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WATER BALANCE IN UZBEKISTAN DURING PERIODS OF WATER SCARCITY

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Abstract: *The article delineates the primary beneficiaries of water resources in the Republic of Uzbekistan. The analysis of water resource utilization revealed that over the past decade, there has been a decrease in total water withdrawal per hectare in the republic. Specifically, the withdrawal has decreased from 13,000 m3/ha to 12.2 thousand m3/ha. During the vegetation period, the withdrawal has decreased from 10.7-11 thousand m3/ha to 8.8-9.6 thousand m3/ha. In the non-growing period, the withdrawal has, on average, fluctuated between 2.4-2.7 thousand m3/ha. Simultaneously, it was observed that the yearly restriction on water usage for municipal and domestic purposes in the economy is 2.65 billion m3, constituting 4.35% of the overall water consumption in the country. The centralized water supply to the urban population in the republic is, on average, 85.9%, while the rural population has a centralized water supply of 61.9%. The average daily water use per person is 137 liters for urban areas and 75 liters for rural areas. Simultaneously, the water delivery network in the republic has significant losses, averaging around 24.9%, due to its low technical condition and underutilized capacity. The yearly water intake limit for fisheries with artificial ponds is 0.6 billion cubic meters, with around 30-32% being fresh water. The primary source of water consumption for the fishery industry is derived from natural water bodies, such the Arnasay depression, Priaralie zone, and other similar areas. In order to achieve sustainable development in the fisheries sector and safeguard the environment, it is necessary to yearly supply approximately 1.5 billion cubic meters and 3 billion cubic meters of fresh water to the Arnasay depression and the Priaralie zone, respectively. The analysis of water balance indicates that even if the current techniques, technologies, and management of water resources in various sectors of the country's economy are maintained, there will still be a deficit of water resources. If water resources are limited to 100%, the deficit will be up to 10 km3/year. However, if the provision is reduced to 80%, the deficit will increase to 14 km3/year.The essay concludes that the remedy for the issue of water resource scarcity lies in water conservation, not only in irrigated agriculture, but also throughout other sectors of the nation's economy. As an economic mechanism, a phased shift is suggested, where payment for water delivery services would be accompanied by heightened penalties for those who violate water usage and consumption regulations*

INTRODUCTION

The issue of water resource utilization is increasingly pressing in the context of Central Asia. The rapid increase in temperature and the rising demand for water in various

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sectors of the economy are leading to a range of challenges in the utilization of water resources. The annual population expansion in the republic, along with the constant per capita water consumption, is leading to a steady increase in the municipal sector's demand for water resources. If the current per capita water consumption level is sustained, the municipal sector's yearly demand for water resources will rise by 16-20 million m3. The growth of the industrial sector is anticipated to drive an increase in demand[1-14]. By 2030, the population of the republic is expected to reach over 40 million individuals, resulting in a decrease of accessible water resources by approximately 7-8 cubic kilometers. Given these circumstances, the scarcity of water resources is projected to escalate from the current level of 13-14% to 44-46% by 2030. This would impede the progress of not only the agricultural sector, but also other industries.In 2018, the World Bank reported that Uzbekistan had a significant loss of drinking water, amounting to 469 million cubic meters. This accounted for almost 32% of the entire volume of drinking water generated.

