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Implications for Uzbekistan's Water Supply of Qosh Tepa Canal Construction in Afghanistan

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14 November, 2023

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Introduction

The purpose of this article is to analyse the developments surrounding the construction of the Qosh Tepa canal in Afghanistan and its potential impact on Uzbekistan's irrigation water supply. This canal, measuring 285 kilometres in length, 100 meters in width, and 8.5 meters in depth, is intended to be filled with water from the Amu Darya to irrigate 500,000 hectares of land in Afghanistan's northern provinces of Balkh and Faryab[1]. Starting in 2022 with a budget of US$684 million, the construction is

anticipated to conclude in five years. As of early October 2023, the initial 100-kilometer section has been already completed.[2]

Predictably, the announcement of the canal's construction has raised significant concerns among Afghanistan's northern neighbours, especially Uzbekistan and Turkmenistan, both heavily dependent on water supplies from the Amu Darya - one of the two primary water sources for Central Asian countries. Uzbek President Shavkat Mirziyoyev has already publicly expressed his apprehension and tried to reach out to Afghan authorities to negotiate compromises regarding water intake from the Amu Darya.[3] Concurrently, the Uzbek government is implementing domestic measures to prepare for the potential reduction in access to the river's water resources.

This article seeks to provide an overview of the broader situation concerning the utilization of water resources from the Amu Darya, shedding light on the steps taken by the Uzbekistan government to address the implication of the construction of Qosh Tepa canal and proposing potential solutions to mitigate the looming water-supply crisis.

What is Known About Amu Darya Water Resources

According to Uzbek official sources, the average annual water flow from all sources in the Aral Sea basin is 116.2 billion cubic meters, with 67.4 percent originating in the Amu Darya River basin[4] the river begins in Tajikistan, where 74% of its flow is generated[5] and has a length of 1415 km, calculated from the point of its formation by the confluence of two main tributaries - the mountain rivers Panj and Vakhsh. Considering the primary tributary, the Panj River, the length of the Amu Darya extends to 2540 km[6]. The main tributaries of the Amu Darya include, in addition to the Panj and Vakhsh, the rivers Kunduz, Kafirnigan, Sherabad, and Surkhandarya. All these rivers are situated in the upper reaches of the Amu Darya, and beyond the last tributary, it stretches without further tributaries for a length of 1200 km.

As of 1984, the recorded runoff of the Amu Darya, including all its tributaries, was 77.7 km3/year. This figure was established based on data from gauging stations over a 49-year period of actual observations, starting from 1932[7], and corroborated by the Concept for the Development of Water Resources of the Republic of Uzbekistan for 2020-2030.[8]

Low-water periods near the Amu Darya occur every 4-5 years, with high-water periods happening every 6-10 years. Besides, there are prolonged periods of dry years lasting 5-6 years or more, leading to interruptions and significant complications in the water supply for countries located downstream of the riverю[9]

Water Supply Situation in Uzbekistan

According to the World Resources Institute, Uzbekistan, alongside Afghanistan and Turkmenistan, is categorized as a country facing "high" water stress[10]. In Uzbekistan, a staggering 90% of its available water resources are allocated to agriculture, a sector that contributed 28% to the country's GDP as of 2019.[11]

During the Soviet era, the distribution of the Amu Darya's water resources among the Central Asian republics was governed by the General Scheme for the Development of Water Resources in the Amu Darya Basin, established in 1987 by Decision No. 566 of the USSR's Scientific and Technical Council of the Ministry of Land Reclamation and Water Resources. According to this decision, the allocation of country quotas was as follows:

- Kyrgyzstan: 0.6%
- Tajikistan: 15.4%
- Turkmenistan: 35.8%
- Uzbekistan: 48.2%

Following the dissolution of the Soviet Union, on February 8, 1992, leaders from all five Central Asian countries signed in Almaty an Agreement on Cooperation in the Field of Joint Management and Protection of Transboundary Water Resources. According to this document, the system of water distribution, inherited from the Soviet era, was supposed to be preserved until new rules were developed on the basis of international treaties.[12]

However, in 1996, a bilateral agreement signed in Chardzhuy (now Turkmenabat) between the leaders of Uzbekistan and Turkmenistan led to an equalization of shares between the two countries.[13] This agreement, establishing a 50%/50% share of water withdrawal from the Amu Darya, remained in effect until 2022 when a new agreement was signed in Ashgabat among the Central Asian countries. This pact outlined temporary limits for water withdrawal from the Amu Darya for the period from October 2022 to October 2023. According to it, a total of 55.4 km³ of water from the river basin was to be distributed as follows[14]:

- Uzbekistan - 23.6 km³,
- Turkmenistan - 22 km³, and
- Tajikistan - 9.8 km³.

