Uzbekistan
General Water Security Assessment

Public Disclosure Authorized

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Executive Summary

Water Security is more than coping with resource scarcity	**Water security is defined** as "The availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems and production, coupled with an acceptable level of water-related risks to people, environments and economies" (Grey and Sadoff, 2007). Water security is critical to attaining development goals by delivering benefits for people, the economy, and the environment, and mitigating water risks amplified by climate change.
Water Security Diagnostic Initiative Vision	Against this background, the World Bank's Water Global Practice initiated a **Water Security Diagnostic Initiative**[1] in 2017. The initiative seeks to make the best use of the World Bank's technical experience, instruments, and financial resources to produce studies that influence senior policymakers beyond line ministries. The initiative contributes to attaining the World Bank's vision of achieving a "**Water-Secure World for All**" by sustaining water resources, delivering services, and building resilience.
Conceptual framework	The World Bank's conceptual **Water Security Diagnostic Framework (WSDF)** recognizes that not all water-related challenges are equally significant in their impacts on people, ecosystems, and economies. A consistent approach is important to identify the most severe risks and significant opportunities. The concept determines water security **outcomes** from how water is managed and used. These are results of water **sector performance**, resource management, service delivery, and risk management. The performance, in turn, depends on water **sector architecture**, institutions and infrastructure and all areas are conditioned by water **endowment**. Therefore, the framework includes four main topical areas or dimensions: (i) water outcomes, (ii) water sector performance, (iii) water sector architecture, and (iv) water endowment.
One-Water Methodology	The **One-Water Methodology (O-WM)** aims to establish a consistent and systematic approach to diagnosing water security at country and regional levels without being overly prescriptive. It contributes to operationalizing the WSDF, identifying and benchmarking critical current and future challenges around water security in Europe and Central Asia (ECA) countries and proposing follow-up activities at the country level to improve water security.
Uzbekistan water security report	This report assesses Uzbekistan's current water security and future change drivers, aiming to spotlight issues for enhanced water security. It compiles knowledge, offering an overview of challenges, risks, and opportunities. The focus is on identifying key areas for immediate and future improvements in water security.
Diagnostic of Uzbekistan's water security and proposed priority actions for enhancing	The results of the diagnostic indicate that Uzbekistan could significantly enhance the economic, social, and environmental outcomes from using its water resources, including improving safely managed drinking water and sanitation coverage, reducing pressure on water bodies, and maximizing economic water productivity. To do so, the following major challenges spanning over the different water security dimensions need to be addressed and prioritized:

[1] https://www.worldbank.org/en/topic/water/publication/water-security-diagnostic-initiative

water security in Uzbekistan

- **Endowment** – Uzbekistan's water resources are dependent on transboundary rivers, which face growing pressures due to human interventions. The country experiences a continental climate marked by low annual precipitation and a pronounced dry season. Throughout the arid summer months, water sources become increasingly scarce. Agriculture stands as the primary consumer of water, accounting for approximately 90% of usage. Recognizing the imperative of water conservation, the Uzbekistani government has placed significant emphasis on enhancing water efficiency within the agricultural domain. However, modern practices such as precision farming and drip irrigation remain underutilized, constituting a mere fraction of overall irrigation methods. The state of irrigation infrastructure across the nation poses a considerable challenge. Urgent attention to bolstering water usage efficiency, particularly within the irrigation sector, is paramount for Uzbekistan's sustainable water management efforts.

- **Architecture** – Uzbekistan's water sector operates under the primary legal framework known as the Water law, which has undergone amendments since its inception. Suvtaminot serves as the principal provider of water supply and sanitation services, operating under the purview of the Ministry of Housing and Communal Services (MHCS). Additionally, Uzsuvtaminot JSC oversees regional Suvtaminot entities as Limited Liability Companies (LLCs), aimed at advancing further development within the Water and Communal Services (W&C) sector. Moreover, the irrigation sector and groundwater falls under the Ministry of Water Resources and the Ministry of Mining Industry and Geology respectively. Establishing and reinforcing an independent regulatory body is crucial for Uzbekistan's water sector.

- **Performance** – Uzbekistan needs to scale up its investment in water supply and sanitation (WSS) infrastructure to improve WSS coverage, especially in rural areas. Monitoring water losses and supporting the development of staff capacities to detect, manage and address water losses, as well as identifying projects for the rehabilitation and replacement of water supply networks, would be needed. Moreover, a review of the water tariffs for improved cost recovery would be necessary to ensure operation, maintenance, and continued investments in WSS and irrigation infrastructure. Irrigation infrastructure in Uzbekistan is not very efficient and often outdated. The agricultural sector requires investments to modernize existing irrigation schemes to introduce more efficient irrigation technologies. Lastly, Uzbekistan is vulnerable to floods and droughts, requiring the development and implementation of flood and drought management plans.

- **Outcomes** – Uzbekistan has good coverage of WSS services, and the urban–rural supply gap with regards to at least basic services is very small. However, looking at piped water supply and flush toilets, significant inequalities between urban and rural areas exist. The proportion of safely managed WSS services needs to be increased. Uzbekistan’s water bodies face pressures due to growing water abstractions but also water pollution, requiring implementing effective water quality monitoring systems, improved wastewater treatment, and strengthening regulations and enforcement related to water pollution. The overall economic water productivity in Uzbekistan is very low. Improving the institutional capacity and promoting the adoption of

modern technologies (e.g., precision farming techniques, drip irrigation) could help leveraging the untapped economic potential.

Abbreviations

ADB	Asian Development Bank
AQUASTAT	FAO global information system on water resources and agricultural water management
BMOs	Basin management organizations
CMIP5	Coupled Model Intercomparison Project - Phase 5
EBRD	European Bank for Reconstruction and Development
ECA	Europe and Central Asia
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross domestic product
IBNET	International Benchmarking Network for Water and Sanitation Utilities
IPCC	Intergovernmental Panel on Climate Change
IWRM	Integrated Water Resources Management
JMP	Joint Monitoring Programme
MHCS	Ministry of Housing and Communal Services
NRW	Non-Revenue Water
OECD	Organization for Economic Cooperation and Development
O-WM	One-Water Methodology
RCP	Representative Concentration Pathways
SPEI	Standardized Precipitation Evapotranspiration Index
SDG	Sustainable Development Goal
SSP	Shared Socioeconomic Pathways
WASH	Water, Sanitation and Hygiene
WB	World Bank
WFD	Water Framework Directive
WHO	World Health Organization
WRI	World Resources Institute
WSDF	Water Security Diagnostics Framework
WSS	Water supply and sanitation
WUAs	Water User Associations

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1 Background and Project Introduction

1.1 Scope and Objectives of the Water Security Report of Uzbekistan

This report provides a high-level assessment of Uzbekistan's water security status across different water security dimensions (endowment, sector architecture, performance and outcomes) with the aim of highlighting where efforts should be focused to increase the resilience of the water sector now and in the future. The assessment focuses on identifying the key water security challenges, risks, and opportunities, following the *One-Water Methodology*. It responds to key questions such as: why does water security matter for Uzbekistan? What risks threaten its water security currently and in the light of future climate change? How is its performance constrained or enabled? What areas require special attention to overcome existing gaps and enhance water security in Uzbekistan? The findings in this report provide a high-level picture of Uzbekistan's water security but also offers a general set of recommendations for action, including water security areas where comprehensive analysis is required to identify leverage points, and sector investment plans.

This report is meant for policy and decision makers working in the space of water security for which water is a critical input, as well as non-state water institutions working on water security.

The report is organized as follows. The remainder of Chapter 1 provides a short overview of the Water Security Diagnostic Framework, the *One-Water Methodology*, and a general overview of key physical, and socio-institutional features of Uzbekistan. Chapter 2 provides a diagnosis of current water security status of Uzbekistan across its four main dimensions (endowment, sector architecture, performance and outcomes). Chapter 3 describes Uzbekistan's future trajectories imposed by global climate and socio-economic scenarios, and drivers related to ongoing and foreseen development plans. Chapter 4 elaborates a preliminary country narrative and related policy recommendations based on the main water security challenges, risks, and opportunities that Uzbekistan is and is likely to face in the near future.

1.2 The Water Security Diagnostic Framework

Water security is a complex, multi-dimensional and multi-sectoral concept. It concerns the building of a water secure future for the people, the economy, and the environment in the face of local and global challenges. Achieving water security is therefore the overarching goal of water management and includes leveraging productive aspects of water for human well-being, livelihoods, environment and socio-economic development, and the management of the destructive impacts of water such as floods, droughts, and pollution to protect societies, economies, and the environment. Water insecurity is typically driven by a combination of environmental, socio-economic, technological, and governance factors. The most water insecure countries combine challenging hydrological environments with weak institutions and chronic under-investment in water infrastructure. Even when water is abundant, and the hydrologic regime is benign, mismanagement (for example, poor pollution regulation) or inadequate infrastructure investments can lead to water insecurity.

Water security cannot be adequately assessed by any single integrative index. In addition, water security often intersects with other security concerns, including energy, food, climate change and overall national security. As an alternative to establishing a strict methodology for measuring water security, the Water Global Practice of The World Bank has developed a **Water Security Diagnostic Framework (WSDF)** (Figure 1). The WSDF focuses on establishing a consistent and structured conceptual approach to diagnosing water security without being overly prescriptive. This approach is important to identify the most severe risks and significant opportunities, facilitate global comparisons, and benchmark countries. Moreover, seeks to make explicit the relationship between a country's **water endowment** (given and subject to change due to climate change) and its linkage to **social, economic and environmental outcomes**. This is done by examining the role of **water sector architecture**, encompassing infrastructure and institutions, in the **performance** of the water sector in managing **water resources**, delivering **water services**, and mitigating **water-related risks**.

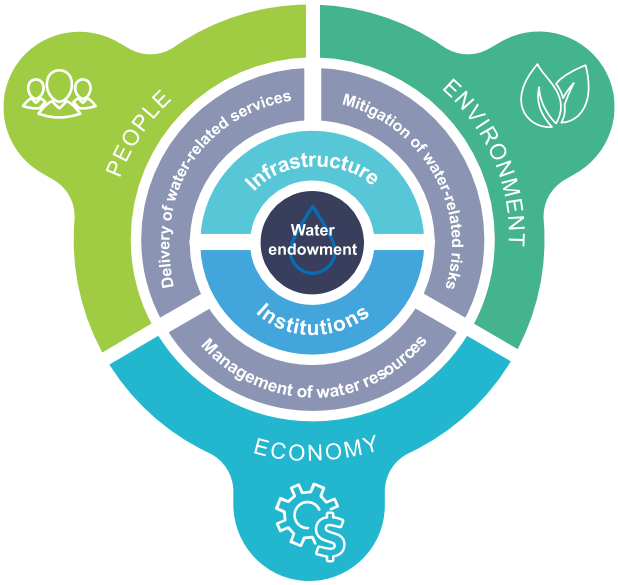

Figure 1: The Water Security Diagnostic Framework (WSDF) and its different dimensions. Source: World Bank (2019)

1.3 The One-Water Methodology

The **One-Water Methodology (O-WM)** has been developed to **operationalize the WSDF** using an innovative method which maximizes the use of available country data and stakeholder knowledge to establish a **rapid, consistent, and systematic diagnosis of the water sector** across the different dimensions as defined in the WSDF. Through an innovative set of qualitative and quantitative indicators structured in the form of a *performance* matrix, the O-WM allows countries to map where are they standing; but also provides the basis to **identify high-impact actions** to incrementally improve the performance of the water sector and put the country on the right track to water security. The O-WM promotes a dynamic learning cycle i.e. *learning by doing* that continuously strengthens the methodology and accelerates the systematic identification of new gaps and new opportunities.

The O-WM for country analysis and strategy comprises three phases and each phase includes several steps as shown in Figure 2:

Phase A: Preparatory and Diagnosis Phase: This phase defines the current water security status of a country using a set of quantitative and qualitative indicators which help describing the different water security dimensions of the WSDF. Such indicator-based assessment is combined with desktop review and several stakeholder interactions, including scoping interviews and one workshop with key water-related actors. The main output of this phase is a detailed narrative of a country's water security status along the four water security dimensions of the WSDF, along with an identification of the main risks and opportunities of existing and future climate and socio-economic scenarios. The list of quantitative and qualitative indicators used to assess a country's water security is provided in the Annex I.

Phase B: Action Planning and Decision Phase: Based on the diagnosis, this phase supports countries in the identification of pathways to enhance their water security through the identification and prioritization of actions through a participatory multi-criteria analysis. The main output of this phase is a roadmap that includes a set of priority actions that should ideally feed into a strategic action plan that builds on the momentum to accelerate policy reforms and investments to achieve a long-term water security vision.

Phase C: Learning phase and preparation for next cycle: Accumulation and analysis of experiences and lessons learned during the implementation of the O-WM and preparation for the next One-Water cycle.

Figure 2: The 10-Steps-Process of the country One-Water-Methodology.

In this report, only the Phase A of the **O-WM** is implemented to provide a preliminary assessment of water security in Uzbekistan. The country narrative serves as the basis to identify strategic areas of concern of the countries' water security, and where further efforts should be placed for action planning and implementation.