Significant water losses are occurring in the Central Asian region, namely in Uzbekistan, amidst concerning predictions regarding future water supply. According to World Bank projections, the water flow in the Syr Darya river basin is expected to decline by 2-5% and in the Amu Darya river basin by 10-15% by 2050. This decrease in water flow would lead to an increase in water shortage. Not just agriculture, but also hydropower will be affected by this. The production of hydropower plants in certain areas of the region may fall by up to 20 percent by 2050[2,15-17].
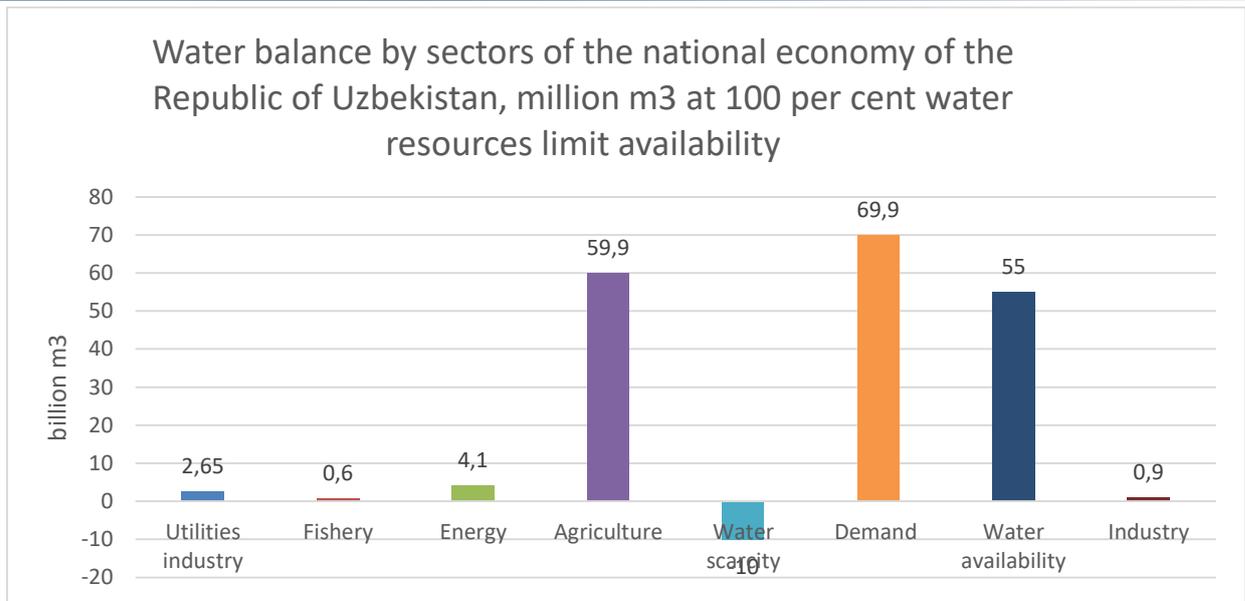
The aforementioned issues necessitate the development of a water balance for the sectors of the national economy of the Republic of Uzbekistan under various water availability scenarios. The primary goal of this study is to identify any problems that arise in this process. In order to accomplish this objective, it is imperative to formulate a water balance for the various sectors of the national economy of the Republic of Uzbekistan, measured in million cubic meters, based on water resource allocation at 80% and 100% capacity. This will be done using a research approach. The primary research methodology of this study focuses on examining the distribution of water resources across different sectors and conducting an analysis of these resources.

Results and analysis. A maximum annual water consumption threshold of 55 cubic kilometers per year has been established for agricultural purposes. The hydropower resources in Uzbekistan constitute a mere 4.92% of the country's total land area. The annual water resources amount to 50-60 km3, out of which only 12.2 km3 are generated within the country's borders. The remaining water is sourced externally, primarily from the Tien Shan and Pamir-Altai mountains, as well as from the melting snow and glaciers during the summer.The user's text is a reference to a source or citation. Over the past decade, there has been a shift towards using less water, resulting in a decrease in total water intake per hectare in the republic. Specifically, the intake has decreased from 13 thousand cubic meters per hectare to 12.2 thousand cubic meters per hectare. During the growing season, the intake has decreased from 10.7-11 thousand cubic meters per hectare to 8.8-9.6 thousand cubic meters per hectare. In the non-growing period, the intake has averaged between 2.4-2.7

