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On the state of the drinking water sector in relation to climate change in Uzbekistan

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Abstract

This article provides a detailed analytical overview of the drinking water supply sector, including water consumption by the population. Uzbekistan belongs to the countries with a sharply continental arid climate and extremely high temperatures in the summer period, reaching up to +60-70 C°. As a result, higher temperatures and lower humidity can have a negative impact on a country's economy. This article examines the impact of climate warming on the state of the country's drinking water supply sources as an example. Relevant conclusions are drawn. Recommendations are made to stimulate innovation and mobilise public and private investment to achieve climate-resilient development in the drinking water supply sector.

Key words: drinking water, water losses, climate finance, water quality, quality of water services, water consumption costs, gender.

Introduction

The continuous increase in water consumption, including for domestic and drinking needs of the population is one of the main features of the current period of social and economic development in Uzbekistan. The problem is acute because water resources are distributed extremely unevenly across the republic, causing the population in some regions to face serious difficulties in obtaining drinking water of good quality.

In the Republic of Uzbekistan, 60% of the population is supplied with water from groundwater resources.

The impact of climate changes on groundwater is characterised by the following factors:

1. Climate change affects groundwater level and its recharge.
2. The salinity and overall hardness of the water in water supply sources, especially groundwater, is expected to increase.
3. The surface-groundwater connection tends to deteriorate due to natural and human factors (application of water-saving measures) resulting in a decrease in freshwater resources.

In that regard, the priority of drinking water supply is explained by the fact that it is a key source for the population of the republic and the society. Over the last 15 years, the annual per capita water availability has decreased from 3,048 m^3 to 1,589 m^3. The main risks in the use of water supply are acute shortage of freshwater, competition for use, its pollution, drought, etc (President of the Republic of Uzbakistan, 2021).

The results of high vulnerability analysis of the selected direction of drinking water supply confirm the following data.

According to the World Bank forecast, water demand in Uzbekistan will decrease from 59 km3 to 62-63 km3 by 2050, and available water resources will decrease from 57 km3 to 52-53 km3 which will increase the current water shortage five times (from 2 km3 to 11-12 km3) (Makhmudov, 2019). Thus, climate change has a significant impact on water resources and reducing freshwater sources, overcoming this problem has become an integral part of achieving sustainable development. Due to the shortage of water resources, since 1993 the country has adopted a limited (restricted) water use for all consumers, which is set according to the principle of equal water availability and priority of water supply (Agency of IFAS, 2021).

Methods

The survey was conducted in January-February 2021. The analytical review was formed on the basis of statistical data and certificates of the joint-stock company "Uzsuvtaminot" under the Ministry of Housing and Communal Services of the Republic of Uzbekistan. Also, when writing the study, individual interviews were conducted with representatives of Uzsuvtaminot joint stock company for advisory purposes.

Results

Current situation in the sector of drinking water supply

In Uzbekistan, there has been a steady increase in water consumption, including housing, utilities, and drinking water, due to an increase in the standard of living and quality of life of the population. The distribution of water resources within the republic is extremely uneven, particularly because a large part of the republic is located in an arid climate, which makes it difficult to provide drinking water of good quality to the population in a number of regions.

It is worth noting that with the growth of population, which currently is 1.7% annually in the republic (500 000-600 000 people annually), with a high population density from 55 people/km^2 to 524 people/km^2 (Andijan province) per capita water consumption also increases, putting pressure on water resources, food supply, energy, social infrastructure, therefore, demand is significantly higher than supply (Ibatullin et al., 2007; OECD, 2017).

In addition to this, a general increase in water shortage is expected in the medium term. The flow of water into rivers will decrease by 5-10% as a result of reduced snow and glacier melt (USAID, 2018).

The shortage of water resources to a limited (restricted) water use by all consumers, prioritises the provision of water for domestic and drinking water supply and for municipal water supply (Green Climate Fund, 2021).

At the same time, the issues of ensuring safe conditions for water consumption, compliance of water quality with regulatory requirements, universal public access in both urban and rural areas, protection against anthropogenic pollution and wastewater intrusion, and rational use remain extremely topical. To date, Uzbekistan is at the stage of issue development of the Protocol on Water and Health issues but has not yet ratified it (Asian Development Bank. 2013).

However, the Government of the Republic has already done and continues to do great work to achieve progress towards ensuring broad public access and improving the quality of the drinking water supply. This is supported by the following numbers and facts. In Uzbekistan, the coverage level of centralised water supply services reached 70.8% in 2020, compared to 63.7% in 2016 (Table 1; Muinov & Turaev, 2020).