However, in light of the construction of the Qosh Tepa canal, this agreement will likely require revision, particularly in terms of reducing the total volume of water resources available for the Central Asian countries from the Amu Darya.

It should be noted that due to climatic and anthropogenic changes over the past 50 years, Uzbekistan's key rivers, the Syr Darya and the Amu Darya, have lost 20% of their volume. Consequently, from 2008 to 2022, the amount of available water per person in Uzbekistan decreased by 48%, dropping from 3,048 to 1,589 cubic meters. Calculations indicate that if the average temperature increases by 2°C, the reserves of glaciers, which are the primary source of water of the Amu Darya and Syr Darya, will decrease by 50%, and with a 4°C increase, by 78%. The region is projected to experience an average temperature increase of 5-6°C by 2100.[15]

Even without the Qosh Tepa canal, Uzbekistan anticipates worsening water shortages due to global warming and the persistent high rates of population growth, with an average annual increase of 650-700 thousand people.[16]

Irrigation System of Uzbekistan

In 2022, agriculture in Uzbekistan consumed 39 billion cubic meters of water from both basins, the Syr Darya and the Amu Darya. President Shavkat Mirziyoyev acknowledged that 36% of this resource, or 14 billion cubic meters, were lost in canals with an earthen bed.[17] 70% of the country's irrigated land still relies on outdated methods and technologies, predominantly furrow irrigation.[18] On this reason, 5-6 billion cubic meters were wasted due to outdated irrigation methods, resulting in inefficient use of more than 50%, or almost 20 billion cubic meters, of water.[19]

Furthermore, as of 2020, 77 percent of irrigation canals in the country were in need of repair and rehabilitation. Most concrete-made gutter watering networks that have a lifespan of no more than 30

years are due to delayed repairs. 70 percent of these networks now require reconstruction and replacement. Notably, water intake gateways for farms lack water counters in the majority of cases.

On the top of that, 94 percent of the 1,687 registered pumping stations under the country's water management organizations have already completed their standard terms of service, necessitating modernization and replacement. One-tenth of pressure water-delivering pipelines, totalling 2,887 km, also requires replacement.[20] As of 2023, 80% of pumps have been in operation for 35-40 years, surpassing their intended service life. In comparison to the 2020 report stating that over 60% of pumps had exhausted their resources, the 2023 figure has escalated to 80%. This implies that despite allocated funds over the past three years, the situation has deteriorated further.[21]

Qosh Tepa Canal: Background and Current Situation

Historically, the waters of the Amu Darya have been utilized in Afghanistan for irrigation only along a narrow strip of land adjacent to the river, covering a total area of approximately 10 thousand hectares, with water intake from the Amu Darya not exceeding 2 km³ per year.[22] Prolonged wars the country was involved in have hindered authorities from addressing the irrigation problem on a larger scale in northern regions, despite initial plans to expand the irrigation zone.

The inception of the Qosh Tepa Canal project dates back to the 1970s under Afghanistan's first president, Mohammad Daud Khan. The government returned to the project again in 2004[23] and again in 2021 when under President Ashraf Ghani the government initiated the construction of the canal Qosh Tepa and did so with the support of U.S. administration. When the Taliban seized power in August 2021, it accelerated the project by allocating about $100 million, approximately a quarter of Afghanistan's annual tax revenues.[24]

The crucial question revolves around the volume of water the Qosh Tepa canal will divert from the Amu Darya upon completion. Differing figures are presented in various publications, with some estimating 17 km³ per year.[25] Considering the Afghan authorities' plans for a canal capacity of 668.4 cubic meters per second,[26] calculations suggest the canal could redirect as much as 21 km³ per year from the Amu Darya. Even accounting for a practical 10% reduction in water withdrawal, 19 km³ annually would still be taken from the Amu Darya, thus constituting 27% of its total flow. This is assuming the river’s total flow is around 55 km³.