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thousand cubic meters per hectare.The municipal and household sector of the economy has an annual limit of 2.65 billion m3, accounting for 4.35% of the total water consumption in the republic. The urban population in the republic has a centralized water supply rate of 85.9%, while the rural population has a rate of 61.9%. The average daily water use per person is 137 liters for urban areas and 75 litres for rural areas. Simultaneously, the water delivery system in the republic has significant losses, averaging around 24.9%, due to its poor technical state and the utilization of network capacities. The maximum annual water intake allowance for fisheries utilizing artificial means The total number of ponds is 0.6 billion, with around 30-32% consisting of fresh water. The primary source of water usage in the fisheries industry is derived from natural reservoirs, such as the Arnasai depression and the Aral Sea region. In order to ensure the sustainable development of fisheries and safeguard the ecosystem, an annual supply of approximately 1.5 billion cubic meters of water is required for the Arnasai depression, and 3 billion cubic meters of fresh water is needed for the Aral Sea area.The technical water supply for thermal power plants is limited to 4.1 billion m3. Out of this, 0.153 billion m3 or 4% of the energy-water usage is irretrievably lost.

The republic is home to over 400 industrial and other establishments and organizations, collectively possessing an annual capacity of 0.9 billion cubic meters. Simultaneously, the quantity of wastewater discharged from industrial plants exceeds 0.45 billion cubic meters. Approximately 0.172 billion cubic meters of water are released into open sources as a result of the inadequacy of the water purification system in industrial businesses. 3 cubic meters of wastewater contaminated with pollutants. The republic experiences an average annual population growth of 350 thousand individuals. While keeping the existing per capita water usage unchanged, the utilities' yearly demand for water resources is projected to rise by 16-20 million m3. As industry advances, the demands of this sector are anticipated to increase. In order to address the increasing water consumption in these industries, it is crucial to focus on minimizing operational losses and implementing stricter limits on water intake in agriculture.

The provided data enabled the creation of the water management balance (Figures 1 and 2) for different sectors of the national economy of the Republic of Uzbekistan, considering various scenarios of water availability.

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Fig. 1 Water balance by sectors of the national economy of the Republic of Uzbekistan, mln.m under 100% water resources limit provision

Water balance gives grounds to consider that under preservation of existing techniques, technologies and organisation of management of water resources use by branches of economy of the country even under water resources limit provision at 100% (fig.1) water resources deficit will be felt within 10 KM3/year.

And if water availability is 80% (Fig.2), water resources deficit for the country's economy will reach up to 14 KM3/year. According to the calculations of the Ministry of Agriculture and Water Resources, under the conditions of preserving the efficiency of water management systems and irrigation network, to cover the biological demand of agricultural crops, as well as the demand of other sectors of the economy, the need for water resources in the country is about 69.4 billion m³', including agriculture 59.4 billion m³'. including agriculture 59.9 billion m3. Based on the above, it can be considered that in case of water availability in the amount of 80 % of the water resources limit (59.3 billion m3), the deficit can be up to 14.3 billion m3, and under water availability of 100 %, the water deficit is expected to be 10.1 billion m3, and irrigation of crops on irrigated lands can be reduced.

Fig. 2 Water management balance by branches of the national economy of the Republic of Uzbekistan, million m3 with 80% water resource limit.

An annual water intake limit of 55 km/year has been set for agriculture. With the transition to limited water use over the past ten years, the total water intake per complex hectare in the republic has decreased from 13 thousand m3/ha to 12.2 thousand m3/ha, including during the growing season from 10.7-11 thousand m3/ha to 8.8-9.6 thousand m3/ha, and in the non-growing period on average it ranged from 2.4-2.7 thousand m3/ha.

The annual limit of the municipal and household sector of the economy is 2.65 billion m3, which is 4.35% of the total volume of water consumption in the republic. The centralized water supply of the urban population in the republic averages 85.9%, and the rural population - 61.9%, the actual average daily water consumption per capita is 137 and 75 liters, respectively. At the same time, due to the low level of technical condition and the

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use of water supply network capacities, losses in this system amount to about 24.9% on average in the republic.

The total annual water intake limit of fisheries with artificial ponds is 0.6 billion meters, of which 30-32% is fresh water. The main volume of water consumption of the fishery falls on natural reservoirs, such as the Arnasai depression, the Aral Sea area, etc. For the sustainable development of fisheries and environmental protection, the annual additional demand of utilities for water resources increases by 16-20 million m3 due to the growth of its population.