Taking into account that there has been a big demographic growth, it is obvious that considerable efforts have been made to achieve the coverage rate of the drinking water supply of over 70%. The highest rate of centralised water supply coverage is in Tashkent city (99.7%), also in Fergana and Andijan regions (about 82-85%). The lowest rate of population coverage is in Bukhara, Kashkadarya and Surkhandarya regions (55-57%) (Abedin et al., 2019).

Table 1

Coverage of centralised water supply services: Drinking water supply to households in 2021, %

Regions	Total
Republic of Uzbekistan	70,8
Republic of Karakalpaksttan	61,5
Provinces	
Andijan	82,2
Bukhara	54,8
Jizzakh	65,5
Kashkadarya	56,0
Navoiy	64,0
Namangan	78,6
Samarkand	66,8
Surkhandaryo	56,8
Sirdaryo	78,0
Tashkent	70,4
Fergana	84,5
Khorezm	62,8
Tashkent city	99,7

Source: JSC Uzsuvtayminot, 2021

There are 8910 (out of 11012) rural settlements with a centralised water supply. This situation emerged due to the fact that water supply and wastewater disposal systems, inherited from the past years, have largely exceeded their standard service lives and demand complete reconstruction and renewal.

Due to frequent breakdowns of worn-out pumps, power outages, failure of electro-technical and other technological equipment and financial instability, the installed capacity of pumping stations in the country as of 2020 was used by 76% (Pannier, 2021). The current state of infrastructure, along with the unstable financial situation and weak institutional capacity, raise questions about the reliable operation of systems, safety, and acceptable quality of services in the sector, which is a key issue for the country. The situation is also exacerbated by a lagging sector strategy, limited planning mechanisms, and an outdated legal and regulatory base.

Water losses.

The level of losses (realisation volume in relation to water produced) is about 32% (Table 2). However, considering the condition of the systems and the existing low level of maintenance, losses in some settlements can be as high as 60%. Reliable metering of water during abstraction and delivery is partly implemented. In many regions water meters have not yet been installed in the water supply networks. As of 01.01.2021, 2.05 million individual water meters were installed, of which 1.96 million in households and 84.6 thousand in legal entities, representing 53% of the total 3.97 million (3.88 million households 50.7%, 89.4 thousand legal entities 94.7%) connected to the JSC Uzsuvtayminot (Russian Federation, 2020). Insufficient metering equipment affects the rational use of water by the population, especially during the summer, when drinking water is used for plant irrigation, food cooling and other needs.

Table 2

Technical water losses in 2020

	Territories	Actual supply t.m3/d	Water realisation, $t.m^3/d$	Network length, km	General losses, n, $t.m^3/d$	Specific losses, m^3/km
Total, nationwide		6032,8	4149,2	75768,1	1883,6	24,9
1.	Republic of Karakalpakstan	148,4	72,0	5843,8	76,4	13,1
Regions						
2.	Andijan	364,3	274,3	8014,6	90,0	11,2
3.	Bukhara	141,3	102,3	3321,4	39,0	11,7
4.	Jizzakh	98,9	67,3	3145,2	31,6	10,0
5	Kashkadarya	215,3	87,8	6831,8	127,5	18,7
6.	Navoiy	60,1	57,8	2969,8	2,3	0,8
7.	Namangan	303,3	190,4	5365,7	112,9	21,0
8.	Samarkand	494,9	375,1	5873,3	119,8	20,4
9.	Surkhandarya	229,8	133,9	7427,7	95,9	12,9
10.	Sirdarya	135,1	103,2	2968,4	31,9	10,7
11.	Tashkent	888,9	560,0	7230,8	328,9	45,5
12.	Fergana	577,1	445,1	7111,6	132,0	18,6
13.	Khorezm	183,3	95,7	5967,9	87,6	14,7
14.	Tashkent city	1994,4	1404,0	3696,1	590,4	159,7
15.	Damkhuja	190.0	178.0		12,0	
16.	Chimgan-Charvak	7.74	2.3		5,4	

Source: JSC Uzsuvtayminot, 2020

In addition, the installation of metering equipment will create incentives for water utilities to improve service quality, i.e., consumers will only pay for the water they receive and thereby reduce household water bills (Pearson & Pelling, 2015). The most effective method of dealing with water loss is metering of water supplied to the consumers. Numerous data confirm that the installation of water meters results in the reduction of water consumption. According to the World Health Organisation, water meters allow save up to 33% of water. Of all the water used, 74% is used efficiently and 26% is wasted (Latipov, 2021).

