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ECONOMIC CONSEQUENCES OF RESOURCE SCARCITY IN UZBEKISTAN AND WAYS TO ELIMINATE THEM

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Abstract: Uzbekistan faces growing water and energy resource constraints that have significant economic implications for growth, livelihoods, and food security. This paper reviews 2023–2024 statistical data on water availability, energy production, consumption, and trade, linking them to economic outcomes such as agricultural productivity, fiscal balance, and industrial performance. The analysis shows that Uzbekistan remains highly dependent on irrigation (80–90% of water use) and on natural gas (about 75–78% of electricity generation). These dependencies make the country vulnerable to climate variability and production shortfalls, which in turn affect GDP growth and household welfare. The paper concludes with recommendations for improving water efficiency, diversifying energy sources, and protecting vulnerable populations.

Keywords: Uzbekistan; water scarcity; energy security; natural gas; irrigation efficiency; economic impact; 2023–2024 statistics.

As is well known, Uzbekistan is an agro-industrial country with a high share of irrigated agriculture and significant electricity consumption in the agricultural sector. A deteriorating irrigation network, dependence on gas-fired generation, and rapid economic and demographic dynamics create a significant risk of systemic water and energy shortages. The purpose of this article is to assess the economic consequences of current shortages and propose realistic solutions for them in the medium term (up to 2030), based on data from 2023 to the first half of 2025. The analysis is based on statistical data from the State Statistics Committee of Uzbekistan, reports from the World Bank, IEA, and UNECE, as well as government press releases from 2023 to 2025. The analysis uses indicators of electricity production, reservoir volumes, and estimates of the share of electricity consumed in agriculture to assess the dynamics. The research method is a comparative time analysis (2023-2024 and the first half of 2025), a qualitative analysis of the impact on economic sectors, and the development of a set of recommendations based on international experience and local projects in this area. The study examined the state of water and energy resources, which are the most widely used in the country's economy. The distribution of surface water across Uzbekistan is extremely uneven. Water is used for irrigation and to generate electricity. There are more than 600 rivers in the country, all of which belong to the Aral Sea basin. The main area of water flow is the mountainous part of the country, where the most precipitation falls and evaporation is minimal. Of all the countries in the Central Asian region, Uzbekistan is the most dependent on irrigated agriculture, as it has the highest share of irrigated land, the largest rural population of 18,563,300 people (49% of the total population), and the highest population density of 83.6 people per square kilometer. The average annual volume of water use in the country is 51-53 billion m3, with about 80% coming from transboundary rivers (mainly the AmuDarya and SyrDarya). The potential of groundwater is estimated at about 27.6 billion. m^3 per year, however, it is distributed extremely unevenly across the regions. Agriculture consumes about 80-90% of all water resources, which makes the agricultural sector the most vulnerable to droughts and reduced river flow. Industry and public utilities account for only about 10-15% of the total. After the dry year of 2022, there was a slight improvement in water reserves in 2023-2024. According to the Ministry of Water Resources, the volume of water in reservoirs reached 11.15 billion cubic meters at the beginning of 2024, which

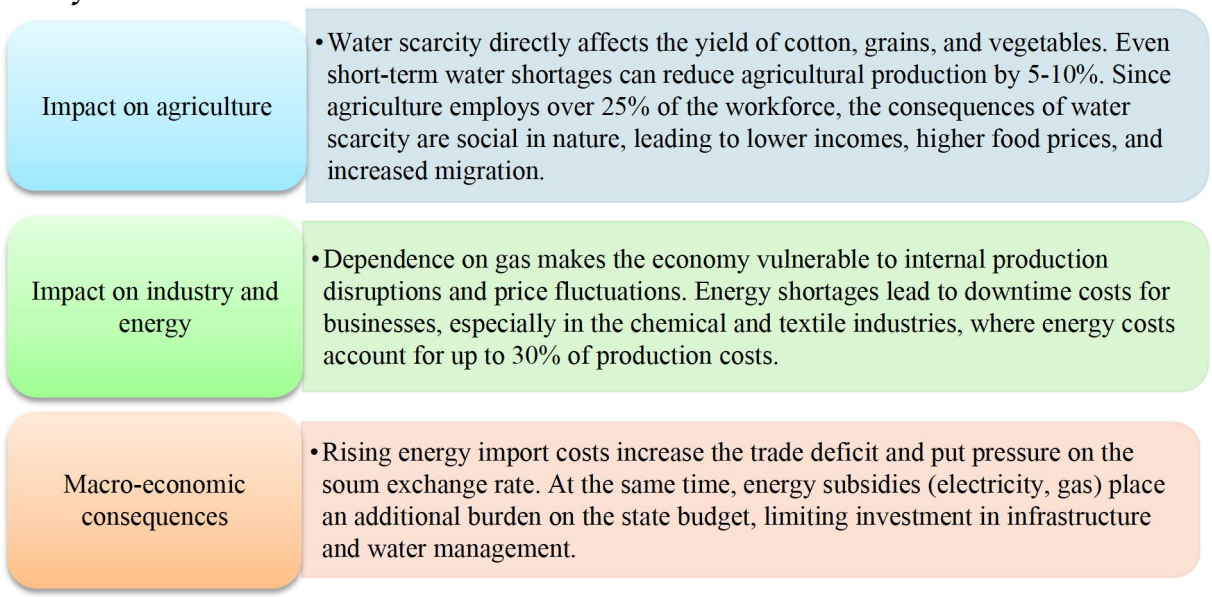
is 12% higher than at the beginning of 2023. However, this increase is temporary and does not address the structural issues of low water efficiency. According to estimates by the World Bank and UNECE, water losses in the irrigation network amount to up to 40-45% due to aging channels, leaks, and insufficient automation. At the same time, crop yields are directly dependent on the volume and stability of water supply. The country's water productivity remains low, with international estimates indicating a GDP per cubic meter of water of around 0.6 dollars, compared to the global average of around 15 dollars.