1.4 Setting the scene: Uzbekistan main physical, socio-economic and governance features

Geography. Uzbekistan is a landlocked country situated in Central Asia, sharing borders with Kazakhstan to the north, Kyrgyzstan to the northeast, Tajikistan to the southeast, Afghanistan to the south, and Turkmenistan to the southwest. The territory of Uzbekistan is a peculiar combination of flat and mountainous relief. Most of the territory of Uzbekistan is occupied by plains (about four-fifths of the territory). One of the main ones is the Turan plain. In the east and north-east of the country are the spurs of the Tien Shan and Pamir, here is the highest point of the country (4643 m). In the north of the central part of the territory of Uzbekistan there is one of the largest deserts in the world - Kyzylkum.

Uzbekistan lies within a seismically active zone due to its proximity to the convergence of the Indian and Eurasian tectonic plates. While earthquakes are less frequent compared to some neighboring countries, they still pose a risk to the region. Additionally, the Aral Sea crisis, resulting from extensive irrigation projects diverting water from the Amu Darya and Syr Darya rivers, has significantly impacted Uzbekistan's environmental landscape and socio-economic conditions.

Figure 3: topographic map of Uzbekistan. Source: Philippe Rekacewicz, Emmanuelle Bournay, UNEP/GRID-Arendal

Climate. The climate of Uzbekistan is sharply continental. It is characterized by a sharp amplitude of day and night, summer and winter temperatures. The difference in temperature depending on the time of the year is quite significant. The average January temperature drops to -6°C, and the average July temperature rises to +32°C. The average annual amount of precipitation falling on the plains is 120 - 200 mm, in mountainous areas - up to 1000 mm. Rainfall is negligible, so agriculture is more dependent on irrigation.

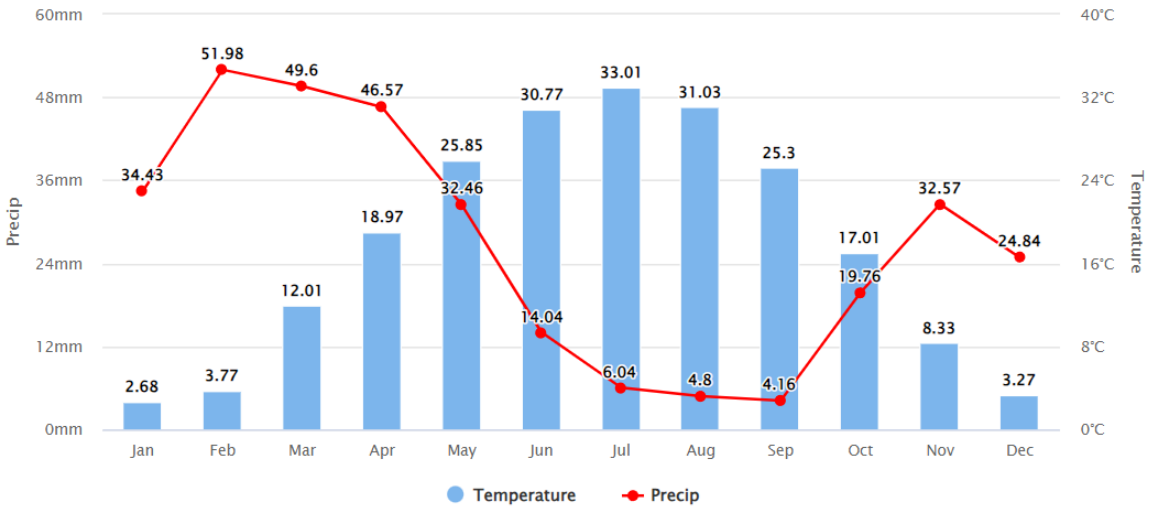

Figure 4: Uzbekistan Climate Graph. Source: https://weatherandclimate.com/uzbekistan

Administration.

The Republic of Uzbekistan consists of regions, districts, cities, settlements and villages. The Republic of Karakalpakstan is part of the Republic of Uzbekistan. The highest state representative body is the Oliy Majlis of the Republic of Uzbekistan, which exercises legislative power (hereinafter referred to as the Parliament), consisting of two chambers - the Legislative Chamber (lower house) and the Senate (upper house).

In Uzbekistan, the administrative structure comprises of 12 regions (viloyatlar), autonomous republics, and the capital city, Tashkent. The governance framework for these regions, including the capital, operates under legal provisions and decrees. Public administration within Uzbekistan's regions adheres to directives outlined by the President and legislative measures aimed at fostering efficient governance and regional progress. Each region is overseen by a governor (hokim) tasked with implementing governmental policies and orchestrating administrative operations within their respective territories. Governors hold pivotal roles in executing national directives at the regional level, overseeing local executive branches, and ensuring alignment with broader national objectives and strategies.

Figure 5: Administrative regions of Uzbekistan.

Source: https://www.nationsonline.org/oneworld/map/uzbekistan-political-map.htm

Population. Uzbekistan, situated in Central Asia, boasts a population of approximately 34 million people. The population density across Uzbekistan is relatively varied, with an average of around 76 persons per square kilometer, akin to neighboring countries like Kazakhstan (7 persons per square kilometer) and Turkmenistan (12 persons per square kilometer). The ethnic composition of Uzbekistan is predominantly Uzbek, forming a significant majority, while other minority groups include Russians, Tajiks, Kazakhs, and Tatars, reflecting the country's historical diversity and cultural heritage. Uzbekistan's population exhibits a median age of approximately 27 years, indicative of a youthful populace, with a stable birth rate influenced by various socio-economic factors. The nation has experienced some emigration trends, primarily driven by economic opportunities and political dynamics. Urbanization in Uzbekistan is notable, with over half of the population residing in urban areas,

particularly in major cities like Tashkent, which accounts for a significant portion of the total population. Rural areas still house a considerable portion of the population, contributing to the country's diverse demographic landscape.

Economy. Uzbekistan's economy is diversified, encompassing agriculture, services, and manufacturing sectors. Agriculture has historically been a significant contributor to the economy, with products such as cotton, fruits, vegetables, and livestock playing pivotal roles in rural livelihoods. The services sector, including industries like tourism, information technology (IT) services, and financial services, has been steadily expanding and has emerged as a key driver of economic growth. Uzbekistan also has a developing manufacturing sector, producing textiles, processed foods, machinery, and electronics, among other goods.

In the first half of 2023, Uzbekistan experienced stronger than expected economic growth, with real GDP rising from 5.4% in first half of 2022 to 5.6% in the same period of 2023. Additionally, agriculture saw accelerated growth from 2.6% to 3.8%, while services experienced a slight decline from 7.9% to 6.4%. (ADB, 2023).

Uzbekistan is undertaking comprehensive reforms to its economy with the aim of enhancing sustainable development. Key strategies include upgrading infrastructure, streamlining regulations, prioritizing environmental sustainability and social development through initiatives such as improving water management, advancing irrigation technology, enhancing energy efficiency, and fostering rural development. Overall, these efforts are designed to build a robust and resilient economy capable of withstanding external shocks and providing a higher quality of life for citizens.

Agriculture. Uzbekistan has 27 630 000 ha of agricultural land, of which 82 % is classified as rangeland. 16.2 % as arable land and 1.2 % as permanent land crop. According to the World Bank, Uzbekistan's agricultural sector encompasses a significant portion of the country's land area, totalling approximately 58.3 % of the total land area, which amounts to 256,906 sq. km. The arable land in Uzbekistan spans around 4,023,000 hectares (4,023.00 sq. km). Agriculture plays a vital role in Uzbekistan's economy, serving as a primary source of economic activity in rural regions and making a significant contribution to the country's GDP. As of 2023, agriculture accounts for approximately 28% of Uzbekistan's GDP (FAO, 2023).

Energy. Uzbekistan is capable of meeting its energy needs from its own energy resources. Uzbekistan owns a significant part of the installed capacity of the united power system of Central Asia. The majority of primary energy came from fossil fuels, with natural gas, coal and oil the main sources. Hydroelectricity, the only significant renewable source in the country, accounted for about 2% of the primary energy supply. Natural gas is the source for 73.8% of electricity production, followed by hydroelectricity with 21.4%.

2 Country Diagnosis

The country diagnosis of the water security situation of Uzbekistan is performed for the four dimensions of water security (endowment, architecture, performance, and outcomes) following the methodological approach provided in the O-WM. The overall assessment of each dimension is provided using radar charts that summarize the ranking of different indicators on a range band from 0 to 5 as defined in the O-WM[2]. A rating of 1 indicates Low performance (i.e., the country is at a very unfavourable status or performing poorly for a particular indicator), 2 rating is a Low-Medium (i.e., the country is underperforming although some progress has been made), 3 is Medium (i.e., the country is performing at an average level compared to other countries), 4 is Medium-High (i.e., the country is performing above average and showing good progress towards the desired outcome), and 5 is High (i.e., the country is at a high favourable status, outperforming and can be considered as best practice). The raw values of the indicators used to describe the different dimensions are described in Annex II.

2.1 Endowment

Water endowment refers to the total available water resources in quantity and quality. Available water resources include renewables (surface runoff and groundwater recharge), non-renewable (fossil groundwater) and non-conventional sources of water, including reused wastewater. The details of diagnosis are mentioned in section 2.1.1.

Uzbekistan's water availability and withdrawal are positioned at a Low-Medium level on the global scale. Figure 6 shows Water Availability per capita score of 2 and the Water Withdrawal per capita score of 2, which indicates that the country is underperforming in terms of water availability and withdrawal compared to other nations, signifying an area of concern that may impact sustainable water use practices. Additionally, the country experiences a moderate level of interannual and seasonal variability.

In terms of Drinking Water Quality, the assigned index score of 3 signifies a moderate level of quality. While the country maintains a certain standard, there is room for improvement in ensuring consistently high-quality drinking water for the population. Lastly, the Dependency Ratio score of 1, showcasing a degree of dependency on the upstream countries.

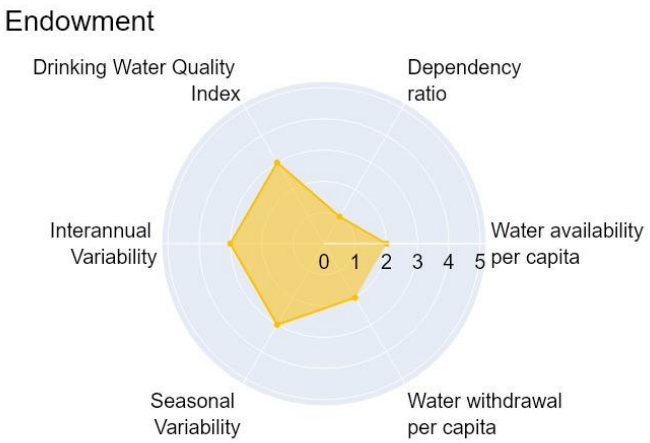

Figure 6: Results of indicator assessment regarding the water endowment in Uzbekistan.

[2] A score of 0 is equivalent to No Data

2.1.1 Supply

Water availability

Uzbekistan's water endowment is relatively low medium but still exceeds the regional average for the South Caucasus. The country has an average water availability of approximately 1,504 m3/capita/year (52.64 km^3/year.). This places Uzbekistan's water resources below the regional average for South Caucasus countries, which is approximately 2,000 m3/capita/year (FAO, 2022).

The total renewable water resources are on average 48.87 billion m3/year. Renewable surface waters in Uzbekistan are composed of locally generated runoff as well as potential contributions from neighboring regions. From the total available renewable water resources, approximately 84% (42.07 billion m3/year) are surface waters and the remaining 24% (8.80 billion m3/year) are groundwater sources. However, the allocation between these sources can be complex, influenced by various factors such as precipitation patterns, water management practices, and transboundary agreements. This intricate distribution may also fluctuate over time due to changes in climate conditions and regional water usage dynamics.

Dependency ratio

Uzbekistan's water resources are significantly influenced by transboundary waters, which face mounting pressures due to human activities. A substantial portion, around 80%, of Uzbekistan's surface water flows originate from neighbouring countries (FAO, 2022).

The country's largest rivers are transboundary water bodies with high regional importance for agriculture and the energy sector. The Amu Darya and Syr Darya rivers are pivotal transboundary water bodies, vital for agriculture, industry, and communities not only within Uzbekistan but also across Central Asia. However, these rivers are susceptible to fluctuations in flow due to activities upstream in Tajikistan, Kyrgyzstan, and Afghanistan. Issues such as dam construction, water diversion for irrigation, and hydropower generation in upstream countries can impact Uzbekistan's water availability, agricultural practices, and overall water security. For instance, the Amu Darya River, which originates in Tajikistan and flows through Uzbekistan, plays a critical role in sustaining agricultural livelihoods and providing water for domestic and industrial use. Changes in flow patterns caused by upstream activities can have profound effects on Uzbekistan's water resources, affecting the country's ability to meet its agricultural and energy needs. Similarly, the Syr Darya River, originating in Kyrgyzstan and flowing through Uzbekistan, is vital for irrigation and electricity generation within Uzbekistan and neighboring countries. However, the construction of dams and reservoirs upstream, particularly in Kyrgyzstan, can disrupt the flow of water downstream, impacting Uzbekistan's agricultural productivity and energy security.

In summary, Uzbekistan's dependence on transboundary water sources underscores the importance of regional cooperation and adaptive water management strategies to address the challenges posed by upstream activities and ensure sustainable use of shared water resources across Central Asia.

Interannual and seasonal water variability

Uzbekistan experiences moderate interannual variability along with a notable seasonal variability in its water availability. Situated at the heart of Central Asia, Uzbekistan's topography spans vast deserts and semi-deserts, exacerbating its susceptibility to water scarcity. The country experiences pronounced seasonal contrasts, with summers characterized by high temperatures and minimal rainfall, while winters are bitterly cold and even drier. In summers, the average monthly temperature is 32°C in the hottest month (July), with average daily maximums of 35°C in many major cities. In winters, the average monthly temperatures range from -1°C to -6°C between December and February, with western areas experiencing relatively colder temperatures and the highest temperatures found in the south near Turkmenistan and Afghanistan.

