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Priority topic "Infrastructure issues, resilience to climate change (Nexus approach) in the Syr Darya basin"

Report

on the results of field mission to water infrastructure in the Syr Darya River Basin: Fergana Valley (Republic of Tajikistan and Republic of Uzbekistan)

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Introduction

This report presents the results of the field mission to water infrastructure in the middle reaches of the Syr Darya River (Republic of Tajikistan) and the Fergana Valley (Republic of Uzbekistan) organized as part of priority topic “Infrastructure issues, resilience to climate change (Nexus approach) in the Syr Darya basin” of the GIZ Regional Program “Climate-sensitive water resources management in Central Asia” (Green Central Asia Initiative) in April 2026.

The mission was conducted with the support of the:

- Ministry of Energy and Water Resources of the Republic of Tajikistan;
- Ministry of Water Resources of the Republic of Uzbekistan and its territorial branches in Namangan, Andizhan and Fergana provinces;
- Basin Water Organization (BWO) Syr Darya.

Building on the initial two-day field trip to the Middle Syr Darya infrastructure in Uzbekistan in October 2025, this follow-up field mission allowed experts from the Scientific-Information Center of the Interstate Commission for Water Coordination (SIC ICWC) to expand their research scope and continue the comprehensive assessment of climate resilience of transboundary water infrastructure. The mission’s route covered the Kayrakkum HPP (Bahri Tochik reservoir) in Tajikistan and key hydraulic facilities across Uzbekistan's Fergana Valley.

During the mission, the experts examined the operation of key hydraulic infrastructure, including reservoirs, irrigation canals, and hydroschemes, and held discussions with local specialists on the practical aspects and day-to-day challenges associated with the operation and maintenance of these facilities.

Statement of the Problem

The Syr Darya River Basin is a critical transboundary basin in Central Asia, essential to the food, energy, and environmental security of Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan.

The impacts of climate change are increasingly evident in the region:

- rising mean annual temperatures;
- receding glaciers;
- increasingly variable and deficient precipitation.

These factors are already causing significant shifts in the seasonal and interannual distribution of water resources. Climatic changes are straining existing infrastructure - including reservoirs, canals, hydroschemes - and threatening the reliability of regional and national water supply. Consequently, building climate resilience of the water sector has become a shared priority, necessitating coordinated joint actions and modernized approaches to transboundary water management.

Aim, objectives and methodology of the field study

The **aim** was to assess the current status of water infrastructure in the Syr Darya River Basin in terms of its climate resilience and its role in transboundary water management.

Particular attention was paid to the assessment of technical condition of key structures and their adaptation capacity.

To achieve the above aim, the following **tasks** were completed:

- experts performed a **visual survey** of key water infrastructure in the Syr Darya Basin. Assets assessed included the Kayrakkum HPP, Bahri Tochik reservoir, Somgor-1 pumping station, North Fergana Canal (NFC), Big Namangan Canal (BNC), Big Fergana Canal (BFC), Uchkurgan Hydroscheme, Kuyganyar Hydroscheme, and Andizhan reservoir;
- analysis of the operation of reservoirs, HPP, canals and hydroschemes, collection of data on the results of recent **reconstruction and modernization** efforts to provide a preliminary technical assessment of the current condition of infrastructure;
- on-site **water conservation** measures were evaluated, including concrete lining of irrigation canals, deployment of water-saving irrigation technologies, including drip and sprinkler irrigation;
- **primary data** was collected through a series of consultations with representatives of water management organizations and local field staff;
- **photo and video documentation**, including interviews for a documentary film that will highlight the current state of infrastructure, ongoing actions, and climate challenges facing the Syr Darya River Basin.

Methodology of the field study

The field study took the form of a technical study tour and covered key water infrastructure facilities in the Republic of Tajikistan and the Fergana Valley of the Republic of Uzbekistan, including the Kayrakkum HPP, the Bakhri Tojik Reservoir, Somgor-1 pumping station, the North Fergana Canal, the Big Namangan Canal, the Big Fergana Canal, Uchkurgan Hydroscheme, Kuyganyar Hydroscheme, and Andizhan reservoir. It included on-site surveys and a preliminary assessment of the technical condition of water infrastructure in the middle reaches of the Syr Darya River in the Republic of Tajikistan and the Fergana Valley of the Republic of Uzbekistan. The assessment was based on information provided by staff at the surveyed facilities, as well as supplemental data from SIC ICWC (CAWater-Info) platform and available reports by national project experts.