In conditions of maintaining the efficiency of water management systems and irrigation network, to cover the biological needs of crops, as well as the demand of other sectors of the economy, the demand for water resources in the republic is about 69.4 billion m3, including agriculture 59.9 billion m3.
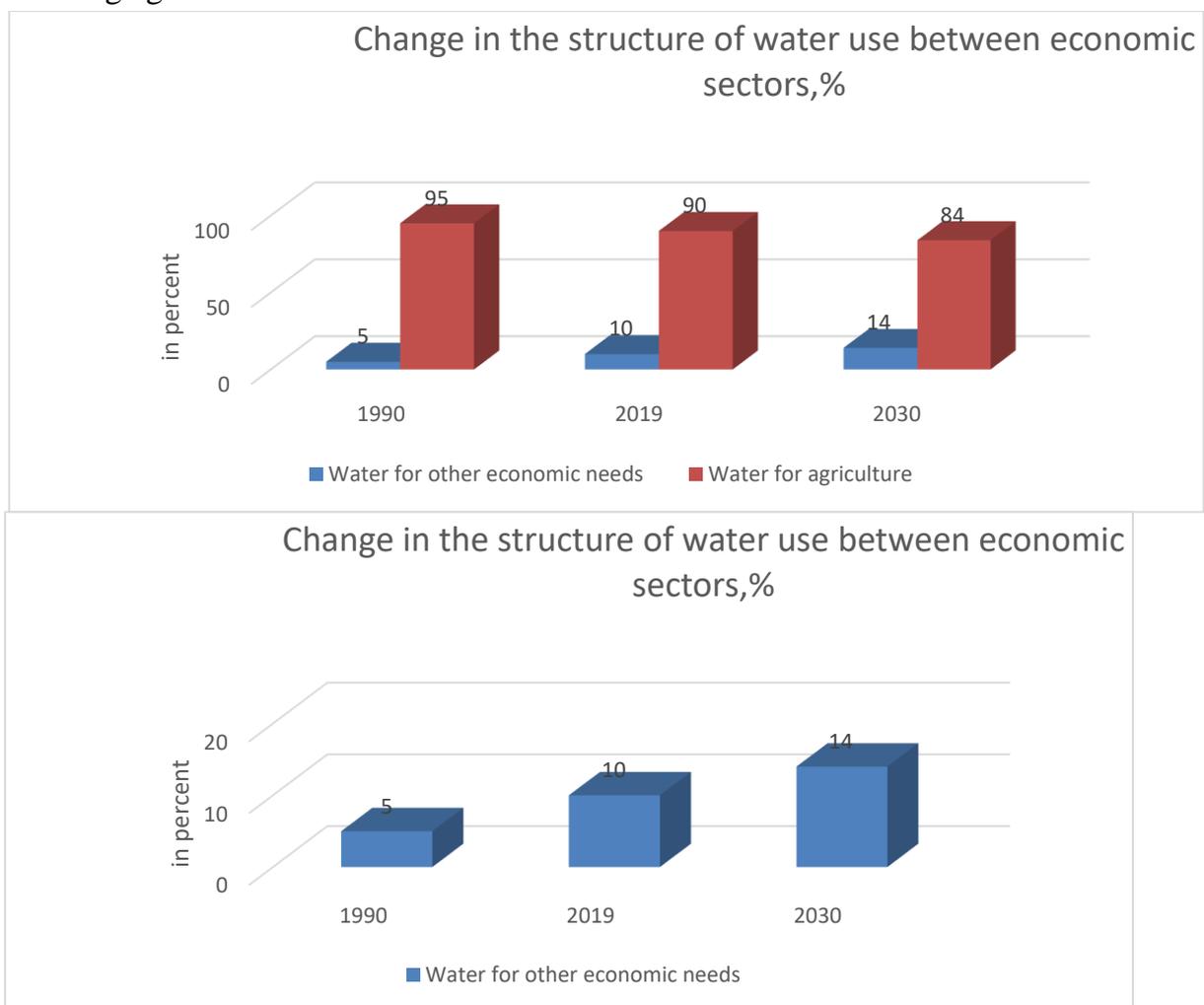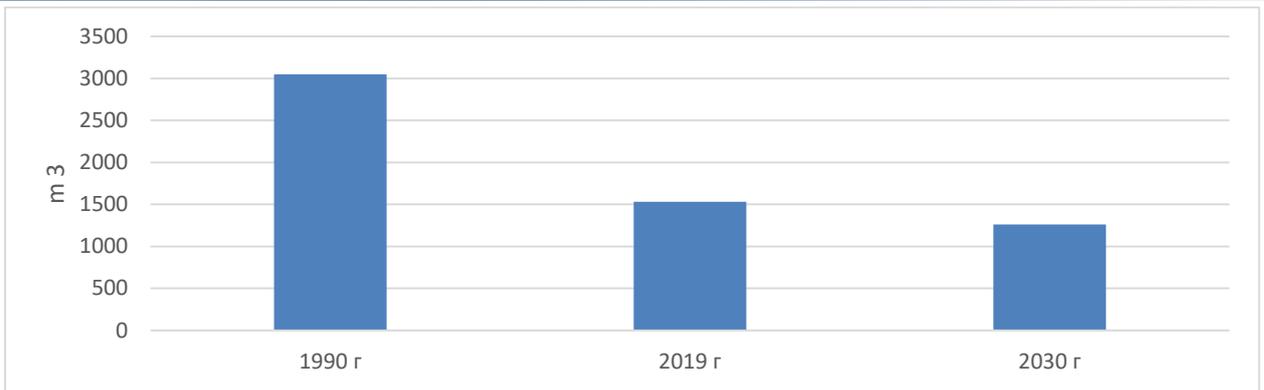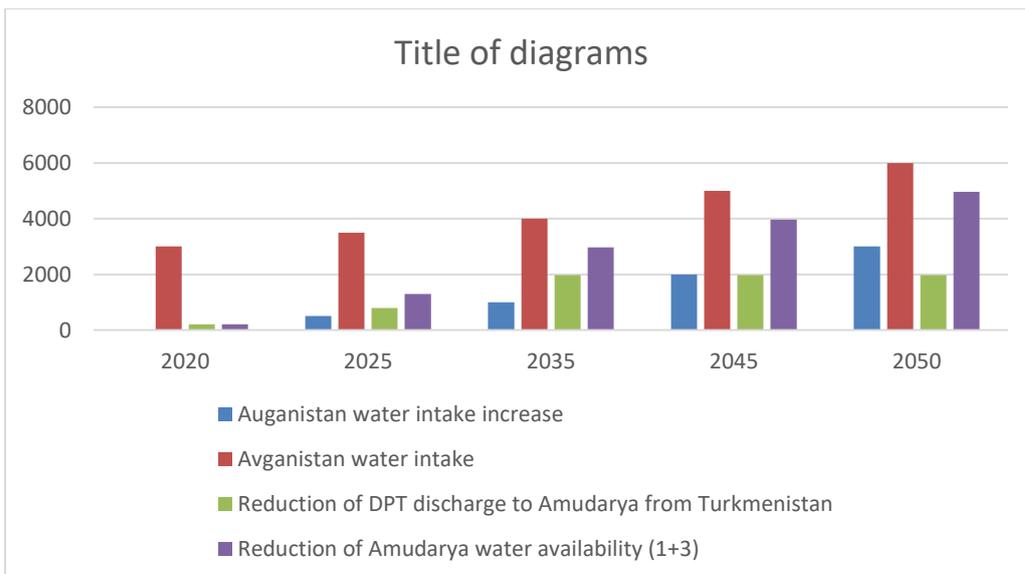