Until 1995, energy-intensive "D" type pumping equipment was used in the republic's water supply and treatment system. Since the beginning of the project "Clean Water, Sanitation and Public Health in the Aral Sea Region" with the participation of the World Bank, frequency pumps were used for the first time in the framework of a pilot project. Today, energy-efficient technologies are taken into account in the development of all a pre-feasibility justifications (PFJs), but the issue of replacing outdated pump models remains important.

Quality of water and drinking water supply services.

Analysis of the drinking water supply sector demonstrates that, despite the high level of coverage by centralised water supply (70.8% nationwide, of which 79% in urban areas and 59% in rural areas), the quality of services remains low (Kholikulov, 2020; Armitage & Nellums, 2020).

Effective use of water treatment capacities is ensured only in Tashkent city. The capacity of other municipal and departmental water treatment facilities is used by 37% and 32% respectively, indicating an increasing trend towards supplying untreated water to consumers, which poses a threat to public health. Thus, according to the Ministry of Health, there was a stable sanitary-environmental situation regarding the quality of drinking water and water quality indicators of water reservoirs in the first 9 months of 2020 (Kurpayanidi, 2020).

In the first nine months of the current year, 12008 samples were taken for bacteriological indicators of tap water, of which 779, or 6.5%, did not comply with O'z Dzt:950-2011 "Drinking water" requirements. The highest non-compliance was in Namangan (13.6%, 70 out of 516), Surkhandarya

(13.3%, 39 out of 293), Syrdarya (10.5%, 70 out of 664) and Khorezm (20.2%, 231 out of 1143) provinces. Out of 7948 samples, 516 (6.5%) did not comply with O'z Dzt: 950-2011 "Drinking water" standard. The Republic of Karakalpakstan - 23.1% (45 out of 195), Surkhandarya region - 25.9% (62 out of 239) and Namangan region - 15.9% (59 out of 372) showed the highest non-compliance (Dadabaev & Djalilova, 2021).

During the nine months of monitoring the quality of water in open reservoirs for bacteriological indicators 2,701 samples were taken, of which 154 or 5.7% did not meet sanitary and hygienic requirements. The biggest non-compliance was observed in Surkhandarya (10.2%, 33 out of 324), Navoi (7.0%, 17 out of 242) and Khorezm (21.9%, 30 out of 137) regions. As for chemical indicators, 2212 samples were taken, 285 or 12,9% of them failed to meet sanitary-hygienic requirements. The highest non-compliance was observed in Tashkent city - 23.0% (12 out of 52 samples), Bukhara city - 52.6% (34 out of 57), Namangan city - 22.6% (38 out of 168), Khorezm region - 23.0% (60 out of 261) and the Republic of Karakalpakstan - 60.0% (12 out of 20) (Waśkiel, 2018).

The main reasons for this are that increasing climatic temperatures have a significant impact primarily on the surface flow and discharge of water in rivers, i.e., drying them out and thus reducing their volume and increasing the concentration of pollutants, among other things:

-The sources of drinking water supply in the western regions of the republic are taken from surface water mainly Amudarya source, particularly in Karakalpakstan, Bukhara and Khorezm regions, and for other regions, from groundwater sources, which are the most reliable and require fewer treatment measures and costs.

- Since the water supply in the regions is highly intermittent due to the capacity of the pumps, and the disinfection of drinking water is a continuous process, the concentration of liquid chlorine varies - where it is low and where it exceeds it

- Water disinfection is performed by chlorination with liquid chlorine, calcium hypochlorite. Both products are produced domestically at the Navoiy chemical plant. The quality of the disinfection depends on the condition of the relevant equipment. In recent years, electrolysis plants using table salt have been widely used.

However, the production of the Navoiy Chemical Plant covers only 40-45% of the country's domestic demand; the rest is imported, mainly from Russia.

- There is also the fact that the patterns of water quality formation of surface sources (for example, the Zarafshan river) are characterized by the fact that there is a direct dependence between the composition of discharged collector-drainage, domestic and industrial effluents, and river water quality. In the upper reaches (the "Ravatkhoja" site No. 1 at the border with Tajikistan), water quality according to organoleptic and chemical indicators meets the requirements. However, there is microbial contamination of water.

Analysis shows that there is a tendency of peak deterioration of water quality in rivers in the summer season compared to winter and spring periods by the results of investigations after discharges of industrial and domestic industrial wastewater.