The regional climate nuances further accentuate the variability, with southeastern regions enduring more pronounced aridity compared to their northern counterparts. This geographic gradient amplifies the disparity in precipitation levels between seasons, exacerbating the seasonal variability observed across the nation.

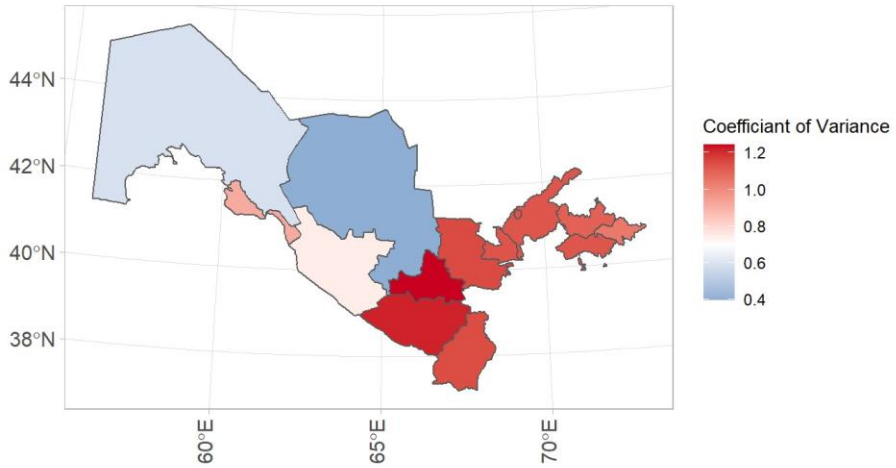

Figure 7: Spatial variation of seasonal variability of water availability across states in Uzbekistan. Source: Gassert et al. (2014).

Water quality

Water quality in Uzbekistan is generally moderate and comparable to the regional average. When assessing water quality in Uzbekistan, it is essential to consider both drinking water and ambient water quality. Regarding drinking water quality, it is typically evaluated by measuring the number of age-standardized disability-adjusted life-years lost per 100,000 individuals (DALY rate) due to exposure to unsafe drinking water. A score of 100 indicates that a country has one of the lowest DALY rates globally (≤5th-percentile), while a score of 0 suggests that a country falls among the highest DALY rates (≥95th-percentile). Uzbekistan falls within the medium range with a score of, for instance, 53.8, which is akin to the regional average (Environmental Performance Index 2022). Ambient water quality in Uzbekistan is assessed using the SDG indicator 6.3.2, which measures the proportion of water bodies with good ambient water quality. This indicator's scale ranges from 0 to 100, with Uzbekistan achieving a score of 64%. This means that approximately 64% of the country's water bodies, which encompass rivers, lakes, and aquifers, exhibit a favourable status according to national and/or subnational water quality standards, as determined through measurements of global water quality parameters.

2.1.2 Demand

Water withdrawals per source of water

Uzbekistan's water withdrawal is high and unevenly distributed across the country. Uzbekistan's current water withdrawals of 1527.62 m^3/capita/year. The total water withdrawal is approximately 49.95 billion m^3/year.

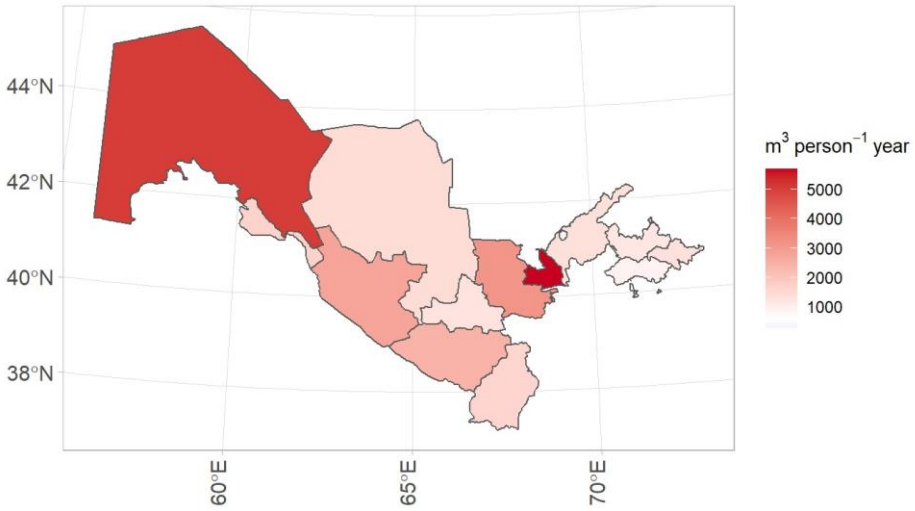

Figure 8: Water withdrawal per capita in Uzbekistan at the county level. Source: Gassert et al., (2014)

Uzbekistan has internal reserves of underground fresh water in the amount of 18.5 km³ of which 7.7 km³ / year is allowed for use (Schmidt, 2024). Over the past thirty to forty years, due to excessive pumping, many water deposits have been depleted. This is especially true for the territories of the Republic of Karakalpakstan, Khorezm, Bukhara and Navoi regions. Reserves of fresh underground water in Samarkand, Jizzakh, Tashkent, Fergana and Surkhandarya regions have significantly decreased. The quality of groundwater continues to rapidly deteriorate and, consequently, their possible use for household needs will inevitably and drastically decrease, this should be taken into account when compiling hydroeconomic calculations. Return waters are a significant part of the overall balance of water resources in the Aral Sea region. This water leaches minerals and chemicals from the soil and contributes to an increase in the level of anthropogenic pollution of water resources and aquifers, and damages the drinking water supply.

Sectoral water withdrawals

Agriculture: The sector that uses the bulk of the water resources is irrigated agriculture, which consumes about 90% of the total water withdrawal. Agriculture is the largest employment sector in Uzbekistan (about 45% of the labor force), roughly a quarter of GDP (FAO, 2020), and is heavily dependent on irrigated water. Uzbekistan therefore has a huge interest in ensuring that the distribution and management of the region's water resources is formal, transparent, and mutually beneficial rules are agreed with neighbours.

Municipal and Domestic Use: Water withdrawals for municipal and domestic purposes, including drinking water supply and household use, are also significant. Urban and rural areas depend on these water sources for their daily needs.

Industry: The industrial sector in Uzbekistan also relies on water for various processes, such as manufacturing, energy production, and mining. Industrial water use can vary depending on economic activity and industrial development in different regions.

2.2 Architecture

The architecture of the water sector in Uzbekistan is assessed by looking at the institutional set up and regulatory framework and the availability and status of the infrastructure for key uses (water supply and sanitation and irrigation). Figure 9 displays the results of the indicators used for assessing the status of the water infrastructure. The institutional and regulatory framework will be assessed qualitatively but not benchmarked. As described in Section 2.1, the higher the score, the better is the country performing against the specific indicator.

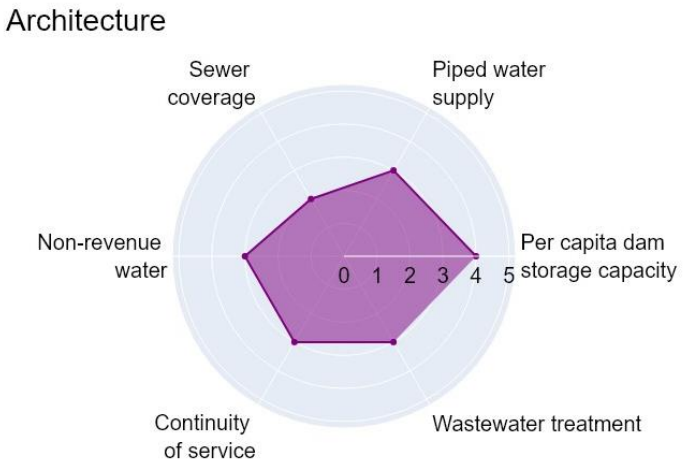

Figure 9: Status of the water sector architecture in Uzbekistan.

2.2.1 Regulatory framework and institutions

Institutional arrangement, roles, and responsibilities

In Uzbekistan, institutional mechanisms for the provision of water supply and sanitation services are undergoing significant changes, with a transition towards a more structured governance system. This initiative of the Uzbekistan government led the Presidential Resolution #6074, "Comprehensive Development and Modernization of Water Supply and Sanitation Systems, 2021–2025" and the establishment of a state-owned umbrella institution dedicated for the WSS sector in 2020 (Presidential Resolution #5883). The state-own company, "Uzsuvtaminot Joint Stock Company" (herein shortened as Uzsuvtaminot) was established to manage regional WSS companies ("Suvtaminot Limited Liability Company," herein shortened as Suvtaminot) and promote the WSS utilities improvement over the country. In order to enhance its institutional and operational capacity, Uzsuvtaminot is planning the establishment of a specialized training center called the "Water Academy" as a hub for training its staff as well as 14 regional Suvtaminots.

The Ministry of Construction, Housing and Communal Services conducts and permits water and sanitation utility construction and improvement projects, and drafts related policies. It has a public enterprise specialized in WSS sector (i.e., Uzsuvtaminot) under its umbrella, which leads and controls local WSS companies (i.e., Suvtaminots). Suvtaminots take charge of operation and maintenance (O&M) of local water and sanitation utilities, while local communities, "Mahalla" are managing simple water supply facilities (e.g., wells and/or springs) in some rural regions.

On the other hand, the Ministry of Health ensures the quality of tap water by overseeing the compliance with established state standards and is responsible for prevention of and response to waterborne diseases. The Councils of People's Deputies oversee local utility management. In terms of WSS related

budget, funds and water tariff policies, they are led by the Ministry of Economy and Finance and the National Antimonopoly Committee. Uzbekistan's institutes related to WSS service and their roles are presented in Table 1.

Table 1: Uzbekistan's state agencies related to WSS service

Agency	**Role**
Parliament ("Olli Majilis")	• Highest state representative body with legislative power, consisting of two chambers: Legislative Chamber and the Senate • Adopts laws and state budgets; sets key policy directions; defines the structure and powers of the legislative, executive, and judicial branches of power; establishes tax and other obligations; regulates executive legislation
Cabinet of Ministers	• Administrates state committees, ministries, and other state bodies • Coordinates activities of local executive authorities
Ministry of Economy and Finance	• Responsible for developing the country's socioeconomic programs, industrial development based on macroeconomic indicator analysis, and coordinating activities with other sector ministries/departments • One of the institutions supporting utility sector reform • Proposed several resolutions to increase the financial and operational efficiency of WSS facilities
Ministry of Health	• Supervises the quality of tap water in the water supply network through sanitary and epidemiological services (oversees the compliance with established state standards)
Ministry of Mining Industry and Geology	• Responsible for groundwater permits (with operation of the national committee)
Ministry of Ecology, Environmental Protection and Climate Change	• Corporate/individual legal compliance and execution with regard to pollution, surface water and groundwater, and soil • Environmental regulations and standards for reducing emissions to established standards
Antimonopoly Committee	• Participates in the utility financial condition improvement program and oversees the activities of the sector and the pricing/tariff mechanism
Ministry of Construction, Housing and Communal Services	• Legal compliance and supervision, project review, and coordination of activities of design and survey organizations in the fields of construction and architecture • Establishes, implements, and enforces policies in the fields of housing supply and communal services • Uzsuvtaminot, a public company that takes charge of the national WSS services, is under its umbrella. • Develops tariff and presents to other ministries for approval
Councils of People's Deputies	• Responsible for socioeconomic/cultural development, local budget allocation/ execution, local taxes, non-budgetary fund formation, local utility management, environmental protection, etc. • Approves tariffs at local levels
Governor of the Provincial Office ("Khokim")	• Overall responsibility for the local council, budget, executive branch, etc.
Local WSS Companies ("Suvtaminot")	• Limited Liability Corporation (LLC) in charge of local WSS services
Local ("Mahalla") Committee	• In some towns, local committees manage and provide water from wells or springs

These institutions work together to ensure the provision of water supply and sanitation services, while also addressing regulatory compliance, infrastructure development, financial sustainability, and environmental protection within the sector. Coordination among these entities is essential for effective governance and management of Uzbekistan's water resources and infrastructure.