It is essential to note that varying sources provide different figures for the annual flow of the Amu Darya, ranging from 35 km³ to 78 km³.[27] This disparity leads to varying estimates of the Qosh Tepa's expected water intake from the Amu Darya, ranging from 31% to 48%, respectively. Table 1 presents various scenarios of the redistribution of water intake from the Amu Darya by the region's countries after the completion of the Qosh Tepa construction.

The calculations indicate that in the best-case scenario, with a total annual flow of 78 km³, Uzbekistan may receive annually 27.5 km³ of water from the Amu Darya after the completion of the canal construction. In the worst-case scenario, with a total flow of 35 km³, the projected water allocation drops to only 6.7 km³ per year, potentially leading to catastrophic consequences for the country. Considering a more likely scenario with a total annual flow of 55 km³, Uzbekistan would still face a critical situation, receiving only 16.4 km³ - nearly 30 percent less than its current share of 23 km³. Thus, this assessment presents a more pessimistic outlook for Uzbekistan and Turkmenistan than suggested by other sources that estimated losses in the range of 15-20% of Uzbekistan's current share[28]

Table 1. Possible scenarios of redistribution of water intake from the Amu Darya by countries of the region after completion of the Qosh Tepa construction.

Share in annual intake from Amu Darya flow		Different assessments of Amu Darya total annual flow									
		Variant 1		Variant 2		Variant 3		Variant 4		Variant 5	
		km³	%	km³	%	km³	%	km³	%	km³	%
Amu Darya total flow		78	100%	62	100%	55	100%	40	100%	35	100%
Afghanistan	Existing intake	2		2		2		2		2	
	Qosh tepa	19		19		19		19		19	
	Total	21	27%	21	34%	21	38%	21	53%	21	60%
Remaining flow		57	73%	41	66%	34	62%	19	48%	14	40%
Uzbekistan, according to 1992 agreement (48.2%)		27.5	35.3%	19.8	31.9%	16.4	29.8%	9.2	23.0%	6.7	19.1%
Turkmenistan, according to 1992 agreement (35.8%)		20.4	26.2%	14.7	23.7%	12.2	22.2%	6.8	17.0%	5	14.3%
Uzbekistan, according to bilateral agreement (41%)		23.4	30%	16.8	27%	13.9	25%	7.8	20%	5.7	16%
Turkmenistan, according to bilateral agreement (41%)		23.4	30%	16.8	27%	13.9	25%	7.8	20%	5.7	16%

It's crucial to note that to save costs and expedite construction, the Qosh Tepa canal's bed is not filled with concrete, resulting in a significant amount of water seeping into the soil. An estimated 22 percent of the water entering the canal will be lost due to this construction method.[29] Consequently, Afghanistan's demand for water resources is expected to increase, unless it starts adopting water-saving technologies.

Legal Considerations

The question is also whether Afghanistan's actions to build the Qosh Tepa canal are legitimate and lawful without the consent of its northern neighbours, or at least without consulting them. The background in this regard is as follows.

During the Soviet era, the joint use of Amu Darya waters by the USSR and Afghanistan regulated bilateral agreements between them. The initial agreement in 1946 granted Afghanistan the right to annually extract up to 9 km³ of water from the Panj River, the main tributary of the Amu Darya. In 1958, a second bilateral treaty confirmed this provision. However, relations soured after 1963, leading to unsuccessful negotiations in 1977. The proposed agreement, in which Moscow insisted on reducing Afghanistan’s quota to 6 km³ per year, was not accepted by Kabul[30]

In 1987, at the height of the war in Afghanistan unleashed by the Soviet Union, the latter unilaterally adopted Protocol No. 566, according to which Afghanistan would receive 2.1 km³ of the total flow of the Amu Darya, estimated then at 61.5 km³ per year. This quota even wasn’t discussed between the two parties.[31]

After the collapse of the USSR, the newly independent states of Central Asia apparently counted on the fact that, as successors of the USSR, they would inherit the rights and duties defined by earlier

agreements with Afghanistan. However, in view of the Soviet military aggression against Afghanistan, which had inflicted enormous human and material losses to this country, all treaties concluded between the two sides during the Soviet period should be considered to lose their legitimacy, and therefore invalid.