At present, Bukhara and Tashkent water utilities have switched to disinfection with sodium hypochlorite. Due to changes in water treatment and treatment technologies, disinfection types, and the emergence of many new pollutants that easily enter drinking water, it is necessary to revise the existing Standard for Drinking Water Supply in the republic. Therefore, in order to prevent the negative impact of water sources on health, O′zDSt 31351:2017 "Maximum permitted concentrations of chemical substances in water. Development and scientific justification" approved by the Agency "Uzstandart" on 24.01.2017 No. 05-813. The new standard addresses the issue of unification of experimental studies on hygienic regulation of chemical substances in water bodies, considering existing regional specificities and the requirements of the World Health Organization (WHO).

As a result, according to the analysis of data from the report submitted by the Republican Centre for State Sanitary and Epidemiological Surveillance of the Ministry of Health, the highest percentage of samples in the republic that do not meet the requirements of the standard was observed in rural water supply system (The report is submitted in accordance with the draft report submitted under the Protocol on Water and Health, 2010). Rural water pipes are generally of low capacity, most of them lack disinfection facilities, sanitary protection zones, they operate irregularly and, as a result, they supply water of lower quality, which poses the greatest threat and risk to the health of the rural population and is a factor of transmission of acute intestinal infections (Fong, 2017).

Water supply.

A large proportion of households are supplied with water for only a few hours a day (Table 3). Only 17% of consumers receive water within 24 hours, 18% within 12 hours and an overwhelming number of consumers (50%) receive water for no more than 2-6 hours per day.

Table 3

Actual level of services in 2020

	24h/day	Up to 12 h/day	About 6 h/day
% of water utilities	17%	18%	50%

Source: JSC Uzsuvtayminot, 2020

Such interruptions and partial water supply are explained by the high-water debts of consumers (physical entities) and primarily to Uzbekenergo, as water pumps are operated with electricity. There is also a negligent attitude towards their responsibilities and abuse of their position by officials in electricity supply companies. In 2020 alone, electricity arrears of 80.1 billion soms were incurred. Water utilities are making every effort to improve water supply at the expense of their losses (A representative of Uzbekenergo, 2021).

Efforts are being made to reduce arrears, since drinking water and wastewater treatment tariffs are being raised everywhere from 1 January 2021.

Measures to improve the culture of consumption, strengthen payment discipline and conserve drinking water are foreseen for individuals fines for water disconnection and reconnection, and for legal entities fines of 10 minimum wages for water disconnection and reconnection.

The unpredictability of potable water interruptions further aggravates the situation, not only, as mentioned above, in terms of water quality but also in terms of comfortable use for domestic purposes. Some water supply systems are so unusable that they cannot even be repaired.

In recent years, the Government of the Republic, with the support of international financial institutions, has made a number of investments to modernise and extend the coverage of the water supply and sanitation system.

Household expenditure on drinking water services.

Over 7% of households drink water of non-potable quality from springs, rivers, canals, and ditches, and 8.1% of the population uses imported water, the cost of 1m^3 of imported water in some regions is 20 000-50 000 soms/m^3 (Table 4). In the absence of local water sources, residents of rural areas not covered by the centralized water supply system use imported water. The cost of such water depends on distance and can reach 20,000-50,000 soms/m^3, while the highest tariff for centralized water supply systems is recorded in Navoiy province - 3,000 soms/m^3.

Table 4

The actual water supply regime for the population in 2020

Type of water supply	% population coverage
Connection to central system	70,8
Pumping stations (domestic)	8,2
Wells	5,8
Springs, rivers, channels, wells, etc.	7,1
Imported water	8,1
Total	100

Source: JSC Uzsuvtayminot, 2020

According to information from water utilities and Uzsuvtaminot JSC, in 2020, the average daily water consumption of the population connected to the centralised water supply system across the country was 128 litres/person/day, and in Tashkent city 273 litres/person/day, and in rural areas less than the project norms and water consumption standards, which indicates the imperfection of the current standards and their failure to adapt to effective demand management and optimization of investment resources (Table 5).