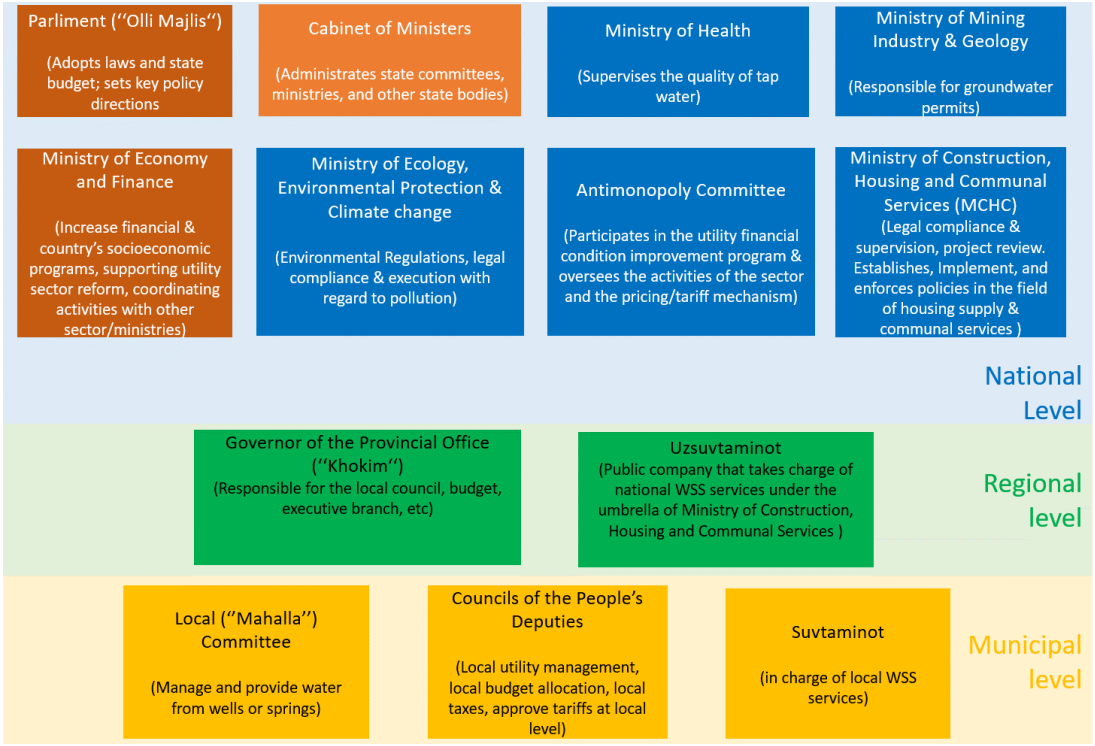

Figure 10: Sector institutions at national, regional, and local level in the Republic of Uzbekistan

Legal framework

The Law of the Republic of Uzbekistan on Water and Water Use of 6 March 1993, constitutes the primary legal framework governing water management in the country. Its overarching objective is to regulate water relations, ensuring the rational use of water resources while safeguarding the rights of various entities involved in water-related activities.

The Law on Water and Water Use comprises 119 articles divided into 29 chapters, each addressing specific facets of water management and regulation. These chapters encompass a broad spectrum of topics, starting with foundational principles and definitions in the General Provisions section.

Within this legal framework, regulations govern the establishment and operation of structures impacting water bodies and delineate activities within designated protection zones and strips. The law also addresses the rights and obligations of water users and consumers, classifies various forms of water utilization, and establishes procedures for obtaining the right to use water bodies.

Moreover, specific chapters regulate water usage for different purposes, such as human consumption, agriculture, industry, energy production, fisheries, and recreation. They also address the management of water bodies located in protected areas, navigation purposes, wastewater discharge, firefighting, and other public needs.

The legal framework further includes provisions for the operation of water infrastructure, management of interstate water use within the Aral Sea basin, dispute resolution mechanisms, and measures to protect water quality and mitigate harmful effects on water resources. Additionally, systems for state

accounting, planning, liability, compensation for damages, and international cooperation are established to ensure effective water resource management and governance.

Complementing the Law on Water and Water Use are various ministerial decrees, government decisions, and regulations that supplement and support these foundational laws. Together, these legal instruments aim to ensure the sustainable use, equitable distribution, and effective regulation of water resources throughout Uzbekistan.

To further improve water use and protection and effectively counter emerging new threats, several institutional and regulatory changes are being implemented in the industry. Notably, the Law № 733, dated November 30, 2021, amended and supplemented the Law on Water and Water Use, expanding the powers of the Cabinet of Ministers in regulating water relations. These expanded powers include implementing measures aimed at the development of water management, promoting the rational and efficient use of water, mitigating the negative impact of water shortages, approving other water use programs, and approving the procedures for state support in the introduction of water-saving technologies.

2.2.2 Infrastructure

Water supply and sanitation

Uzbekistan's water supply and sanitation infrastructure, largely constructed during the Soviet era, and is mainly life expired. The non-revenue water is approx. 35% within the water supply sector. According to the Joint Monitoring Program of the WHO the total water supply coverage by piped improved facilities is 70%. By contrast, the coverage of sanitation services by improved facilities especially in rural areas are significantly lower than for drinking water supply. The total sanitation coverage by sewer facilities of 26%. The connection rate of sewer systems to treatment plants is with 44 % medium low. The situation is particularly dire in rural areas, where communities face chronic service breakdowns or absence of any service. The inadequate treatment of wastewater has significant environmental impacts, including the contamination of surface and groundwater sources, which exacerbates the challenge of ensuring safe drinking water. Additionally, poor water quality resulting from insufficient treatment infrastructure contributes to health risks and undermines overall water security in the region.

Uzbekistan had received financial support and assistance from various international organizations and donors to support the rehabilitation and improvement of water and sanitation infrastructure. Some of the organizations that are or have been involved in recent years in providing financial support and assistance to Uzbekistan's water sector include The World Bank, the European Bank for Reconstruction and Development (EBRD) the European Union (EU), the Asian Development Bank (ADB) and bilateral aid agencies.

Irrigation, reservoir storage and hydropower

Uzbekistan's irrigation infrastructure is aging and in need of maintenance and modernization. The country has a network of irrigation infrastructure, including canals, pipelines, and reservoirs, designed to support agricultural activities, but water efficiency and distribution is a challenge. Efforts are, however, underway to improve irrigation practices and infrastructure to increase water use efficiency and promote sustainable agriculture. According to FAO's AQUASTAT (2020) the share of cultivated land under irrigation is 97%. Around 99% of the Country's irrigation systems is flood irrigation and less than 1% drip irrigation. Uzbekistan is making efforts to increase the use of drip irrigation.

Uzbekistan has several reservoirs and dams, which serve various purposes, including irrigation, water supply, and hydropower generation. There are several large artificial lakes in Uzbekistan, such as the Chardarya reservoir. According to FAO's AQUASTAT (2020) the storage capacity per inhabitant is 688 m³. Other countries in the Caucasus region have a significant higher dam storage capacity per capita (Georgia 850 m³, Azerbaijan 2,190 m³) than Uzbekistan. In Central Asian countries

such as Kazakhstan, Kyrgyzstan and Tajikistan, the per capita storage capacity is even higher at 3,000 to more than 4,000 m³.

Uzbekistan is the second largest electricity producer in Central Asia, with an installed electrical capacity of 14,000MW in 2019, of which only 12% is hydroelectricity.

2.3 Performance

The performance of the water sector in Uzbekistan is assessed under three categories: water resources management, management of water risk, and service delivery. The results of the indicator assessment for water sector performance are provided in Figure 11.

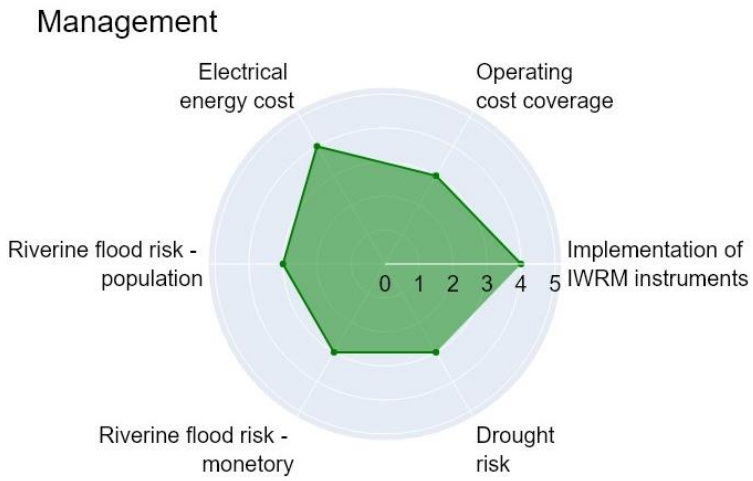

Figure 11: Results of indicator assessment regarding Uzbekistan's water sector performance.

2.3.1 Water Resources Management

Strategic Planning

The legal framework facilitating the introduction of Integrated Water Resources Management (IWRM) in Uzbekistan has undergone significant development over the years.

The concept of IWRM has evolved through various stages, including the sectoral approach, cooperative approach, management-oriented IWRM, and goal-oriented IWRM. Uzbekistan has witnessed this evolution and is committed to implementing IWRM principles.

The legal framework supporting IWRM in Uzbekistan includes a series of decrees, resolutions, and laws issued by the President and the Cabinet of Ministers. Key legislation includes the Law of Uzbekistan on water and water use, which underwent significant amendments in 2009 to strengthen economic reforms in agriculture and water resources.

Operational Planning

Uzbekistan has established Basin Irrigation Systems Administrations (BISA) and Main Canals System Management Organizations to transition from administrative-territorial to watershed-based management principles. The creation of these entities reflects a commitment to implementing IWRM at the basin level.

While progress has been made, challenges remain, including the need for further legislative improvements to fully integrate IWRM principles at the national scale. Uzbekistan is committed to ongoing efforts to enhance its legal framework and promote sustainable water management practices.

Overall, Uzbekistan has made significant strides in developing a legal framework conducive to implementing IWRM principles. However, continued efforts are needed to address remaining challenges and ensure the effective management of water resources across the country.

2.3.2 Management of Water Risks

Flood Risk

Uzbekistan is at risk of hydrometeorological hazards and natural disasters, which primarily affect the agricultural sector, through seasonal flooding and periods of drought. Impacts from climate change make Uzbekistan increasingly vulnerable to: droughts, high temperatures, heat waves, heavy precipitation, mudflows, floods, and avalanches. Looking at the average annual hazard occurrence in Uzbekistan in the last four decades, almost 18% of all natural disasters (earthquakes, storms, droughts, landslides, floods etc.) have been flood events. In 2020, around 70,050 people were affected by flood. Figure 12 shows the direct flood damage experienced by a country as a percentage GDP in an average year, while considering flood protections[3].

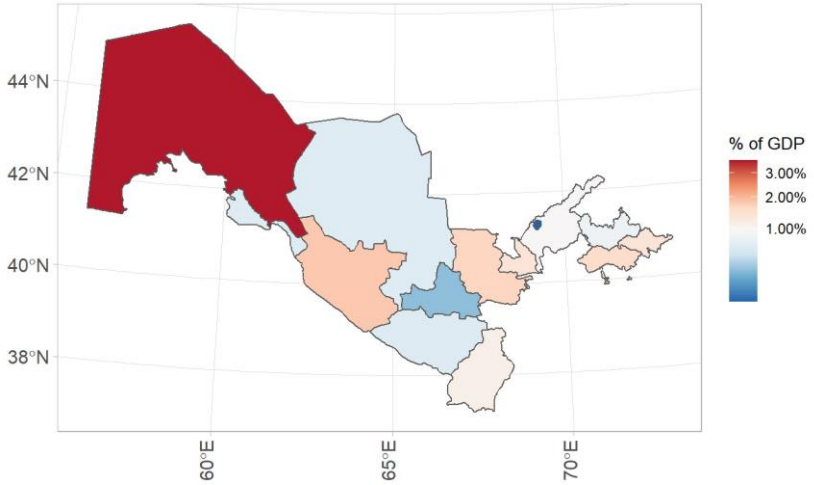

Figure 12: Riverine flood risk measured as damage experienced as a percentage of GDP in an average year in Uzbekistan on sub-national level. Source: Hofste et al. (2019)

[3] According to the global dataset of AQUEDUCT (Hofste et al., 2019), annually an average of 1.15% of population in Uzbekistan are affected by floods, while losses over a 100-year return period are equivalent to 1.00% of GDP.

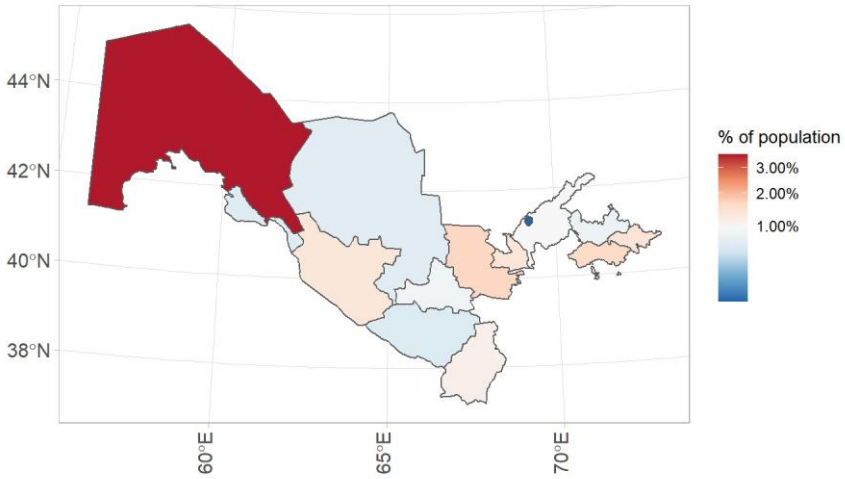

Figure 13: Riverine flood risk measured as percentage of population affected in Uzbekistan on sub-national level. Source: Hofste et al. (2019)

Drought Risk

The average drought risk in Uzbekistan is rated "Medium", but large areas of Uzbekistan face drought risk. Uzbekistan's climate is characterized by dry summers and relatively low annual precipitation. This makes the country inherently vulnerable to drought, particularly during the warm and dry summer months. Drought can have severe consequences for agriculture, which is a vital sector of Uzbekistan's economy. Insufficient rainfall and soil moisture deficits can lead to reduced crop yields, livestock water shortages, and food security concerns. To address drought risk, Uzbekistan has implemented various measures, including improved water management practices, the development of drought monitoring and early warning systems, and efforts to enhance water use efficiency in agriculture (World Bank 2010).