After 1991, Afghanistan found itself excluded from both new interstate agreements and regional water management structures related to the Amu Darya river, such as the Interstate Commission for Water Coordination of Central Asian Countries (ICWC). Despite these exclusions, the Afghan authorities made attempts in 2002 and again in 2014 to propose a new agreement on Amu Darya water division to the northern neighbours. Unfortunately, these proposals from Kabul did not garner support from its counterparts in the north[32]

Besides, Afghanistan has not yet acceded to the 1992 UN Convention on the Protection and Use of Transboundary Watercourses and International Lakes. Consequently, Afghanistan is not bound by any legal obligations or constraints concerning its unilateral decisions to utilize the waters of the Amu Darya for its needs. Kabul's decision was also based on the ground that up to 17% of the total flow of the Amu Darya is generated within the borders of Afghanistan.[33]

On the flip side, Kabul might assert its own grievances against the Central Asian countries, contending that they unilaterally increased water withdrawal from the Amu Darya basin over the past decades without seeking consent from Afghanistan, which, in the meantime, utilized only about 2 km³ of the annual flow of the Amu Darya. In 2007, the Ministry of Energy and Water Resources of Afghanistan formulated a document titled "Afghanistan Policy on Transboundary Waters." Subsequently, in 2008, Afghanistan adopted the National Water Security Strategy, emphasizing that "the states bordering Afghanistan, without consulting Afghanistan as a source of water resources in the upper reaches of the Amu Darya, have increased their water consumption from transboundary waters during the thirty-year period of occupation, civil disobedience, and reconstruction after armed conflicts"[34]

Thus, from the standpoint of historical justice and international law, Afghanistan, ranking second after Tajikistan in terms of forming the flow of the Amu Darya, had a legitimate right to augment its water intake from the river, and the quantity Afghanistan anticipates receiving through the construction of the Qosh Tepa canal aligns with this right. Nevertheless, the only potential impediment for Afghanistan would be its willingness to demonstrate goodwill and interest in restoring friendly relations with the Central Asian countries, entailing due consideration of their interests. This is the only prospect which Uzbekistan and Turkmenistan, facing the most significant repercussions from the reshuffling of water resources due to the Qosh Tepa canal, could potentially rely on.

Switching To Water-Saving Irrigation Technologies

Paradoxically, the construction of the Qosh Tepa canal could prove to be a boon for Uzbekistan, as it will compel its leaders to accelerate the modernization of country's water management and agriculture in general.

First of all, it is necessary to completely switch from furrow to new water-saving irrigation technologies, preferably to drip one. The drip irrigation technology involves supplying water to the plants to be grown through a system of plastic pipes of small diameter, at a very low speed (2-20 litters per hour). Such pipes are equipped with outlets called emitters or drippers. The water is supplied close to the plants, So only a fraction of the soil around their roots is moistened, as opposed to furrow and sprinkler irrigation, which involves moistening the entire soil profile.[35]

According to some sources, furrow irrigation consumes water 10.5 thousand cubic meters per 1 hectare, while with drip irrigation only 1.1 thousand cubic meters is consumed, that is, up to 10 times less. At

the same time, optimization of the irrigation system and the delivery of fertilizers in liquid form to the crops grown allows also to increase the yield, for instance, grain yield by 3 tons per hectare.[36] Drip irrigation has proven to be most efficient among all advanced water-saving technologies, allowing to reach 95-100% efficiency in the use of water, compared to sprinkler irrigation with its 80-85% efficiency.[37]

At the same time, one should not ignore the possible "cons" associated with the use of drip irrigation. First, it should not be used with water high in iron and salt, and in general, polluted, poorly filtered water, with various deposits, as emitters can quickly become clogged. In order to avoid contamination of the pipes, pre-filtration of irrigation water is strictly required.[38] It is also important that a water test is carried out before installing the system. The results of the water test determine the type of filtration system used. Organic materials such as plant materials, algae, small living organisms and inorganic sand, silt and clay are also the primary concern if the water source is surface water. All of these problems are solvable if producers have a few precautions in place, whereas farmers don't skimp on these measures from the start.[39]

A second possible problem could be the fact that the cotton crop is harvested by combines, which can damage the pipe and emitter systems. However, farmers, in cooperation with the engineers who install drip irrigation systems, will find and may have already found a solution, for example, by temporarily folding pipe systems for the period of cotton harvest.