The following sections provide a detailed overview of the surveyed facilities, presented in chronological order according to the mission's itinerary.

Reservoirs

Bakhri Tojik Reservoir/ Kayrakkum HPP

The first and principal site visited to assess the current condition of water infrastructure was the **Kayrakkum HPP and the Bakhri Tojik Reservoir**, a strategic facility in the middle reaches of the Syr Darya River. Each year, 14–16 km³ of water passes through the reservoir's hydraulic structures. In the transboundary context, the reservoir serves as a key regulating facility, attenuating flood flows and balancing water releases from the Toktogul Reservoir in line with the downstream flow capacity of the Syr Darya. This reduces flood risks while ensuring a reliable water supply across the region.

Building of Kayrakkum HPP

The facility was designed in 1952 and constructed between 1953 and 1957. The reservoir was first filled to its normal operating level in June 1956. Commissioning of the hydropower plant was phased: the first two generating units entered service in 1956, followed by the remaining four in 1957. The facility was fully commissioned between October and December 1959.

Tailwater of Kayrakkum HPP

The mission team examined operation of the reservoir and HPP, distribution of water resources, the outcomes of modernization, and automation of the control system, as well as implementation of nature-based solutions and reservoir shoreline protection measures.

B. Ismailov, Chief engineer of Kayrakkum HPP and D. Ziganshina, Director of SIC ICWC

F. Kh. Avezov, Director of Kayrakkum HPP, noted that the plant underwent a comprehensive modernization between 2019 and 2025. The project included replacement of all six generating units, upgrades to control systems, transformers, switchgear, and auxiliary equipment. As a result, installed capacity increased from 126 MW to 174 MW, while annual generation rose substantially. Modern digital monitoring and automated control systems were also adopted. The $196 million project was financed through a package arranged by the European Bank for Reconstruction and Development, comprising an EBRD loan of $88 million, a European Investment Bank loan of $37 million, and

additional grants and loans from the Green Climate Fund and the Climate Investment Funds.

He also emphasized that the modernization prioritized environmental sustainability and green technologies. Environmentally friendly biodegradable oils were used for hydromechanical equipment, fish-friendly turbine runners were installed to reduce impacts on aquatic ecosystems, and shoreline stabilization and site landscaping works were carried out. The rehabilitation also eliminated the use of asbestos-containing materials, improving the facility's environmental and occupational safety.

Participants also visited the Somgor-1 floating pumping station, a unique water infrastructure facility on the Bakhri Tojik Reservoir. Commissioned in 1958, the station supplies irrigation water to approximately 6,000 ha of agricultural land in Bobojon Gafurov district, Sughd province.

Somgor-1 floating pumping station

Andizhan (former Kampyrrawat) reservoir

The Andizhan Reservoir is located in the eastern Fergana Valley on the Kara Darya River, one of the Syr Darya's principal tributaries. It lies primarily within Andijan province of Uzbekistan, with part of the reservoir extending into border areas of the Kyrgyz Republic, giving it transboundary significance.

This is an in-stream reservoir designed for multi-year flow regulation. Construction of the facility began in 1969 and was fully completed and commissioned in 1983.

Andizhan reservoir
(source https://static.norma.uz/images/186152_62cd4a06b0c2cf6742a2d185fd66.jpg)

The reservoir enabled the irrigation of 44,000 ha of newly developed land and improved water supply to an additional 257,000 ha in Uzbekistan and 159,000 ha in the Kyrgyz Republic. Its primary functions are irrigation and hydropower generation. The reservoir has a maximum depth of 98 m, a length of 20 km, and a width of 6 km. Its total storage capacity is 1.9 km³, with an active storage of 1.75 km³ and a design surface area of 56 km².

The dam is equipped with the Andizhan HPP, which has an installed capacity of 190 MW and generates approximately 170 million kWh annually. In addition to power generation, the reservoir plays a vital role in irrigating vast agricultural areas of the Fergana Valley, one of Uzbekistan's most fertile regions.

Construction of the powerhouse began in 1980. The first two generating units were commissioned on 20 December 1982, while the remaining two entered service in December 1983, marking the completion of the project. The reservoir also enabled the development of 44,300 ha of new irrigated land.