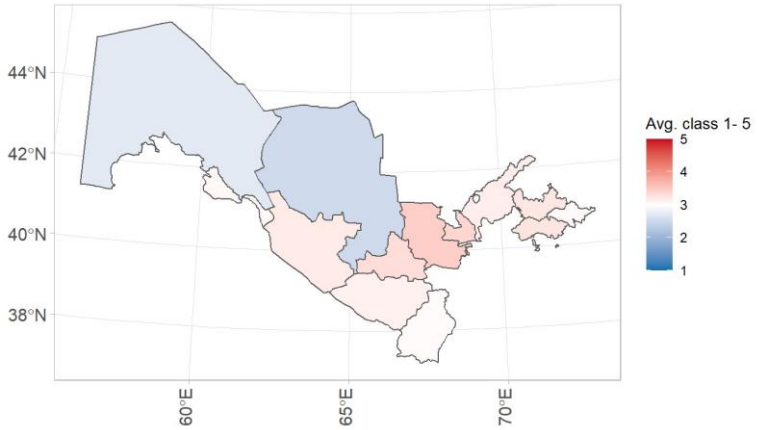

Figure 14: Drought risk in Uzbekistan. Source: Hofste et al. (2019)

2.3.2 Service delivery

Uzbekistan's water supply and sanitation systems are in urgent need of extensive reconstruction to ensure the population's access to reliable, safe, and affordable services. The government faces significant challenges in addressing degraded infrastructure, precarious financial conditions, and weak institutional capacity within the water and communal services (W&C) sector. Compounded by outdated sector strategies, limited planning mechanisms, and obsolete standards, the situation presents a complex set of obstacles.

Survey data reveal concerning realities in rural settlements, where households often receive water supply services for only a few hours a day (Droogers, 2017). Merely 19% of consumers have access to water supply round the clock, with 18% within 12 hours, while the majority (60-65%) access water for no more than 6 hours daily. The situation exacerbates in small and medium-sized cities, where water supply systems operate arbitrarily, with many abandoned or destroyed.

Approximately 26.2% of households resort to non-disinfected water from springs, rivers, canals, and ditches for drinking, while 8.7% rely on costly imported water. Despite a moderate average consumption of 112 liters per person per day, Uzbekistan faces challenges in effectively metering water intake and supply. While some progress has been made in installing meters for subscribers, the coverage remains insufficient, impacting the rational use of water.

Efforts to address the lack of safe water sources include the construction of 2,150 km of interregional water supply pipelines. However, their efficiency is currently estimated at only 52% of capacity, highlighting further challenges in ensuring widespread access to safe water.

High electricity consumption per cubic meter of water, attributed to the operation of outdated pumping equipment, underscores the need for modern technologies to minimize energy consumption in the water supply sector. As Uzbekistan's public water supply sector intensively develops, the adoption of innovative technologies becomes imperative for sustainable operations and resource management.

2.4 Outcomes

This section summarizes the analysis of the benefits derived from water and its use in Uzbekistan. Benefits are measures in terms of social, economic, and environmental outcomes. As with other dimensions, the higher the score, the better is the country performing on that aspect or indicator. Figure 15 describes the indicator performance across the social, environmental and economic outcomes.

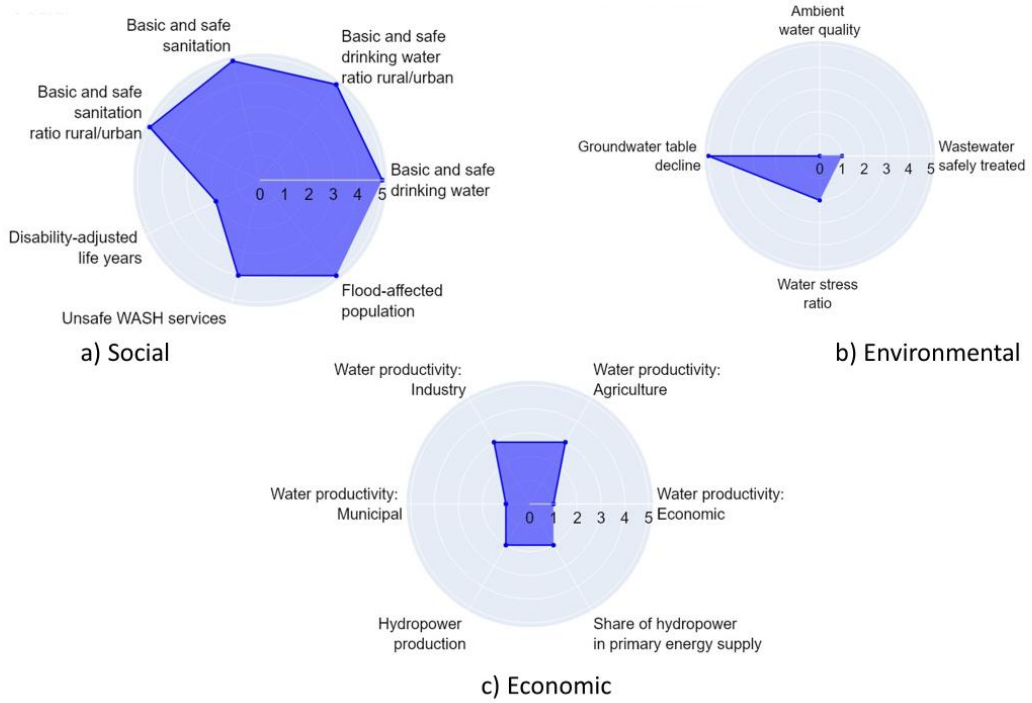

Figure 15: Results of indicator assessment regarding Uzbekistan's water sector outcomes.

2.4.1 Social outcomes

Supply of drinking water and sanitation services

Almost 97.8 % of the population in Uzbeksitan had access to basic or safely managed drinking water sources. This data indicates that most individuals within the country benefitted from access to clean and uncontaminated drinking water, a fundamental necessity for upholding optimal health and overall welfare. The availability of clean water is indispensable for myriad facets of everyday existence, encompassing hydration, culinary endeavors, and personal cleanliness.

About 98% of the population in Uzbekistan had access to at least basic sanitation services. This signifies that most individuals across the nation had access to facilities and infrastructure designed to effectively manage human waste, such as toilets and sewage systems. Sufficient sanitation services play a critical role in curbing the transmission of diseases and upholding the broader public health landscape.

Health and safety

Uzbekistan performs moderately in terms of health consequences of insufficient water supply and sanitation services. The number of DALYs ("disability adjusted life years") due to unsafe water, sanitation and handwashing is with 238 DALYs/100,000 inhabitants, a value in range with the middle range for the ECA countries (medium ranges between 200-350 DALYs/100,000 inhabitants). The mortality rate attributable to unsafe WASH services is 0.44 people/100,000 inhabitants, which is below the middle range of ECA countries (0.5-1 people/100,000 inhabitants).

2.4.2 Environmental outcomes

Water quality and ecological status

Uzbekistan has not reported information regarding the proportion of water bodies with good ambient water quality for SDG indicator 6.3.2. However, the country faces significant challenges in maintaining water quality across its various water bodies. In addressing these challenges, Uzbekistan has implemented measures to mitigate water quality issues. Efforts include water quality monitoring initiatives, habitat restoration projects, and steps to prevent further deterioration of water bodies. Despite these efforts, significant challenges persist, particularly in ensuring adequate wastewater treatment.

Water stress

Uzbekistan currently faces a high level of water stress overall. The water stress ratio is the ratio between total freshwater withdrawn by major economic sectors and total renewable freshwater resources, after considering environmental water requirements.

The water stress ratio of withdrawals to supply is according to the global dataset of AQUEDUCT (Hofste et al., 2019) at 168%. Water stress might increase in future due to climate change. Agriculture is a significant water user in Uzbekistan, and it accounts with 92% for a substantial portion of the country's water consumption. Ensuring a consistent and sufficient water supply for agricultural needs is crucial for food production. Uzbekistan's climate is characterized by relatively low annual precipitation and a dry summer season. During the dry summer months water resources become scarcer.

2.4.3 Economic outcomes

Uzbekistan is considered as a lower-middle income[4] economy. Uzbekistan's economic growth is based on different sectors including agriculture, information technology (IT) and high-tech industries, tourism, mining and energy.

The overall economic water productivity in Uzbekistan is low. "Economic water productivity" measures the efficiency with which water is used in the economy at national level and is shown in USD per m³ of water extracted. Uzbekistan's overall water productivity is about USD 1.34/m³, and below the average of other countries in the Caucasus Region (≈ USD 4-5/m³). Uzbekistan should find ways to further leverage its water resources. The country´s municipal water productivity is USD 14/m³, productivity of the industry sector is about USD 12/m³ and the agriculture USD 0.45/m³.

The agricultural sector in Uzbekistan is economically very important. Agriculture is the largest employment sector in Uzbekistan (about 45% of the labor force), roughly a quarter of GDP, and is heavily dependent on irrigated water. It provides livelihoods for a substantial portion of the population, including farmers, agricultural laborers, and those involved in related industries such as food processing. Cotton production in Uzbekistan is important to the national economy of the country.

Hydroelectricity, the only significant renewable source in the country, accounted for about 2% of the primary energy supply**.**

Water-related risks and economic costs

Uzbekistan faces a medium risk from hydrometeorological hazards and natural disasters, particularly impacting the agricultural sector, through seasonal flooding and periods of drought. The effects of climate change exacerbate Uzbekistan's vulnerability to various hazards,

[4] The classification of a country's income level is based on its Gross National Income (GNI) per capita, and Uzbekistan falls within the lower-middle-income category according to World Bank criteria.

including droughts, high temperatures, heat waves, heavy precipitation, mudflows, floods, and avalanches.[5]

Analyzing the average annual hazard occurrence over the past four decades, almost 18% of all natural disasters in Uzbekistan have been flood events. In 2020, around 70,050 people were affected by floods.

Drought poses severe consequences for Uzbekistan's agricultural sector, which is crucial to the country's economy. Insufficient rainfall and soil moisture deficits can result in reduced crop yields, shortages of water for livestock, and concerns regarding food security.

[5] In comparison the indicator "population affected by floods" based on "(EM-DAT, the International Disaster Database)" shows a low risk for the entire population. The indicator ''Riverine Flood Risk Population" is ranked medium. It shows the population that is expected to be directly affected by the riverine flood risk in an average year, while considering flood protections. This indicator is calculated by considering hazard and exposure.

3 Future Trajectories

This section provides quantitative projections for several indicators representing selected water security dimensions described earlier. The following indicators with future projections include renewable water availability, total water demand, water stress, and flood risk.

3.1 Future climate and socioeconomic scenarios

The Intergovernmental Panel on Climate Change (IPCC), a United Nations organization tasked with advancing knowledge on climate change, uses a collection of climate and socio-economic projections for modelling and research. The climate/emission scenarios, the Representative Concentration Pathways (RCPs), are four projections of how concentrations of greenhouse gases in the atmosphere will change due to human activities. The four RCPs (i.e., RCP2.6, RCP4.5, RCP6.0, and RCP8.5) range from low future concentrations (RCP2.6) to high (RCP8.5). In this assessment, three RCPs are considered, and for simplification, these are referred to as low (RCP2.6), medium (RCP4.5) and high (RCP8.5) emission scenarios. For each RCP, we used the projections of five climate models: GFDL-ESM4, IPSL-CM6A-LR, MPI-ESM1-2-HR, MRI-ESM2-0, and UKESM1-0-LL6F6F[6]. Climate models provide projections of climate conditions (e.g., temperature, precipitation) under the various RCP scenarios.

The socioeconomic scenarios, the Shared Socioeconomic Pathways (SSPs), are five narratives of development, cooperation, and priorities. For example, SSP1 is called the Sustainability Path and imagines a world acknowledging environmental boundaries, increasing equality and education, economic growth motivated by human well-being, and decreasing the use of resources and energy. SSP5 is called Fossil-Fueled Development. Each of the SSPs is associated with quantitative projections of population and GDP (Jones et al., 2016), which drive the changes in water demand. Population and GDP per capita projections are translated into water demands following the methodology of Wada et al. (2011).

3.2 Projections of some water security indicators

3.2.1 Water availability, water demand, and water stress

In this section, we provide future projections up to 2050 for some water security indicators, such as water availability and demand, under three climate and socio-economic scenario combinations to provide a range of possibilities. We refer to these combinations as **Optimistic** (SSP1 with RCP26), **Middle** (combining SSP3 with RCP70), and **Pessimistic** (combining SSP5 with RCP85). The projections are the results of simulations conducted with the global hydrological models CWatM (Burek et al. 2020).

Figure 16 presents a comparative analysis of annual water availability spanning the historical period (1970-2020) and future projections (2020-2050). Our examination reveals a slightly increasing trend in annual water availability till 2050. Specifically, the median yearly water availability is projected to increase by around 10% compared to the 20th century. Moreover, our analysis suggests an elevated frequency of hydrological anomalies, with both drier and wetter years more extreme than those experienced in the 20th century.

[6] The climate models are from the ISIMIP project: https://www.isimip.org/

Figure 16: Annual water availability for historical and three future scenarios.

Top) Line graphs show the median of the five models for each scenario and the entire range as a shadow, Bottom) Box-whisker plots showing the data variance through quartiles – quartiles divide the data into four relatively equal sizes.