Finally, the installation of drip irrigation systems may pose financial challenges for cotton farmers. As of 2004, the capital cost for setting up and maintaining a drip irrigation system ranged from US$1,500 to US$2,500 per hectare, contingent on specific irrigation conditions.[40] Notably, the most expensive components of these systems include pumps, water flow sensors, main and secondary lines, drip tape, pressure valves, filters, fertilizer injectors, and flushing manifolds (source: https://ag.umass.edu/vegetable/fact-sheets/irrigation-drip). However, the use of drip tape with thicker walls can extend its lifespan to three or more years, potentially offsetting the initial installation cost and leading to long-term savings.[41]

While the price situation may have improved over the past 20 years, recent sources from Tajikistan indicate that farmers there, lacking adequate support from authorities, may still find it financially challenging to adopt drip irrigation technology. According to Tajik sources, the current cost of implementing this technology ranges from $2,000 to $3,000 per hectare for irrigation of one hectare of land.[42]

Conversely, observations from online markets in Uzbekistan suggest a more favourable supply and pricing situation compared to Tajikistan, offering a variety of systems from different manufacturers and sellers. For instance, in 2022, Dripmax proposed the installation of a complete drip irrigation system for fields and orchards at a rate of 2,500,000 UZS/hectare. At the exchange rate of the same year, this roughly equated to $240/hectare, appearing notably inexpensive and affordable.[43]. However, it is essential to ensure that such a low price does not compromise the quality and reliability of the proposed irrigation systems.

Yet, in the unique conditions of Uzbekistan, where a command economy still drives affairs in the cotton industry, farmers face challenges in achieving profitability and accumulating sufficient investment capital for adopting drip technology. Due to its high capital costs, drip irrigation is primarily recommended for high-value crops even by its developers. Considering the current governance system in Uzbekistan's cotton industry, where farmers lack the autonomy to choose their crops, determine sales, and set prices, drip irrigation may be financially out of reach for them. Further exploration of the situation in Uzbekistan's cotton sector regarding the adoption of advanced irrigation technologies will be discussed in more detail below.

What Are Uzbek Authorities Doing To Address The Issue

This is not to say that the Uzbek authorities are inactive and do not take any measures to switch the agriculture to advanced irrigation technologies. Quite the contrary, as early as 2018, the government made a significant decision to support cotton farmers adopting drip irrigation technology. This included extending support to manufacturers of these systems and related components. According to the government's resolution, cotton-growing farmers embracing drip technology received a subsidy from the state budget, amounting to 8 million soums per hectare of the sown area, as a partial reimbursement for their installation expenses. Additionally, the State Fund for Support of Entrepreneurship Development under the Cabinet of Ministers was set to cover 10% of the interest rate imposed by commercial banks for loans to farmers modernizing their irrigation systems, but not exceeding 20 million soums per hectare. The same resolution granted an exemption from customs duties on components and raw materials essential for implementing drip irrigation technology, imported by both cotton-growing farmers and manufacturers of drip irrigation systems, until January 1, 2021. The document also approved a roadmap for the program's implementation.[44]

Indeed, since 2019, with state support, the implementation of a new water-saving irrigation technology system has been initiated. By 2020, drip irrigation technology had been introduced to an area covering 77,470 hectares, sprinkler (spraying) technology to an area of 1,123 hectares, and discrete irrigation (furrow irrigation in portions, at intervals) to an area of 2,000 hectares. However, the share of areas where modern irrigation technologies have been implemented has not yet surpassed 6 percent. Consequently, the volume of water discharged per hectare of cultivated area remains high at 10,690 cubic meters, several times exceeding comparable figures in developed countries. Another challenge is that a significant portion (70 percent) of the government's expenditure on water in the agricultural sector is allocated to electricity, with a mere 2.9 percent designated for the repair and rehabilitation of irrigation systems. Lastly, there is a concern about the average salary of employees in the water management sector, which stands at 64 percent of the country's average wage. This wage gap hinders the recruitment of a sufficient number of highly qualified specialists capable of addressing the challenges associated with transitioning to more advanced irrigation technologies.[45]