Table 5

Projected norms for water consumption l/per capita/day in 2020

Type of populated areas	According to the norms of Ministry of Construction	According to JSC Uzsuvtayminot
Cities with more than 100,000 inhabitants with a centralised sewage system	230	128
Cities with less than 100,000 inhabitants with a centralised sewage system	200	
Cities with less than 50,000 inhabitants without a sewage system	150	
Rural settlements with sewage system, including flooding of livestock	170	
Rural settlements without sewage system	120	
Rural settlements via street water points	50	50

Source: JSC Uzsuvtayminot, Ministry of Construction of the Republic of Uzbekistan, 2020

Gender issues in the drinking water sector

The most important of all issues is the need for improved access to safe drinking water and sanitation. Access to safe drinking water and proper hygiene improve the health and quality of life of the population, which is particularly important for women, who are usually engaged in providing their families with water and keeping their homes clean, as well as taking care of sick family members.

It is worth noting that there is no gender discrimination in the republic in this area. Moreover, women are fully involved on an equal basis with men in the process of development and monitoring of "drinking water supply" projects; additional jobs for women have been created in all water utilities (Asian Development Bank, 2013). Also, if previously women had to spend a lot of time to provide their families with water, today the situation has changed dramatically, with construction and installation works to improve water supply and sanitation (sewerage) being carried out in almost all rural settlements.

On the permanent basis, it is women who are involved in personal and community hygiene awareness and capacity building programmes carried out to ensure that the benefits derived from improved water supply systems are more fully realised. These training programmes have enhanced the positive social impact of improved water and sanitation services on these women's families and on the communities in which they live in general.

In fact, according to the norms developed by the Ministry of Construction "Urban Planning Norms and Rules" (KMK 2.04.02-2019, second edition, with amendments and additions) and "Water Supply. Outdoor networks and facilities" (instead of CMK 2.04.02-15), item 2 "Estimated water consumption and free pressures", item 2.1. When designing water supply systems in settlements, specific average daily (per year) water consumption for household and drinking needs of the population may be accepted according to Table 6.

Table 6

Estimated water consumption, specific average daily (annual) water consumption for household and drinking needs of the population

Degree of residential area improvement in housing estate	Specific domestic and drinking water consumption in settlements per inhabitant average daily per year), l/day, q1	
	2020	2035
Buildings equipped with domestic water supply and sewage system:		
centralised hot water supply	195 – 230	200 – 280
Bathtubs and domestic hot water heaters	150 – 200	150 – 230
with in-house water supply without sewage system	95 - 120	120
Note: Specific water consumption within the limits given in Table 1 is selected depending on water quality, degree of improvement, local and climatic conditions.		

Table 2 (continue)

	Water consumer	Specific domestic and drinking water consumption in settlements per inhabitant average daily (per year), l/day, q	
		2020 г.	2035 г.
1	Cities with a centralised sewage system: with more than 100,000 inhabitants (with 60-70% sewerage coverage)	230	260
2	Same, with a population of up to 100,000 people (with 20-25% sewerage coverage)	200	-
3	Same, with a population of up to 100,000 people (with 30-45% sewerage coverage)	-	230
4	Cities, urban settlements, and district centres up to 50,000 inhabitants with no centralised sewage system: (with 5-10% sewerage coverage)	150	-
5	Cities, urban settlements, and district centres with up to 50,000 inhabitants with centralised sewerage systems (with sewerage coverage of up to 30%)	-	170
6	Rural settlements (with sewerage coverage of up to 25%), considering watering of private livestock.	120	170
7	Rural settlements (without sewerage), considering watering of private livestock.	115	-
Note: Specific water consumption within the limits given in Table 1 is selected depending on water quality, degree of improvement, local and climatic conditions.			

Source: Ministry of Construction of the Republic of Uzbekistan «Urban planning rules and regulations», 2019

From these norms, the division into male and female gender is completely absent. Therefore, the issue of gender is currently irrelevant in the country.

Conclusions

The analysis carried out leads to the following conclusions.

1. According to official data, 60% of drinking water is derived from groundwater sources. More than 20% of the proven fresh groundwater resources in the country are not suitable for drinking purposes, and demand, due to demographic growth and increasing urbanisation, is increasing steadily from year to year.
2. The level of coverage of centralised water supply services in 2020 has reached about 70.8% throughout the republic, but there remain districts, especially rural ones, where the coverage of households has access to water supply below 10%, such as in Kashkadarya province (Guzar and Dekhkanabad districts).
3. It has been established that an overwhelming number of consumers receive water only for a few hours a day (50-55%) and face problems related to pressure and water quality. The main reason for this is the high indebtedness of consumers and the negligent attitude of the officials responsible for water supply to their work.
4. As a result, many households rely on other sources of water, such as backyard pumps and open reservoirs - exactly like households that are not connected to piped water. For example, 15.3% of households drink non-potable water from pumping stations, springs, rivers, canals, and ditches, while 8.1% of the population uses imported water, which costs up to 50,000 soms/m^3, depending on distance.