Figure 17 presents projected total water demand across various sectors. The analysis indicates an increase in industrial and domestic water demands until 2050. Irrigation demand remains relatively stable. In these simulations, water demand projections do not incorporate potential alterations in irrigated areas, which are set in the simulations to stay constant at the 2000 level. The interplay between projected changes in water availability and demand produces increasing to steady water stress

till 2050, albeit with intermittent periods of extreme water stress up to 50% higher than historical levels (in Middle and Pessimistic), as depicted in Figure 18.

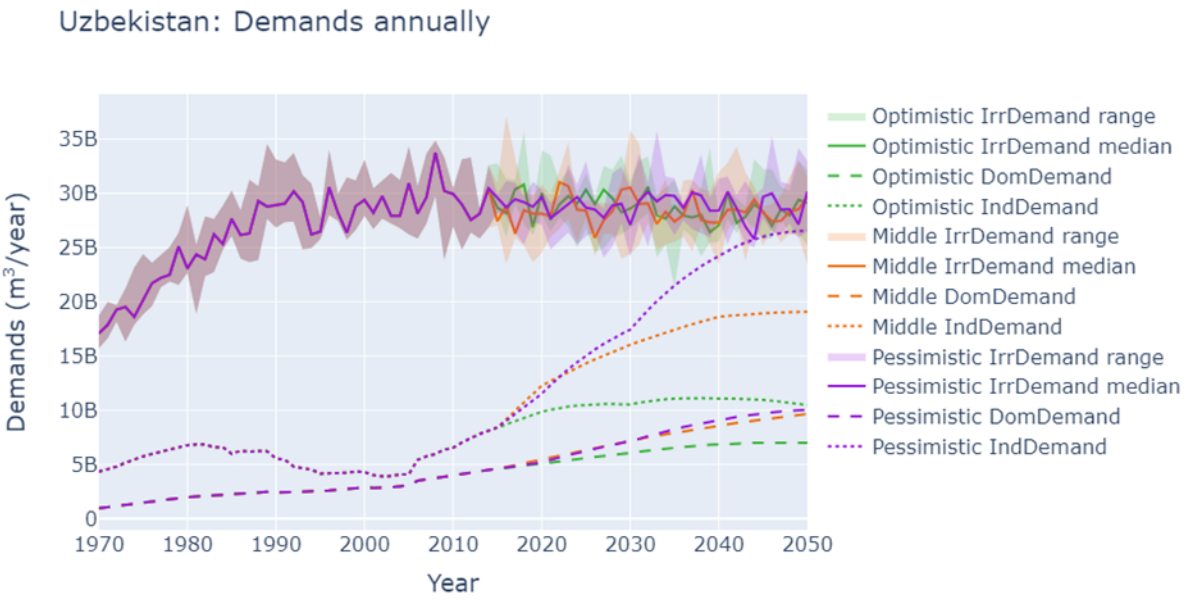

Figure 17: Sectoral demands for historical and future scenarios. Source: Burek et al. (2020)

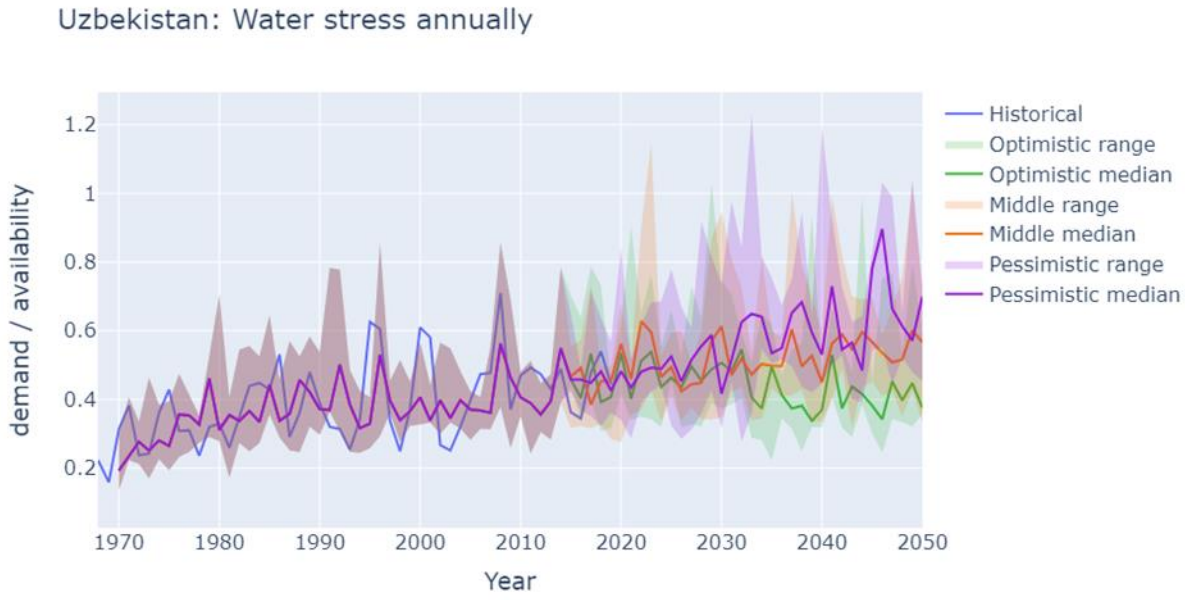

Figure 18: Annual water stress for historical and future scenarios. Source: Burek et al. (2020)

3.2.2 Flood risk

Flood risk due to climate change is expected to mostly decrease or remain relatively constant. The flood risk in terms of GDP relative to baseline decreases in western and southern Uzbekistan, particularly in the Republic of Karakalpakstan and Surxondaryo (reaching approximately a 75% decrease; Figure 4). A slight increase is shown in Samarqand, but its overall risk in economic terms remains quite low. The largest risks in the future are evident in the Republic of Karakalpakstan, Tashkent, Fergana, and Andijan. However, future flood risk cannot only be considered through the lens of climate change. Flood risk is also, for a large part, dependent on several factors:

- The frequency and severity of the flood hazard. While the natural occurrence of floods is likely to increase, the actual occurrence also depends on the readiness of the flood defense system.
- The people/assets exposed in potentially affected areas. Here, the costs and benefits of further construction in at-risk areas must be carefully considered.
- The vulnerability of the people and assets when a flood occurs.

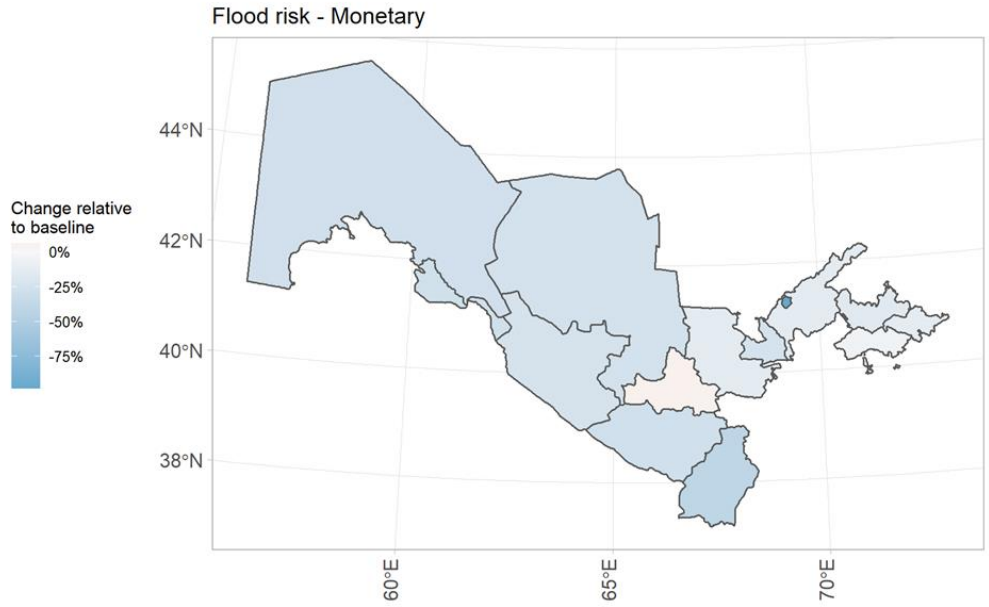

Figure 19: Flood risk in terms of relative change to baseline GDP for the year 2050 based on the Pessimistic scenario. Source: Hofste et al. (2019)

3.2.3 Drought risk

Like flood risk, drought risk is a complex combination of drought hazard, vulnerability and exposure, with many feedbacks between the components. Due to these complexities and uncertainties for future vulnerability and exposure, we limit the analysis to changes in drought hazards, mainly monthly precipitation (i.e., meteorological drought).

Under climate change, Uzbekistan shows increase in precipitation, but also deficits in specific months. Without adaptive measures to cope with this deficits, drought risk may increase. Based on a CMIP5 multi-model precipitation ensemble under RCP 8.5 (Figure 5), Uzbekistan may expect lower precipitation during the early spring (around March), and early winter (October – November) between 2031-2040. On the longer time term, an increase is expected between December and Match, followed by two separate drier months in June and October.

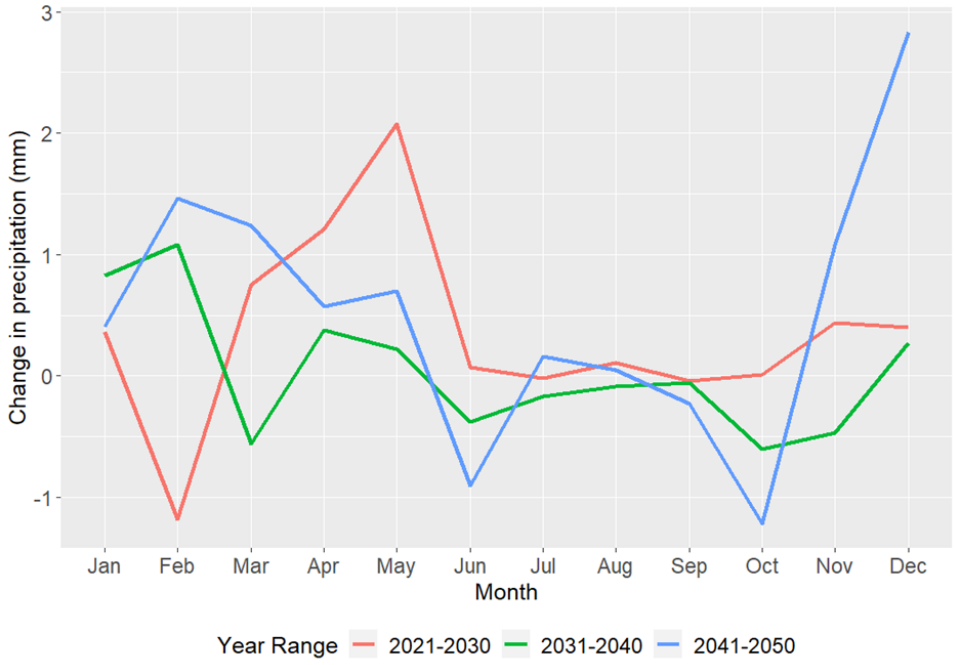

Figure 20: CMIP5 ensemble projected change in monthly precipitation under RCP8.5. (Source: World Bank, 2023)

4 Country Narrative and priority actions to increase water security

This section summarizes the main elements emerging from the water security diagnosis, by focusing on the strengths, risks and opportunities Uzbekistan is facing. This narrative is used as a basis for outlining several general recommendations that will help the country to become more water secure.

Endowment

Availability and demands

The increase of water efficiency is key for the sustainable use of water resources in Uzbekistan. The climate of Uzbekistan is sharply continental. It is characterized by a sharp amplitude of day and night, summer and winter temperatures. The difference in temperature depending on the time of the year is quite significant. The average January temperature drops to -6°C, and the average July temperature rises to +32°C. The average annual amount of precipitation falling on the plains is 120 - 200 mm, in mountainous areas - up to 1000 mm. Rainfall is negligible, so agriculture is more dependent on irrigation.

Uzbekistan therefore has a huge interest in ensuring that the distribution and management of the region's water resources is formal, transparent, and mutually beneficial rules are agreed with neighbours.

Priority actions

1) Promote Water Efficiency and Conservation. Encourage the adoption of water-saving technologies and practices in agriculture, which is a major water user in the country. This includes the use of efficient irrigation methods, such as drip irrigation.
2) Collaborate with neighboring countries on transboundary water management and regional initiatives to address shared water resources and potential climate-induced conflicts.
3) Research on the status and availability of groundwater and its recharge potential.
4) Upgrade and maintain water infrastructure, including reservoirs, irrigation systems, and pipelines, to ensure efficient storage, distribution, and supply of water.
5) Develop and implement an adequate tariff methodology for irrigation.

Architecture

Institutions

The Ministry of Housing and Communal Services (MHCS) established in 2017, conducts and permits water and sanitation utility construction and improvement projects, and drafts related policies. Suvtaminot is the main provider of water supply and sanitation services operating under the Ministry of Housing and Communal Services (MHCS). Uzsuvtaminot JSC oversee regional Suvtaminot in the form of LLCs, aimed at further development of the W&C sector.

Priority actions

1) Enhance collaboration and coordination among Uzbekistan’s key institutions.
2) Strengthen the regulatory authority for effective and transparent regulation.
3) Capacity building and training for water sector professionals, including staff within government agencies, water utilities, and WUAs.