Furthermore, in 2020, the government approved the "Concept for the Development of the Water Sector of the Republic of Uzbekistan for 2020-2030," outlining the implementation of water-saving technologies on an area expanding from 175 thousand hectares in 2020 to 1 million hectares by 2025 and up to 2 million by 2030.[46]

A year later, in 2021, the government adopted the "Strategy for Water Resources Management and Development of the Irrigation Sector for 2021-2023." According to this strategy, there were plans to elevate the proportion of irrigation canals with concrete pavement from 35% to 38%.[47] These figures reveal that 65% of the canals still lack concrete pavement, representing a significant challenge in terms of nationwide water loss.

Between 2021 and 2023, 22 trillion soums ($1.8 billion) were allocated from the Uzbek budget for water management. However, despite these financial allocations, the situation with water loss and the condition of pumps worsened during this period. An additional 1.7 trillion soums and loans worth $300 million are planned to be allocated in 2024.[48]

Are Measures Being Taken Enough?

As mentioned earlier, the government plans to introduce water-saving technologies, including but not limited to drip irrigation, to an area of 2 million hectares by 2030. This constitutes less than half (46%) of all irrigated land, which has a total area of 4.4 million 332 thousand hectares.[49] The question is

whether these measures sufficient or not. The answer to this question can only be provided by considering what Uzbekistan should anticipate following the completion in mid-2027 of the Qosh Tepa canal. Subsequently, the available water volume to Uzbekistan from the Amu Darya basin is anticipated to undergo a significant reduction, as mentioned earlier, from 23 km³ to 16.4 km³, marking a 30% decrease. This reduction poses a threat to farms on the remaining 2.4 million hectares of land still utilizing furrow irrigation, as they may not receive a sufficient water supply. Consequently, these farms could potentially face the loss of their entire harvest or a substantial portion thereof due to inadequate field irrigation.

However, is there a chance to avert this scenario? In our perspective, there is, and the solution lies in a profound reform of the governance system in the country's agricultural sector. While the aforementioned government decisions also target reforms, relying primarily on top-down administrative directives and increased funding for the implementation of advanced irrigation technologies, these measures fall short of being comprehensive. Reforms should extend to the relationships between farms and authorities, as well as with other key stakeholders, such as cluster. These reforms should achieve two primary objectives: 1) enable farmers to be financially capable of investing in water-saving irrigation technologies, and 2) cultivate their interest in adopting such technologies, thereby promoting water conservation.

Cotton Sector Reform is Long Overdue

The cotton sector of Uzbekistan occupies 33% of all irrigated land in Uzbekistan,[50] and it is still subject to the command economy, which prevents enhancing the financial capacity of farmers to invest in new water-saving technologies. Such crucial matters as the selection of crops to be planted and decisions on whom to sell them to and at what price are still determined by the government acting through cotton-textile clusters and local authorities, not by the farmers themselves.

Uzbekistan inherited the system of command economy in the cotton sector from the USSR, and the country's authorities have been slow to reform it, notably in ending the practice of forced labour, a consequence of this system. Only after the international campaign to end forced labour in Uzbekistan's cotton sector initiated a boycott of Uzbek cotton in 2007[51] did the authorities gradually take steps to reduce forced labour. Under President Shavkat Mirziyoyev, who assumed office in 2016, the issue was publicly acknowledged, and a commitment to solving it once and for all was made,[52] and indeed, by now the forced mobilization of citizens to pick cotton has almost ceased.

It seems that the authorities intended to reform the industry in order to encourage the creation of value-added products, promoting not only cotton fibre, but also textiles to world markets, as well as attracting foreign investment. However, the reform resulted in the creation of the so-called cotton-textile clusters, which are established in a centralized manner. In a country with 159 rural districts, 134 such clusters have been created,[53] that is, about one per district. And in each district, such a cluster has become a monopolist dictating to farmers the procurement prices for cotton. Moreover, farmers now receive preferential loans and access to irrigation water through clusters, which, thus, have a leverage to dictate their terms to farmers.