Fig. 3. Forecast change in the structure of water use between sectors of the economy, %

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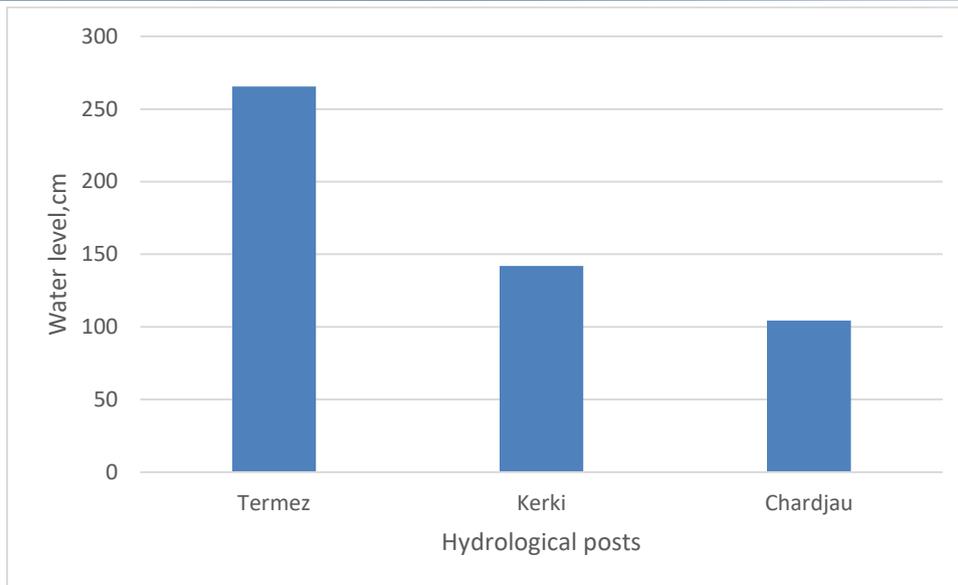mavzusidagi xalqaro ilmiy-amaliy konferensiyasining maqolalar to'plami
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Figure 4 displays the amount of water withdrawn per person on an annual basis, measured in cubic meters per person.

The study considers the water resources of Afghanistan, which include the Murghab, Tedjen, Kokcha, and Kunduz Rivers. The Murghab and Tedjen rivers, located at the border with Turkmenistan, are considered part of the local resources in the Mary and Ahal planning zones. The Kokcha river is considered a component of the Pyandj river water resources. Lastly, the Kunduz river is included in the transboundary flows scheme within the Amu Darya basin. Afghanistan's current annual water consumption from the Panj and Amu Darya rivers is estimated to be approximately 3 cubic kilometers. The research includes projections regarding future water demand options in Northern Afghanistan. An achievable approach is to raise Afghanistan's water consumption to 6 km3, specifically by 3 km3 by 2050 in comparison to the present water intake. The water consumption is factored into the balance   computations.
The graph considers the influence of Afghanistan on the Pyandj and Vakhsh rivers' water flow. This is reflected in the increased withdrawal of water from the rivers and the decreased flow of the Amu Darya river due to the cessation of CDW discharge in its middle reaches.

Figure 5. Factors influencing the Amudarya River flow reduction, mln m3

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Fig. 6. Results of calculation of channel balance for the Amudarya River at the middle sections (starting from the site upstream of the Garagumdarya intake)

The annual average annual water resources in the Syr Darya basin are determined as 37.1 km3. Water resources are distributed as follows. The flow of the Naryn River (Uchkurgan) is about 36 % of the total water resources of the basin, while the flow of the Karadarya River (Kampyrravat) is 11 %. The tributaries within the Fergana Valley are estimated at 21 %, and the rivers within the Hungry Steppe at 2 %. The total flow of the rivers Chirchik (Khojikent), Keles (Stepnoe) and Ahangaran (Turk) is 23 %, and of the Arys River and the rivers of the Karatau Range - 7 %. The total inflow to the main reservoirs of perennial flow regulation (Toktogul, Charvak, Andijan) is estimated for the long-term series (1910-1998) at 21.8 km3/year, which is about 58 % of the total basin flow.

The total water withdrawal from the Naryn and Syrdarya rivers at the sites up to the Shardara reservoir was 9.81 km3 or 82 % of the limit. During the growing season 2023, 2.09 km3 of water was withdrawn less than planned under the limits approved at the ICWC meeting. Water withdrawal for the Republic of Kazakhstan through the Dustlik canal was 0.7 km3 , for the Kyrgyz Republic - 0.19 km3 , for the Republic of Tajikistan - 1.44 km3 , for the Republic of Uzbekistan - 7.48 km3[17].