Regulatory framework

The regulatory landscape governing water supply, utilization, and utility services in Uzbekistan is anchored by pivotal legislative instruments including the Land Code, the Housing Code, and the Laws of the Republic of Uzbekistan pertaining to water governance.

Enhancing the regulatory framework within Uzbekistan's water sector is paramount to institute fair and transparent oversight mechanisms, safeguard the interests of consumers, foster investment, and facilitate the sustainable stewardship of water resources. Comprehensive reforms demand thorough consultation with a diverse array of stakeholders, spanning governmental entities, service providers, civil society organizations, and the broader public, to garner broad-based support and ensure the efficacy of regulatory enhancements.

Priority actions

1) Develop and adopt the Water Code of the Republic of Uzbekistan, which unifies all the norms of the current legislation in the field of water supply, water use and water consumption.
2) Ensure the regulatory authority has autonomy in decision-making and is protected from undue influence.
3) Strengthen the regulatory authority's capacity for data collection, analysis, and monitoring to ensure effective oversight of service providers.
4) Develop and implement an adequate tariff methodology for WSS and irrigation.
5) Review and update of the existing (outdated) irrigation norms.
6) fix the legal status of water supply enterprises at the legislative level.

Infrastructure

The non-revenue water is approx. 35% within the water supply sector. The total water supply coverage by piped improved facilities is 70% and total sanitation coverage by sewer facilities of 26%. Many pipes and other crucial assets of the systems are outdated and are responsible for the high losses (leakages). Adequate asset management is essential for water and energy efficiency.

Priority actions

1) Reduce NRW and increase water and energy efficiency of water utilities
2) Investing in the upgrade and maintenance of water supply infrastructure in urban areas and expand the coverage in the rural areas
3) Reduction of interruptions in water supply and increase the average continuity of service
4) Capacity building of utility staff at all levels

Especially in rural areas, investments are needed to improve sanitation services. The majority of the population has only basic sanitation facilities. Adequate on-site solutions and faecal sludge management in rural areas and the construction or rehabilitation of wastewater treatment plants in urban areas require high investments.

Priority actions

1) Secure investment to improve rural sanitation services and faecal sludge management in rural areas
2) Promote adequate on-site sanitation practices to increase the safely managed sanitation coverage
3) Secure investments for wastewater treatment plants and sewer systems

Uzbekistan's irrigation infrastructure is aging and in need of maintenance and modernization. Agriculture is a significant water user in Uzbekistan, and it accounts with 92% for a substantial portion of the country's water consumption and there is a high potential to increase efficiency through alternative irrigation methods.

Priority actions

1) Investments to modernize existing irrigation schemes. This will not only support more efficient use of water but can also increase crop yields, reduce water stress and maintenance costs. The opportunities to develop the irrigation sector further and increase overall productivity of agriculture are very large and could also help retain the population in rural areas.
2) Increase the access to credit of small farmers, as this will help them invest in new irrigation infrastructure or adopt new technologies that could improve productivity.
3) Capacity building and training for WUAs

Performance

Water resources management

The legal framework facilitating the introduction of Integrated Water Resources Management (IWRM) in Uzbekistan has undergone significant development over the years. The concept of IWRM has evolved through various stages, including the sectoral approach, cooperative approach, management-oriented IWRM, and goal-oriented IWRM. Uzbekistan has witnessed this evolution and is committed to implementing IWRM principles.

Priority actions

1) Allocate more resources to support the hydrological, agrometeorological, climate and meteorological monitoring using Geographic Information Systems.
2) Engage stakeholders, including local communities, in water resource management decision-making processes. Encourage public participation and raise awareness about the importance of water conservation and sustainable use.
3) Continue placing efforts to support transboundary cooperation with all neighbouring countries and promote transboundary water management agreements, especially for shared rivers and basins, to address water resource challenges collaboratively.

Risk management

Uzbekistan faces significant hydrometeorological hazards and natural disasters, notably seasonal flooding and prolonged droughts. These events pose a considerable risk to the nation, impacting various facets of life and infrastructure. Impacts from climate change make Uzbekistan increasingly vulnerable to droughts, high temperatures, heat waves, heavy precipitation, mudflows, floods, and avalanches. Looking at the average annual hazard occurrence in Uzbekistan in the last four decades, almost 18% of all natural disasters (earthquakes, storms, droughts, landslides, floods etc.) have been flood events.

Priority actions

1) Developing and implementing flood risk management plans that take into account the specific risks and vulnerabilities in different regions of the country.
2) Investing in flood protection infrastructure such as levees, dams, and flood walls to reduce the risk of flooding in vulnerable areas.
3) Improving early warning systems for floods, including the use of advanced weather forecasting and monitoring technologies.
4) Developing and implementing drought risk management plans.
5) Enhancing public awareness about flood and drought risks and the importance of taking preventative measures. This can involve public education campaigns, community outreach, and other efforts to raise awareness about those risks and the importance of preparedness.

Outcomes

Social

Almost 97.8 % of the population in Uzbekistan had access to basic or safely managed drinking water sources. This data indicates that most individuals within the country benefitted from access to clean and uncontaminated drinking water, a fundamental necessity for upholding optimal health and overall welfare. The availability of clean water is indispensable for myriad facets of everyday existence, encompassing hydration, nutrition, and personal cleanliness.

About 98% of the population in Uzbekistan had access to at least basic sanitation services. This signifies that most individuals across the nation had access to facilities and infrastructure designed to effectively manage human waste, such as toilets and sewage systems. Sufficient sanitation services play a critical role in curbing the transmission of diseases and upholding the broader public health landscape.

Priority actions

1) Improve WSS infrastructure in rural areas, to ensure that rural communities have access to reliable and safe water supplies and appropriate sanitation services.
2) Promote safely managed on-site sanitation solutions and adequate faecal sludge management
3) Enhancing financing mechanisms: There is a need to enhance financing mechanisms for water supply and sanitation projects in rural areas. This could involve the establishment of dedicated funding sources, such as a rural water and sanitation fund, to support investment in rural infrastructure.

Environment

The State Committee for Ecology and Environmental Protection is responsible for the conservation of environmental conditions, rational use of natural resources and exercises state control over Uzbekistan needs to enhance monitoring and reporting of water quality and the ecological status of water bodies. To improve water quality and ecological status in Uzbekistan, it's important to address pollution, protect natural ecosystems, and promote sustainable land and water management.

Priority actions

1) Establish a comprehensive water quality monitoring program to regularly assess the state of water bodies across the country.

2) Implement and enforce regulations that limit the release of pollutants into water sources, including stringent controls on industrial discharges, agricultural runoff, and improper disposal of hazardous waste.
3) Upgrade and expand wastewater treatment facilities to ensure that domestic, industrial, and agricultural effluents are adequately treated before being discharged into water bodies.
4) Engage stakeholders, including local communities, businesses, and non-governmental organizations, in water quality improvement efforts, encouraging their active participation and support.
5) Collaborate with neighbouring countries on transboundary water quality management and pollution prevention to address shared water resources and cross-border pollution.

Economic

The overall economic water productivity in Uzbekistan is low. Agriculture is the largest employment sector in Uzbekistan (about 45% of the labor force), roughly a quarter of GDP.

Priority actions

1) Promote the adoption of modern technologies such as precision farming techniques. This could involve training programs for farmers, as well as subsidies or other incentives to encourage the adoption of new technologies like drip irrigation.
2) Strengthen the institutional capacities of water user associations, as well as creating more favorable enabling environments to improve efficiency and implement environmental and rural development policies.
3) Support research and development to identify new technologies and practices that can help to improve water productivity.
4) Implement a transparent and fair pricing system for water that reflects its true economic and environmental value, including the costs of sourcing, treatment, and infrastructure maintenance.

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6 Annexes I: List of indicators used in the O-WM

Please note that the general country assessment of water security performed in Uzbekistan is based only on the core indicators listed below in the table. The supporting indicators requires stakeholder engagement which is beyond the scope of this report.

WATER SECTOR OUTCOMES			
Social			
1. Basic and safely managed drinking water coverage	CORE	QUANTITATIVE	
2. Basic and safely managed drinking water coverage urban/rural	CORE	QUANTITATIVE	
3. Basic and safely managed sanitation coverage	CORE	QUANTITATIVE	
4. Basic and safely managed sanitation coverage urban/rural	CORE	QUANTITATIVE	
5. Number of DALYs (disability-adjusted life years) due to unsafe water, sanitation, and handwashing	CORE	QUANTITATIVE	
6. Mortality rate attributable to unsafe water, sanitation, and hygiene (unsafe WASH services)	CORE	QUANTITATIVE	
7. Number of people affected by floods	CORE	QUANTITATIVE	
8. Exposure of people to flood risks	CORE	QUALITATIVE	SUBNATIONAL
9. Exposure of people to drought risks	CORE	QUALITATIVE	SUBNATIONAL
10. Exposure of people to water stress	CORE	QUALITATIVE	SUBNATIONAL
11. Affordability of WASH services	SUPPORTING	QUANTITATIVE	
12. Deaths from floods	SUPPORTING	QUANTITATIVE	
13. Non-availability of flush toilets	SUPPORTING	QUANTITATIVE	
14. Number of diarrheal DALYs from inadequate water, sanitation, and hygiene	SUPPORTING	QUANTITATIVE	
15. Percentage of deaths caused by diarrhea in children under 5 years of age	SUPPORTING	QUANTITATIVE	
Environmental			
16. Share of wastewater safely treated	CORE	QUANTITATIVE	
17. Proportion of water bodies with good ambient water quality (%)	CORE	QUANTITATIVE	
18. Wetland loss	CORE	QUANTITATIVE	
19. Groundwater decline	CORE	QUANTITATIVE	SUBNATIONAL
20. Water stress ratio	CORE	QUANTITATIVE	SUBNATIONAL
21. Share of surface water bodies (rivers) with good ecological status (EU	SUPPORTING	QUANTITATIVE	

WFD)			
22. Share of surface water bodies (lakes) with good ecological status (EU WFD)	SUPPORTING	QUANTITATIVE	
23. Share of groundwater bodies with good chemical status (WFD)	SUPPORTING	QUANTITATIVE	
24. Share of groundwater bodies with good quantitative status (WFD)	SUPPORTING	QUANTITATIVE	
25. Terrestrial and marine protected areas	SUPPORTING	QUANTITATIVE	
Economic			
26. Water use efficiency per sector	CORE	QUANTITATIVE	
27. Economic water productivity	CORE	QUALITATIVE	SUBNATIONAL
28. Agricultural gross value generated by irrigated agriculture	CORE	QUANTITATIVE	SUBNATIONAL
29. Electricity production from hydroelectric sources	CORE	QUANTITATIVE	
30. Share of hydropower in total primary energy supply	CORE	QUANTITATIVE	
31. Tourism share of GDP	SUPPORTING	QUANTITATIVE	
32. Water productivity of irrigation	SUPPORTING	QUANTITATIVE	
33. Water productivity of industry	SUPPORTING	QUANTITATIVE	
WATER SECTOR PERFORMANCE			
Management of water resources			
34. Degree of implementation of integrated water resources management instruments	CORE	QUALITATIVE	
35. Availability and adequacy of national water resources management instruments	SUPPORTING	QUALITATIVE	
36. Availability and adequacy of basin management instruments	SUPPORTING	QUALITATIVE	
37. Availability and adequacy of aquifer management instruments	SUPPORTING	QUALITATIVE	
38. Availability and adequacy of national management instruments to ensure efficient and sustainable water use	SUPPORTING	QUALITATIVE	
39. Availability and adequacy of water quality management instruments	SUPPORTING	QUALITATIVE	
40. Data collection and sharing within countries and across borders	SUPPORTING	QUALITATIVE	
Delivery of Water Services			
41. Operating cost coverage	CORE	QUANTITATIVE	
42. Electrical energy costs as percentage of operational costs	CORE	QUANTITATIVE	
43. Level of water and sanitation strategic planning and strategic investment	SUPPORTING	QUALITATIVE	

planning			
44. Maturity of water and sanitation performance monitoring framework	SUPPORTING	QUALITATIVE	
45. Quality of rural water and sanitation infrastructure operation and maintenance system	SUPPORTING	QUALITATIVE	
46. Quality of asset management	SUPPORTING	QUALITATIVE	
47. Quality of irrigation infrastructure, investments, and operation and maintenance system	SUPPORTING	QUALITATIVE	
Mitigation of risk			
48. Riverine flood risk – population affected	CORE	QUANTITATIVE	SUBNATIONAL
49. Riverine flood risk – monetary	CORE	QUANTITATIVE	SUBNATIONAL
50. Drought risk	CORE	QUANTITATIVE	SUBNATIONAL
51. Management instruments to deal with droughts	SUPPORTING	QUALITATIVE	
52. Management instruments to deal with floods	SUPPORTING	QUALITATIVE	
WATER SECTOR ARCHITECTURE			
Institutions			
53. Fragile State Index (FSI)	CORE	QUANTITATIVE	
54. Degree of IWRM implementation	CORE	QUANTITATIVE	
55. Level of legal and policy framework maturity	SUPPORTING	QUALITATIVE	
56. Level of operationalization of international treaties	SUPPORTING	QUALITATIVE	
57. Variety of government institutions registered in FAO database	SUPPORTING	QUALITATIVE	
Infrastructure			
58. Per capita dam storage capacity	CORE	QUANTITATIVE	SUBNATIONAL
59. Total water supply coverage by piped improved facilities	CORE	QUANTITATIVE	
60. Total sanitation coverage by sewer facilities	CORE	QUANTITATIVE	
61. Non-revenue water	CORE	QUANTITATIVE	
62. Continuity of service	CORE	QUANTITATIVE	
63. Wastewater treatment	CORE	QUANTITATIVE	
64. Share of cultivated land under irrigation	CORE	QUANTITATIVE	SUBNATIONAL
65. Share of irrigated land with flood irrigation	CORE	QUANTITATIVE	
66. Share of irrigated land with sprinkler irrigation	CORE	QUANTITATIVE	