5. It should be noted that the high level of losses exceeding 30% (and up to 60% in some settlements) is primarily due to the condition of water supply systems, obsolete water pipelines, water supply networks, and the existing low maintenance level.
6. The most effective measure against water loss is metering of water supplied to the consumers, i.e. installation of water meters, etc.
7. Most of the existing norms and regulations in the drinking water sector were adopted in the former Soviet times or redrafted on their basis, which reflects imperfections in the form of numerous overlapping standards and mandates of different structures.
8. The issue of gender in the republic is currently irrelevant.

Recommendations

The recommended actions aim to remove barriers, stimulate innovation, and mobilise public and private investment to achieve climate sustainable development in the "Drinking Water Supply" sector.
Even though drinking water supply services (as of 2021) cover about 70% of the population of the country, there are significant problems in this sector, and given the increasing risk of climate change, the situation is only worsening.

Thus**,** 3.5 thousand (38% of the existing) drinking water supply facilities and 49 wastewater treatment plants (84%) need serious repair. Particularly noticeable from the consumer's point of view is the fact that out of 97 available laboratories for water quality improvement, 87 (almost all) need repair and re-equipment (JSC Uzsuvtaminot, 2021). The sector has branched and long (70.4 thousand km) drinking water supply and 7.6 thousand km sanitation networks, of which 32% and 22%, respectively, need repair.

The actual capacity of Tashkent's water intake facilities is 2,100 thousand cubic metres per day. At the same time, an average of 2,067 thousand cubic meters of water is supplied to the capital of the Republic per day. Thus, the available capacity is used practically at the limit (98.4%).
At the same time, a significant part of the water supply networks and equipment of the structures, which are supplied to consumers, were constructed, and installed more than 40 years ago and have considerable wear and tear.

Drinking water supply and drainage organizations, especially in rural areas, are chronically in arrears, and because of low tariffs and obsolete systems, are in a difficult economic situation, unable to finance even the running costs of providing their services, not to mention building new and upgrading existing water supply networks or drilling wells.
In view of the aforementioned, climate finance should be prioritised towards:

- the renovation of existing water infrastructure, including the replacement of obsolete morally and physically deteriorated pipelines.
- construction and modernisation of water reticulation systems.
- upgrading electrical equipment, replacing valves, upgrading reservoirs, and reducing non-revenue-generating water
- designing projects for more efficient rainwater harvesting and storage, industrial recycling, storm water management.
- aquifer management and use of renewable energies
- quality and efficient desalination technologies in remote areas (the Aral Sea area).
- In turn, the rural water supply programme will be expanded to provide 85-90 per cent access to clean water in rural areas
- Procurement of equipment and facilities to improve water treatment, including the repair and re-equipment of laboratories, covering the increasing costs of purchasing reagents (chlorine, aluminium sulphate, sodium hypochlorite and industrial salt) used for drinking water and wastewater treatment. Improvement of primary mechanical and biochemical treatment of wastewater.
- Introduction of digitalisation and information and communication technology in all structures and systems in the sector («Smart Water Supply and Sanitation») based on online hydraulic models, which requires large capital investments over a long period of time.
- Raising awareness of water conservation and conservation policy to reduce unjustified water losses.
- more work will continue to be done to increase civil responsibility for the use of water sources.

To mitigate water scarcity in Uzbekistan, in the context of climate change, the following actions need to be implemented and financed at the national level:

1. Introducing an integrated water resources management system by involving all stakeholders and linking it to land management.
2. Widespread introduction of water saving technologies in water consuming sectors in:
- Industry through implementation of water recycling and reuse.
- Agriculture through implementation of drip irrigation, sprinkling and drought resistant crops.
- Municipal utility sector through the widespread installation of meters, implementation of a differentiated tariff policy, reduction of losses and unproductive expenditures, wastewater treatment and use of treated wastewater for irrigation and technical needs.
3. Reconstruction of water and irrigation systems.
4. Institutional development in the area of water use and consumption.
5. Development of legal mechanisms for regulating water and land relations.
6. Improvement of national capacities of specialists and workers in the water supply sector.

In the future, water scarcity will be the main factor limiting the countries' development. This requires compromises between the states on equitable distribution of water resources.

Integrated water resources management at the regional level is the only way to manage based on the principles of water unity.

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