In the Syrdarya river basin, according to BWO "Syrdarya", current water requirements are estimated at 50 km3/year. The limits for water withdrawal from the river and water supply to the Aral Sea are currently about 27 km3/year, including 22 km3/year for water withdrawal.

In recent years, the trend of warming of the climate continues, including in the territory of the Central Asian countries the annual temperature has increased by 2 0C on average (figure below).

Figure 7: Climate warming in Central Asia

Unfortunately, we can state the fact that such an increase leads to a decrease in glacial reserves, from where the rivers of the Aral Sea Basin originate [3]. This undesirable judgement is confirmed by the example of the dynamics of changes in the size of

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Fedchenko Glacier, from where the main tributaries of the rivers of the Aral Sea Basin originate (Figure 8)

The flow of the Zarafshan River is decreasing from year to year: in 1980-90 years the water discharge in the river reached 750-800 m3/s, now it is not more than 400 m3/s. The main reason for this reduction is the melting of glaciers.

Figure 8: Retreat of Fedchenko glaciers

According to some estimates1 , in the next 50 years the volume of glaciers in the basin will be maximally reduced. The Zarafshan glacier will degrade over an area of 25-30 km2 , which will lead to a 30-35 % decrease in its volume and, accordingly, to a decrease in glacial runoff. Currently, the glacial runoff of the Zarafshan River is estimated at about 1.3 km3 (25% of the total runoff); by 2050, the glacial supply to the Zarafshan may decrease by more than 0.6 km3 (12% of the total runoff). The Uzbek territory of the Zarafshan River basin is poorly endowed with water resources.
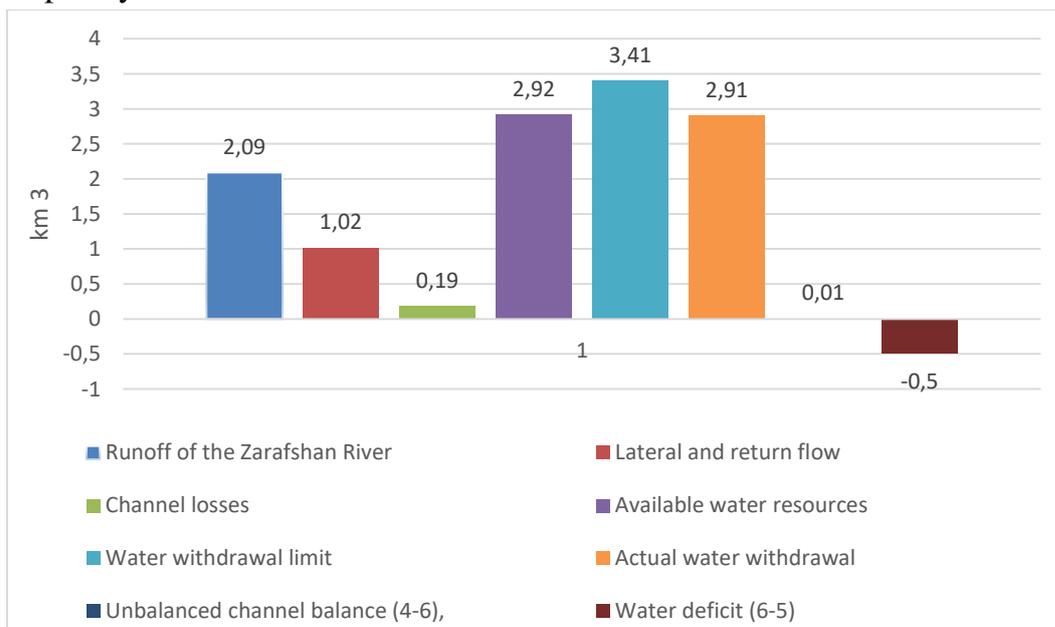
Figure 7. Channel balance of the Zarafshan River

The growing water resources deficit requires the application of an integrated management approach in the basin, which implies a combination of effective regulation and

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uniform flow distribution and, at the same time, optimisation of water requirements, mainly in irrigated agriculture (introduction of new irrigation technologies for irrigated lands, clarification of water consumption rates). According to some estimates, introduction of water-saving technologies can reduce water requirements in the basin by maximum 28-35 %.