Moreover, clusters not only exploit their monopoly position but also rely on local administrations aligning with them. Concerning farmers, they still lack the right to refuse growing cotton; otherwise, their land allocated to them under long-term lease conditions may be confiscated. Under pressure from local khokimiyats, farmers are frequently divested of their land, which is then transferred under the control of clusters, compelling the farmers to transform into farm laborers hired by these clusters. This state of affairs indicates that the country's cotton sector remains under the dictates of a command

economy, albeit in a different form compared to the recent past, with farmers still being deprived of economic freedoms.[54]

The government maintains this command economy due to the benefits it provides to the ruling elite and their associates, including members of the president's extended clan, who control cotton-textile clusters, often through offshore companies with opaque ownership.[55] This system enables the ruling elite and their associates to acquire cotton from farmers at low cluster-imposed prices and export it to world markets at significantly higher prices. This system is rooted in the exploitation of farmers and the infringement of their entrepreneurial rights, preventing them from accumulating sufficient capital to invest in their farms, including advanced irrigation technologies. To alter this status quo, farmers in the cotton industry should be granted the authority to make sovereign decisions on crop selection, selling their products and determining prices based solely on market conditions and considerations of profit, rather than adhering to administrative directives from the government and clusters.

Getting Farmers Interested in Water Conservation

Currently, farmers are subject to a tax on water resource usage. As of 2022, it amounted to 40 Uzbek soums per cubic meter of water, with an annual 10% upward indexation. This rate is six times lower than those set for other sectors of the economy.[56] Although the tax was designed to be based on the actual volume of water consumed, the law permitted the determination of the tax amount according to water consumption norms per hectare approved by the water management authority in cases where information on the farmer's water usage was unavailable.[57] In practice, this is exactly what happens: the tax is determined by these norms, not by the actual amount of water received by the farmer.[58]

This situation arises because Uzbekistan lacks a well-established system for measuring the volume of water intake by each farm. The absence or malfunction of water meters creates a levelling effect, where a farmer employing advanced water-saving technologies pays the same tax per hectare as another using outdated irrigation methods. This discourages farmers and diminishes their financial incentive to save water, hindering investment in advanced irrigation technologies.

To foster water conservation, it is imperative to enhance the accuracy of measuring water consumption and to consider raising water payment rates to a level that prompts farmers to seek water-saving alternatives. However, such increases in rates can only be justified if farmers have complete freedom to manage their land and choose crops based on profitability - a condition not currently met under the existing governance system in the cotton sector.

Conclusions

We have outlined the water supply situation in Uzbekistan's irrigation system in light of the ongoing construction of the Qosh Tepa canal in Afghanistan, which, once completed in 2027, will begin to take a significant share of water resources from the Amu Darya basin. According to our calculations, under the most expected scenario, Uzbekistan will receive only 16.4 km³ per year instead of the current 23 km³, as stipulated in the agreement with other Central Asian states. This prospect, in which the volume of water from the Amu Darya will be reduced for Uzbekistan by 30%, is much more pessimistic than the forecast presented in some other publications, where authors predict a reduction in the country's share by only 10-15%.

Paradoxically, the prospect of a radical reduction in water intake from the Amu Darya may turn out to be a boon for Uzbekistan. It could compel the country to take more decisive measures to switch to advanced irrigation technologies and radically reduce water consumption per hectare of cultivated area. Since 2018, the government of Uzbekistan has been already taking steps in this direction. However,

these measures appear to be far from sufficient to avoid a serious water supply crisis in 2027 and beyond.

To accelerate the transition to advanced irrigation technologies, it is essential to enable farmers, especially in the cotton sector, to become economically viable. This would allow them to accumulate enough capital to invest in advanced technologies. To achieve this, reforming the cotton sector toward freeing it from the dictates of the command economy and giving farmers the autonomy to decide which crops to grow in their fields and to whom and for what purposes to sell their products is long overdue.

Another crucial measure should be an increase in rates of payment for water use, accompanied by a radical improvement in the system of accounting for the supply of water to each farm. This is necessary to make farmers interested in saving water and compel them to switch to new irrigation and farming technologies at an accelerated pace.

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