Uzbekistan's energy system remains heavily reliant on natural gas:

- 75-78% of all electricity generation in 2023 was powered by gas,
- around 8-10% by hydropower,
- the rest by coal and renewable sources.

Per capita electricity consumption was around 1,800 kWh in 2023, slightly higher than the previous year. However, the overall energy intensity of GDP remains high, although there has been a gradual decrease due to industrial modernization and the introduction of energy-efficient technologies. Previously, Uzbekistan was a net exporter of natural gas, but this has changed in 2023-2024. In 2023, the volume of gas imports amounted to about $695 million, and in 2024, imports costs increased significantly due to domestic shortages and rising demand. The increase in imports increases the burden on the country's trade balance and foreign exchange reserves. In 2024, projects for the development of renewable energy were announced, including solar power plants, wind farms and the waste-to-energy project. These measures are aimed at reducing the Republic of Uzbekistan's dependence on gas and gradually transitioning to sustainable energy sources. Resource scarcity (natural, labor, or capital) has economic consequences. The limited availability of resources presents society with the challenge of choosing the most efficient ways to use them in the current period and preserve them for the future. This limitation affects the production processes of economic entities, the country's investment attractiveness, and the overall standard of living for our citizens, who also face resource scarcity and limitations in their consumption. So what are the consequences of resource scarcity in the country? Economic experts identify three main areas of impact of resource scarcity, which have economic consequences for the state. These consequences are presented in Figure 1.

Figure 1 - Economic consequences of resource scarcity



We present a quantitative assessment of the resources of the Republic of Uzbekistan for two full years and consider their changes over time.

Table 1 - Quantitative assessments of the availability and dynamics of resources*

Indicator	The year 2023	2024 (estimated)	deviation
Volume of water use, billion m³	51,0	52,5	+3%
Share of agriculture in water consumption, %	88	87	–1 point
The volume of electricity from gas, %	76	75	–1 point
Gas imports, USD million	695	>1000	+40%
Volume of water in reservoirs, billion m ³	9,9	11,15	+12%

(* - according to CAWater-Yearbook, IEA, Ministry of Energy, and open sources)

Statistical data for 2023-2024 confirm that water and energy shortages remain key constraints on Uzbekistan's economic growth. In 2024, the volume of electricity production increased and was estimated at about 81.29 billion. kWh, which is ≈4.6% more than in the previous year (data for 2024). At the same time, the production profile is changing: the share of small and renewable sources is growing. The agricultural sector remains a major consumer of electricity, consuming around 7-9 TWh, depending on estimates, with a significant portion coming from irrigation pumps. The World Bank and government documents indicate that approximately 2.4 million hectares of irrigated land rely on pumping systems, with 1,700 pumping stations consuming around 7.2 billion kWh per year.

Uzbekistan has been and remains a country with a high degree of water stress (it ranks in the top third of the list of countries with the highest degree of water stress in international rankings), and national reports highlight the need for reforms in water management and network modernization. Some sources have noted that in 2024, due to favorable rainfall patterns, the volume of water in reservoirs increased compared to 2023, but structural issues related to leaks and inefficient distribution remained unresolved. The high dependence on irrigation and natural gas poses systemic risks to food and energy security. Thus, the following ways can be proposed to reduce the consequences of resource scarcity using special mechanisms and tools:

- Technical and investment measures;
- Institutional and legal measures;
- Financial instruments and international cooperation.

Modernization of irrigation infrastructure - replacement of outdated canals, introduction of closed pipelines and local point irrigation systems (drip irrigation), repair and replacement of pumps with energy–efficient models - will lead to rational use of water resources.

Energy conservation and flexible network operation - implementation of demand management systems, support for agricultural machinery with better energy efficiency, and reconstruction of the distribution network - will reduce electricity losses in the country. Diversification of energy sources: strengthening of wind and solar generation programs. Pricing reform - gradually introducing more targeted tariffs with compensation for vulnerable groups of both the population and business entities, in order to remove the subsidy bias and stimulate energy savings. Integrated management of water basins.

Encouraging private investment and SMEs, using special regimes that guarantee the return of investments in water and energy infrastructure, such as guarantees, subsidized loans, and government orders. Attracting international loans and grants.

Despite the positive trends of growing water reserves and the development of green energy, accelerated structural reforms are needed to improve resource efficiency and strengthen economic resilience.

Implementing irrigation infrastructure modernization programs, developing renewable energy sources, and improving institutional management will help Uzbekistan reduce resource

vulnerability and ensure long-term sustainable growth. The expected impact is that in the medium term (3-5 years), a set of measures can significantly reduce regional deficits, reduce agricultural energy dependence, and enhance economic resilience to climate and external challenges.

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