grounded in regional cooperation, technological modernization, and climate adaptation.

Uzbekistan has a predominantly arid to semi-arid climate, with limited precipitation and high evaporation rates. The country's two main rivers—the Amudarya and Syrdarya—originate in glacier- and snow-fed mountain systems in neighboring states. As a result, Uzbekistan's water availability is highly sensitive to both climatic processes in upstream regions and political decisions regarding water allocation [2-4].

Groundwater resources supplement surface water supplies, but over-extraction in several regions has led to declining water tables and increased salinization.

Approximately 80 percent of Uzbekistan's surface water resources are generated outside its borders. Upstream hydropower development, i.e. Roghun HPP of Tajikistan with useful capacity of 10.3 km^3 of water, the reservoir of which is planned to be filled gradually over 15–17 years after construction, expanded irrigation systems, and new diversion projects—such as canals constructed on the Amudarya, i.e. The Qosh Tepa Canal, a large irrigation canal under construction in northern Afghanistan (Balkh and Faryab provinces). It started around 2022 and is planned to be completed in 2028. When completed, this canal is said to have a length of 285 km

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to irrigate 0.5 -1.0 million hectares of farm land by consuming approximately 10 km^3 of water. Such project alone is estimated to reduce downstream flows of Amudarya 10-15 percent and with the consideration of climate change it can reach to 18-20 percent. The lack of fully enforceable regional water- sharing mechanisms creates uncertainty and heightens the risk of future shortages.

Climate change is altering hydrological regimes across Central Asia. Rising temperatures accelerate glacier melt, leading to short- term increases in runoff but long- term declines in water availability as glacier volumes shrink. i.e. “Pakhtakor” glacier which is one of the biggest glacier in Uzbekistan noticeably retreated over the past one year.In a single year, about 20 meters of glacier length retreat and the ice thickness decrease by roughly 3 meters were recorded in 2025. Projections indicate that river flows in the Amudarya basin could decline by up to 30 percent by mid- century, while the Syrdarya may experience reductions of around 20 percent. Increased evaporation further diminishes effective water supply.

Agriculture consumes the overwhelming majority of Uzbekistan’s water resources, largely due to water- intensive crops such as cotton and wheat. Much of the irrigation infrastructure consists of unlined open canals, resulting in substantial losses from seepage and evaporation. Inefficient flood irrigation practices persist in many regions, leading to water waste and soil salinization.

Although in the last 5-7 year the new government has done noticeably a lot, many components of Uzbekistan’s water infrastructure date back to the Soviet period and suffer from insufficient maintenance. Water losses during conveyance remain significant, while limited digital monitoring reduces the ability to manage supply and demand efficiently.

The diversion of rivers for irrigation during the twentieth century caused the Aral Sea to shrink dramatically, triggering ecological degradation, dust storms, and regional climate changes. These effects continue to exacerbate water stress by increasing aridity and degrading soil and water quality.

Water scarcity threatens agricultural productivity, rural livelihoods, and food security. Reduced water availability increases competition among users and heightens the risk of social tension. Environmentally, declining river flows and groundwater depletion contribute to land degradation, biodiversity loss, and increased salinity.

The adoption of modern irrigation technologies such as drip and sprinkler systems can significantly reduce water consumption while maintaining or increasing crop yields. Canal lining, laser land leveling, and improved scheduling based on crop water requirements are among the most cost- effective interventions. Uzbekistan has already put a lot of efforts in modernizing the irrigation systems, getting concessional credits of 200 mln USD from World Bank and channeling the funds to projects that aim to reduce water losses and increasing the energy efficiency of irrigation systems across five regions of the country is one of the examples of many. With such support of World Bank, Uzbekistan has come up with the project which plans concrete lining of 259 km of major canals to reduce seepage as well as re-profiling canals for gravity-fed flow (reducing dependence on pumps). Besides that, the government plans building ~470 hydraulic structures for better water control and installation of gated outlets with flow measurement and SCADA digital control systems.

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Expected results include reducing annual water losses by ~540 million m³ and saving 165 million kWh of electricity.

Reducing reliance on highly water- intensive crops and promoting drought- resistant varieties can lower overall water demand. Climate- smart agriculture practices enhance resilience to variable water availability.

Long- term water security depends on regional cooperation among Central Asian states. Strengthening river basin institutions, improving data sharing, and coordinating reservoir operations can help balance upstream and downstream needs.

Investments in hydrological monitoring, glacier observation, and climate forecasting systems are essential for anticipatory water management. Improved data supports more effective planning under increasing uncertainty.

Introducing water pricing mechanisms, incentives for conservation, and penalties for excessive use can encourage more efficient water management. Public awareness campaigns further support behavioral change.

Discussion

While Uzbekistan faces severe water challenges, the crisis is not solely driven by physical scarcity. Institutional reforms, technological upgrades, and regional collaboration offer significant potential to mitigate risks. The prioritization of agricultural efficiency stands out as the most impactful intervention.

Conclusion

Uzbekistan's water insufficiency is the result of interconnected climatic, geopolitical, and structural factors. Climate change and trans-boundary dependence intensify existing inefficiencies, particularly in agriculture. However, through targeted investments, cooperative governance, and sustainable water management practices, Uzbekistan can enhance resilience and secure its water future which, it is doing now slowly but surely.

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