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IMPACT OF GLOBAL CLIMATE CHANGE ON GROUNDWATER LEVEL DECLINE IN UZBEKISTAN

Abstract. The article examines the problems of global climate change, its direct impact on groundwater and surface water resources, water shortage problems in Uzbekistan, the volume of groundwater resources and their distribution across the regions of the republic, the efficient use of water resources, as well as the rational use of water resources in industry, agriculture and consumption by the population. The reasons for the decline in groundwater levels were also highlighted, and the population was given the necessary instructions on how to protect drinking water sources in the context of global climate change.

Key words: Global climate change, groundwater, surface water, water resources, monitoring, reserves, regions, industry, agriculture, drinking water. population.

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ВЛИЯНИЕ ГЛОБАЛЬНОГО ИЗМЕНЕНИЯ КЛИМАТА НА СНИЖЕНИЕ УРОВНЯ ПОДЗЕМНЫХ ВОД В УЗБЕКИСТАНЕ

Аннотация. В статье рассматриваются проблемы глобального изменения климата, его непосредственное влияние на подземные и поверхностные водные ресурсы, проблемы дефицита воды в Узбекистане, объемы ресурсов подземных вод и их распределение по регионам республики, эффективное использование водных ресурсов, а также рациональное использование водных ресурсов в промышленности, сельском хозяйстве и потреблении населением. Также были освещены причины снижения уровня подземных вод, а

населению даны необходимые указания по охране источников питьевой воды в условиях глобального изменения климата.

Ключевые слова: Глобальное изменение климата, подземные воды, поверхностные воды, водные ресурсы, мониторинг, резервы, регионы, промышленность, сельское хозяйство, питьевая вода. население.

Background. Global climate change is one of the most pressing environmental issues of our time, affecting ecosystems, weather patterns, and water resources worldwide. In Uzbekistan, an arid and semi-arid country in Central Asia, the effects of climate change are particularly pronounced. Among the most alarming issues is the significant decline in groundwater levels, which threatens the sustainability of water resources needed for agriculture, industry, and human consumption. This article examines how global climate change is affecting the decline in groundwater levels in Uzbekistan, discussing the contributing factors and potential implications for the country's future [1; 3; 5; 8].

Currently, the issue of correct and rational use of underground waters and their protection by the population and agricultural consumers is becoming increasingly relevant. As a result of global climate change, anthropogenic effects associated with dehydration of water bodies, reduction of water consumption, excessive use of underground water sources for agricultural development are observed in our region. Particular attention in our country is paid to the efficient use of water. An important legal document in this regard is the Law of the Republic of Uzbekistan "On Water and Water Use" [4; 6; 7; 10].

Results of the research. Currently, 97 groundwater deposits have been identified in the republic, and their total water resources amount to 63.9 million cubic meters per day (25% of the total water resources), of which water with mineralization up to 1 g/l amounts to 25.8 million cubic meters per day (40%). For reference: Groundwater is divided into 4 types according

to the degree of mineralization or content of dissolved salts: fresh (up to 1 g/l), slightly mineralized (1-10 g/l), moderately mineralized (10-50 g/l) and highly mineralized (more than 50 g). Groundwater reserves are distributed unevenly across the republic, mainly in the Tashkent region (28%), Samarkand (14%), Surkhandarya and Namangan (13%), Andijan (12%) and Fergana (8%), and account for 67% of the republic's drinking water supply. Of these, groundwater is widely used in the Fergana (29.1%), Namangan (13.2%), Kashkadarya (10.8%), Samarkand (11.5%) and Tashkent (10.3%) regions. Groundwater is widely used for agricultural and industrial purposes, in a total volume of 18.6 million cubic meters per day or 6.8 cubic kilometers per year. The current groundwater monitoring system is analyzed based on the mineralization level of water samples taken from 1,465 monitoring wells [2; 4; 9; 10] .

According to environmental pollution monitoring data, the main polluters of groundwater are industrial, agricultural and municipal enterprises. The unsatisfactory state of surface water supply networks and drainage systems in some regions of our republic has led to an intensive rise in groundwater levels in some cities and other populated areas. In particular, there are 6 groundwater deposits in the Republic of Karakalpakstan. Today, 46.41 thousand m3/ day of water are withdrawn from 662 wells in operation for various needs [5; 11; 12] .

In recent years, the surface runoff of the Amu Darya has decreased, and the quality of surface water has deteriorated. Mineralization of groundwater is especially common during the low-water period in lenses (layers of groundwater), riverine Increasing to 1.3-2.4 g. Irrigation of agricultural lands has caused the development of regional secondary salinization processes. Mineralization of groundwater is within 0.6-60.8 g / l, mainly salinization by sulfate-chloride-sodium salts is observed [11; 14; 15]

As a result of the decrease in the water level in the canals in the area of the Karakalpak groundwater deposit in the Shumanay district (in observation well No. 1/3), a decrease in the groundwater level to 1.5-3.5 m

and an increase in mineralization to 0.7-1.2 g / l were noted. It was established In 2019-2021, in observation well No. 2z, located at the Ustyurtgazkimyo complex (Aksholak site) in the area of the Ustyurt groundwater deposit, a decrease in the groundwater level from 1.8 m to 5.0 m and a decrease in their mineralization from 2 g / l to 8.0 g / l were noted, an increase was noted. Practical work is being carried out to strengthen control over the depletion and prevention of groundwater pollution, and to carry out measures for local control over the state of the environment. During the inspection of 3886 underground wells used by business entities, it was established that 2299 underground wells were used without the appropriate documents [10; 13] .