Conclusions and recommendations

The analysis of water balance gives grounds to consider that at preservation of existing techniques, technologies and organisation of management of water resources use by branches of economy of the country even at provision of water resources limit on 100 % the deficit of water resources will be felt within the limits up to 10 km3 /year, and if provision will be 80 % the deficit of water resources for economy of the country will reach the value up to 14 km3 /year of water.

It is grounded that in connection with global warming the tendency of sharp decrease of glaciers in the Aral Sea river basin continues. The solution of water resources deficit problem is water saving not only in irrigated agriculture, but also by all branches of economy of the country.

As an economic mechanism, a gradual transition to the first stage of payment for water delivery with strengthening of penalties for violators of water use and water consumption rules is proposed.

REFERENCES:

1. Абдурахманова И.К., Вафоев Р. Состояние и использование земельно-водных ресурсов Узбекистана (орошаемое земледелие) // Вестник Прикаспия. №4. ноябрь 2017.

2. Базаров Д.Р. Тем, кому не безразлично будущее Арала. Uzbekistan today,№39(630) Б20.09.2018. www.ut.uz. стр 3.

3. Базаров Д.Р, Норкулов Б.Э. Повышение эффективности эксплуатационных показателей при бес плотинного водозаборных сооружений. Me'morchilik va qurilishmuammolari (ilmiy-texnik jurnal 2019, №3 Samarqand, 94-100 b

4. Берг Л. Аральское море. — СПб., 1908, — 580 с.

5. Гусев Л.Ю. Водно-энергетические проблемы Центральной Азии и возможные пути их разрешения//Вестник МГИМО университета. 2013. 6 (33). С. 36.

6. Захарова К. Водно-энергетические проблемы в Центральной Азии на современном этапе // Проблемы постсоветского пространства. 2018. 5 (3). С. 302.

7. Отчет по проекту "Адаптация управления трансграничными водными ресурсами в бассейне Амударья к возможным изменениям климата". Ташкент 2022.

8. Разработка основных компонентов политики МКВК в вопросах рационального водопользования и охраны водных ресурсов в бассейне Аральского моря. Сборник научных трудов. Ташкент 2022 г.

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9. Рубанов И. В., Ишниязов Д. П., Баскакова М.А., Чистяков П. А. Геология Аральского моря. — Ташкент: Фан, 1987.247 с.

10. Севастьянов Д. В. (ред.). История озер Севан, Иссык-Куль, Балхаш, Зайсан и Арал. — Л.: Наука, 1991.

11. Экономическое обозрение. № 10 (238). 2019. С. 21.

12. (PEER) за 2017 год Этап 3 "Численные эксперименты" Позиции 3.1 и 3.2.Ташкент 2017 г.

13. Boomer I., Aladin N., Plotnikov I., Whatley R. The palaeolimnology of the Aral Sea: a review. // Quaternary Science Reviews. — 2000.— V. 19.— P. 259-1278.

14. Boomer I., Wunnemann B., Mackay A.W., et al. Advances in understanding the lateHolocene history of the Aral Sea region. // Quaternary International. — 2008. — V. 194. —№1-2. — P. 79-90.

15. Oberhansti H., Boroffka N., Sorrel Ph., and Krivonogov S. Climate variability during the past 2,000 years and past economic and irrigation activities in the Aral Sea basin. //Irrigation and Drainage Systems. -// — 2007. -V.21.-P. 167- 183.

16. Соглашение о совместных действиях по решению проблемы Аральского моря и Приаралья, экологическому оздоровлению и обеспечению социально-экономического развития Аральского региона.Ташкент 2020 г.

17. cawater-info.net.