67. Share of irrigated land with drip irrigation	CORE	QUANTITATIVE	
68. Level of adequacy of water supply infrastructure	SUPPORTING	QUALITATIVE	
69. Adequacy of water and sanitation design standards and guidelines and approval process	SUPPORTING	QUALITATIVE	
70. Level of adequacy of irrigation infrastructure	SUPPORTING	QUALITATIVE	
71. Irrigation infrastructure financing	SUPPORTING	QUALITATIVE	
72. Level of adequacy reservoir/hydropower infrastructure	SUPPORTING	QUALITATIVE	
WATER SECTOR ENDOWMENT			
Supply			
73. Total renewable water resources per capita	CORE	QUANTITATIVE	SUBNATIONAL
74. Share of surface water to total water availability	CORE	QUANTITATIVE	SUBNATIONAL
75. Share of groundwater to total water availability	CORE	QUANTITATIVE	SUBNATIONAL
76. Share of non-conventional water resources to total availability	CORE	QUANTITATIVE	SUBNATIONAL
77. Transboundary dependency ratio	CORE	QUANTITATIVE	
78. Water quality index	CORE	QUANTITATIVE	
79. Inter-annual variability	CORE	QUANTITATIVE	SUBNATIONAL
80. Seasonal variability	CORE	QUANTITATIVE	SUBNATIONAL
Demand			
81. Water withdrawal per capita	CORE	QUANTITATIVE	SUBNATIONAL
82. Share of surface water to total withdrawals	CORE	QUANTITATIVE	SUBNATIONAL
83. Share of groundwater to total withdrawal	CORE	QUANTITATIVE	SUBNATIONAL
84. Share of agriculture water use to total water withdrawals	CORE	QUANTITATIVE	SUBNATIONAL
85. Share of industrial water use to total water withdrawals	CORE	QUANTITATIVE	SUBNATIONAL
86. Share of municipal water use to total water withdrawals	CORE	QUANTITATIVE	SUBNATIONAL

7 Annex II: Results of Core indicator assessment

*) topic/issue reference to Annex 3 of the ToR and the Toolkit

Ind. Number	Dimension	Sub-dimension *)	Indicator	Unit	Data Source	VALUE	RANGE BAND
1	Outcomes	Social	Basic and safely managed drinking water coverage (%)	% population	UNICEF/WHO Joint Monitoring Programme (JMP) https://washdata.org/data	97.8	HIGH
2	Outcomes	Social	Basic and safely managed drinking water coverage (%) rural/urban	Ratio rural-urban (rural/urban x 100): 0-100	UNICEF/WHO Joint Monitoring Programme (JMP) https://washdata.org/data	97	HIGH
3	Outcomes	Social	Basic and safely managed sanitation coverage (%)	% population	UNICEF/WHO Joint Monitoring Programme (JMP) https://washdata.org/data	100	HIGH
4	Outcomes	Social	Basic and safely managed sanitation coverage (%) rural/urban	Ratio rural-urban (rural/urban x 100): 0-100	UNICEF/WHO Joint Monitoring Programme (JMP) https://washdata.org/data	100	HIGH
5	Outcomes	Social	Number of DALYs (disability-adjusted life years) due to unsafe water, sanitation and handwashing	DALYs/100.000 inhabitants	Global Health Database Exchange http://ghdx.healthdata.org/	238	LOW-MEDIUM
6	Outcomes	Social	Mortality rate attributable to unsafe water, sanitation, and	People affected annually per 100.000 inhabitants	SDG 3.9.2 monitoring	0.44	MEDIUM-HIGH

Ind. Number	Dimension	Sub-dimension *)	Indicator	Unit	Data Source	VALUE	RANGE BAND
			hygiene (unsafe WASH services)				
7	Outcomes	Social	Number of people affected by floods/a/100k inhabitants 1980-2021	People affected annually per 100.000 inhabitants	EM-DAT, the International Disaster Database (https://public.emdat.be/)	5.2	HIGH
10	Outcomes	Social	People living in areas under water stress	% population		45	MEDIUM
16	Outcomes	Environmental	Share of wastewater safely treated (%)	%	SDG Indicator 6.3.1 https://www.sdg6data.org/indicator/6.3.1	32	LOW
17	Outcomes	Environmental	Proportion of bodies of water with good ambient water quality (%)	%	SDG Indicator 6.3.2 https://sdg6data.org/indicator/6.3.2		No Value
18	Outcomes	Environmental	Wetland loss	Score 0-100	Environmental Performance Index/Yale University https://epi.yale.edu/epi-results/2020/component/wtl	56	MEDIUM
19	Outcomes	Environmental	Groundwater table decline (cm/yr)	cm/yr	WRI AQUEDUCT Water risk atlas: https://www.wri.org/aqueduct	0.171358131	HIGH
20	Outcomes	Environmental	Water stress ratio	%	WRI AQUEDUCT Water risk atlas: https://www.wri.org/aqueduct	168.9	LOW
26	Outcomes	Economic	Economic water productivity: Overall	USD/m3	FAOSTAT (SDG 6.4.1 indicator) http://www.fao.org/sustainable-development-goals/indicators/641/en/	2.53	LOW
26a	Outcomes	Economic	Economic water productivity: Agriculture	USD/m3	FAOSTAT (SDG 6.4.1 indicator) http://www.fao.org/sustainable-development-goals/indicators/641/en/	0.72	MEDIUM
26b	Outcomes	Economic	Economic water productivity: Industry	USD/m3	FAOSTAT (SDG 6.4.1 indicator) http://www.fao.org/sustainable-development-goals/indicators/641/en/	19.37	MEDIUM

Ind. Number	Dimension	Sub-dimension *)	Indicator	Unit	Data Source	VALUE	RANGE BAND
D26c	Outcomes	Economic	Economic water productivity: Municipal	USD/m3	FAOSTAT (SDG 6.4.1 indicator) http://www.fao.org/sustainable-development-goals/indicators/641/en/	21.81	LOW
28	Outcomes	Economic	Agricultural gross value generated by irrigated agriculture	%	FAO AQUASTAT http://www.fao.org/aquastat/statistics/query/index.html	90.2	HIGH
29	Outcomes	Economic	Electricity production from hydroelectric sources	%	World Bank https://data.worldbank.org/indicator/EG.ELC.HYRO.ZS	20.6	LOW-MEDIUM
30	Outcomes	Economic	Share of hydropower in total primary energy supply	0 to 100	IRENA database https://www.irena.org/Statistics/Statistical-Profiles	1	LOW-MEDIUM
34	Performance	Management of Water Resources	Degree of implementation of integrated water resources management instruments	0 to 100	National: SDG 6.5.1 monitoring	60	MEDIUM-HIGH
41	Performance	Delivery of Water Services	Operating cost coverage (ratio)	ratio	International Benchmarking Network for Water and Sanitation Utilities (IBNET) www.ib-net.org	0.94	MEDIUM
42	Performance	Delivery of Water Services	Electrical energy costs as percentage of operational costs	%	International Benchmarking Network for Water and Sanitation Utilities (IBNET) www.ib-net.org	35.4	MEDIUM-HIGH
48	Performance	Mitigation of Risks	Riverine flood risk - population affected	% population per year	WRI Aqueduct Water Risk Atlas: https://www.wri.org/publication/aqueduct-30.	1.149640489	MEDIUM
49	Performance	Mitigation of Risks	Riverine flood risk - monetory	% GDP per year	WRI Aqueduct Water Risk Atlas: https://www.wri.org/publication/aqueduct-30.	1.005138508	MEDIUM
50	Performance	Mitigation of Risks	Drought Risk	Rating between 1 and 5	WRI Aqueduct Water Risk Atlas: https://www.wri.org/publication/aqueduct-30.	2.827260487	MEDIUM

Ind. Number	Dimension	Sub-dimension *)	Indicator	Unit	Data Source	VALUE	RANGE BAND
53	Architecture	Institutions and governance	Fragile State Index (FSI)	Index between 0 and 120	Accessible online database https://fragilestatesindex.org/country-data/	72	LOW-MEDIUM
54	Architecture	Institutions and governance	Degree of IWRM implementation	Degree between 0 and 100	Accessible online database http://iwrmdataportal.unepdhi.org/countrydatabase	48	LOW-MEDIUM
58	Architecture	Infrastructure	Per capita dam storage capacity	m3/person	FAO AQUASTAT http://www.fao.org/aquastat/statistics/query/index.html Subnational: GRanD database	688.74	MEDIUM-HIGH
59	Architecture	Infrastructure	Total water supply coverage by piped improved facilities (%)	Percentage [%]	Joint Monitoring Programme for Water Supply and Sanitation (JMP) (WHO/UNICEF) https://washdata.org/data	70.18686	MEDIUM
60	Architecture	Infrastructure	Total sanitation coverage by sewer facilities (%)	Percentage [%]	Joint Monitoring Programme for Water Supply and Sanitation (JMP) (WHO/UNICEF) https://washdata.org/data	26.51167	LOW-MEDIUM
61	Architecture	Infrastructure	Non-revenue water (%)	Percentage [%]	International Benchmarking Network for Water and Sanitation Utilities (IBNET) www.ib-net.org	35.98	MEDIUM
62	Architecture	Infrastructure	Continuity of service	h/day	International Benchmarking Network for Water and Sanitation Utilities (IBNET) www.ib-net.org	21.3	MEDIUM
63	Architecture	Infrastructure	Wastewater treatment	Score between 0 and 100	Accessible online database https://epi.yale.edu/epi-results/2020/component/wwt	44.3	MEDIUM
64	Architecture	Infrastructure	Share of cultivated land under irrigation	%	FAO AQUASTAT http://www.fao.org/aquastat/statistics/query/index.html	97.5	Informative
65	Architecture	Infrastructure	Share of irrigated land with flood irrigation	%	FAO AQUASTAT http://www.fao.org/aquastat/statistics/query/index.html	99.2	Informative
66	Architecture	Infrastructure	Share of irrigated land with sprinkler irrigation	%	FAO AQUASTAT http://www.fao.org/aquastat/statistics/query/index.html	0	Informative
67	Architecture	Infrastructure	Share of irrigated land with drip irrigation	%	FAO AQUASTAT http://www.fao.org/aquastat/statistics/query/index.html	0.1	Informative

Ind. Number	Dimension	Sub-dimension *)	Indicator	Unit	Data Source	VALUE	RANGE BAND
73	Endowment	Supply	Total Renewable Water Resources per capita	m3/year/person	FAO AQUASTAT http://www.fao.org/aquastat/statistics/query/index.html	1504.792241	LOW-MEDIUM
74	Endowment	Supply	Share of surface water to total water availability	%	FAO AQUASTAT http://www.fao.org/aquastat/statistics/query/index.html	84	Informative
75	Endowment	Supply	Share of groundwater to total water availability	%	FAO AQUASTAT http://www.fao.org/aquastat/statistics/query/index.html	16	Informative
77	Endowment	Supply	Share of non-conventional water resources to total availability	%	FAO AQUASTAT http://www.fao.org/aquastat/statistics/query/index.html		Informative
76	Endowment	Supply	Transboundary Dependence Ratio (Water Independence)	%	FAO AQUASTAT http://www.fao.org/aquastat/statistics/query/index.html	80.07074033	LOW
78	Endowment	Supply	Drinking Water Quality Index	0	https://epi.yale.edu/epi-results/2020/component/uwd	53.8	MEDIUM
79	Endowment	Supply	Interannual Variability	coefficient of variation	FAO AQUASTAT http://www.fao.org/aquastat/statistics/query/index.html Subnational: WRI Aqueduct Risk Atlas	0.54	MEDIUM
80	Endowment	Supply	Seasonal Variability	coefficient of variation	FAO AQUASTAT http://www.fao.org/aquastat/statistics/query/index.html Subnational: WRI Aqueduct Risk Atlas	0.72	MEDIUM
81	Endowment	Demand	Water Withdrawal per capita	m3/year/person	FAO AQUASTAT http://www.fao.org/aquastat/statistics/query/index.html	1813.633	LOW-MEDIUM
82	Endowment	Demand	Share of Surface water to total water withdrawal	%	FAO AQUASTAT http://www.fao.org/aquastat/statistics/query/index.html	99	Informative
83	Endowment	Demand	Share of groundwater to	%	FAO AQUASTAT http://www.fao.org/aquastat/statistics/query/index.html	1	Informative

Ind. Number	Dimension	Sub-dimension *)	Indicator	Unit	Data Source	VALUE	RANGE BAND
			total water withdrawal				
84	Endowment	Demand	Share of Agriculture water use to total water withdrawal	%	FAO AQUASTAT http://www.fao.org/aquastat/statistics/query/index.html	92.29202	LOW
85	Endowment	Demand	Share of Industrial water use to total water withdrawal	%	FAO AQUASTAT http://www.fao.org/aquastat/statistics/query/index.html	3.616299	LOW
86	Endowment	Demand	Share of Municipal water use to total water withdrawal	%	FAO AQUASTAT http://www.fao.org/aquastat/statistics/query/index.html	4.091681	LOW