Of these, 2,472 wells (11 in QR , 1,226 in Bukhara, 237 in Jizzakh, 44 in Kashkadarya, 310 in Navoi, 3 in Namangan, 438 in Surkhandarya, 97 in Syrdarya, 16 in Fergana, and 90 in Tashkent region) are operated without proper documentation, 760 wells have not received geological reports, 801 wells have not received permits for drilling groundwater wells, 2,237 wells do not have technical passports, 1,578 wells have not received permits for water use, and in 112 cases (63 in Jizzakh region, 22 in Navoi, 27 in Syrdarya) violations of the law were established during well drilling [1; 2; 4; 9] .

Work is currently underway to eliminate cases of violation of the law and ensure the legal registration of wells. To date, out of 2,472 wells operated without issuing the relevant documents, 1,032 wells have been provided with the issuance of the relevant documents in accordance with the law. In addition, given the sharp increase in the need for water, especially groundwater, in all sectors of the national economy, it is considered appropriate to take measures aimed at identifying additional groundwater resources and strengthening groundwater monitoring by geological and hydrogeological units [11; 14; 15] .

The Role of Groundwater in Uzbekistan Groundwater is a critical component of Uzbekistan’s water supply, particularly in regions where surface water is scarce. It serves as the primary source of drinking water for rural communities and is vital for irrigation, the backbone of the country’s

agriculture-dominated economy. Groundwater also plays an important role in maintaining ecological balance, supporting wetlands, rivers, and other ecosystems that depend on stable water levels.

Climate change and its impact on groundwater

Climate change puts significant pressure on groundwater resources in Uzbekistan through various mechanisms:

1. Changing rainfall patterns: Climate change is disrupting traditional rainfall patterns, leading to more frequent and severe droughts in Uzbekistan. Reduced rainfall means less natural recharge of groundwater aquifers, which are replenished primarily by rainfall. With less opportunity for recharge, groundwater levels are declining at an alarming rate.

2. Increased Evaporation: Rising temperatures due to global warming are increasing the rate of evaporation across Uzbekistan. This not only reduces the availability of surface water, but also affects groundwater recharge. Higher temperatures accelerate the loss of moisture from soils and water bodies, resulting in less water seeping into the ground to replenish aquifers.

3. Glacier Melting and River Runoff: Uzbekistan's largest rivers, the Amu Darya and Syr Darya, are fed by glaciers in the Tien Shan and Pamir mountains. As these glaciers melt due to rising global temperatures, river runoff initially increases, but as the glaciers shrink, long-term reductions in river runoff are inevitable. This reduction affects both surface water and the associated groundwater systems, leading to lower groundwater levels **.**

4. Increased Water Demand: Shifts in weather patterns caused by climate change, such as longer, hotter summers, are increasing the demand for water, especially in agriculture. As surface water resources become more strained, there is an increasing reliance on groundwater for irrigation. Due to increased extraction, groundwater reserves are being depleted faster than they can be replenished naturally .

Consequences of lowering groundwater levels

The decline in groundwater levels in Uzbekistan has far-reaching

consequences:

1. Impact on Agriculture: Agriculture, the backbone of Uzbekistan's economy, relies heavily on irrigation. As groundwater levels decline, the cost of pumping water increases, making irrigation more expensive and less accessible, especially for small farmers. This can lead to lower crop yields, threatening food security and livelihoods.

2. Deterioration of water quality: Low groundwater levels can lead to the infiltration of poor-quality water from nearby areas, increasing salinity and polluting aquifers. This deterioration in water quality can make groundwater unsuitable for both agriculture and human consumption, exacerbating water shortage problems.

3. Ecological damage: Many of Uzbekistan's ecosystems, including wetlands and rivers, depend on stable groundwater levels. As these levels decline, ecosystems become disrupted, leading to loss of biodiversity, habitat degradation, and increased vulnerability of the environment to further climate-related stresses **.**

4. Socio-economic impacts: Declining groundwater levels have serious socio-economic impacts. Rural communities that depend on groundwater for drinking and irrigation face increasing hardship as water becomes increasingly scarce and expensive. This can lead to migration, increased poverty and social unrest .

Mitigation and adaptation strategies

Addressing the problem of declining groundwater levels due to climate change requires a multifaceted approach:

1. Sustainable Water Management: Adopting sustainable water management practices is critical. This includes regulating groundwater abstraction, promoting water-saving technologies in agriculture, and encouraging rainwater harvesting and artificial recharge techniques to replenish aquifers.

2. Climate change adaptation strategies: Uzbekistan needs to develop and implement climate change adaptation strategies that take into

account the long-term impacts of climate change on water resources. This includes integrating climate resilience into national water policies and investing in research to better understand the dynamics of groundwater systems under changing climate conditions.

3. Regional Cooperation: Given the transboundary nature of water resources in Central Asia, regional cooperation is important. Uzbekistan should work with neighboring countries to develop joint strategies for managing shared water resources and addressing the impact of climate change on groundwater levels **.**

4. Public awareness and education: Raising awareness about the importance of groundwater conservation and the impact of climate change is critical. Educational programs and public campaigns can encourage communities to adopt water-saving practices and support sustainable water management initiatives .

Conclusions: The impact of global climate change on declining groundwater levels in Uzbekistan is a serious and growing concern. The country must take proactive steps to mitigate the impacts of climate change on its water resources, ensuring that groundwater remains a viable and sustainable resource for future generations. Through sustainable management practices, regional cooperation, and climate change adaptation strategies, Uzbekistan can address the challenges posed by declining groundwater levels and protect its water resources in an increasingly uncertain climate **.**

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