Mission team together with the staff of Andizhan HPP at the dam's headwater

Staff of the Andizhan HPP explained that the facility comprises two dam-toe power plants: Andizhan HPP-1 and Andizhan HPP-2. The facility includes a massive concrete dam with twin buttresses, measuring 1,020 m in length, 15 m wide at the crest, 120 m at the base, and 115.5 m in maximum height, together with the two powerhouse buildings and their tailrace channels.

The combined installed capacity of the facility is 190 MW, including 140 MW at HPP-1 and 50 MW at HPP-2. Average annual generation totals 606 MkWh, of which HPP-1 produces 435 MkWh and HPP-2 generates 171 MkWh. Andizhan HPP-1 is equipped with four 35 MW generating units operating at a design head of 82 m and a discharge of 45 m^3/s. The units are fitted with DPL 115-V-250 diagonal-flow turbines with 2.5 m runner diameters, manufactured by Turboatom, and SV 508/115-18U4 generators produced by Elsib. Andizhan HPP-2 contains two 25 MW generating units operating at the same design head with a design discharge of 35 m^3/s. These units are equipped with HLA743-LJ-196 turbines with 1.9 m runner diameters and SF25-16/4250 generators manufactured by the Chinese corporation CNEEC.

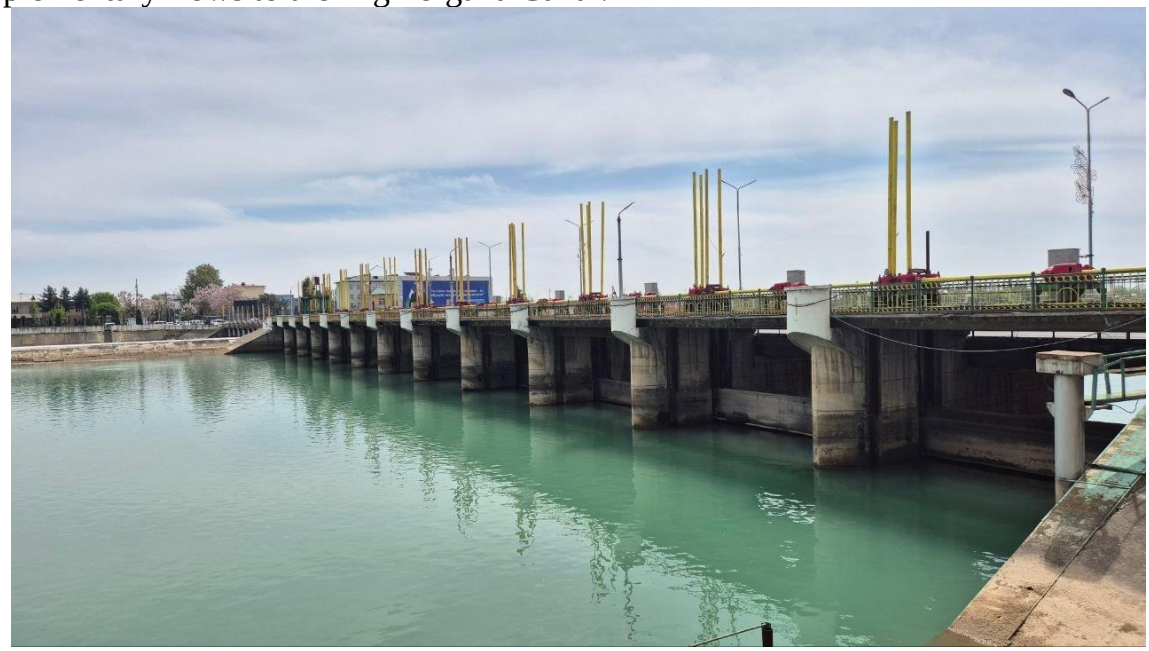
Abdurakhim Kakhramonov, Dispatcher of the Andizhan reservoir explained the operation of HPP and the outcomes of dam modernization. He outlined the phased automation of the dam monitoring and measurement systems. The first stage involved a technical inspection by specialists from Sisgeo to rehabilitate the monitoring system. Automation works included the installation of devices, cabling, and the configuration of both wired and wireless automatic data loggers.

The equipment installed included self-compensating pressure sensors, thermometers, digital biaxial inclinometers, pressure gauges, telecoordinometers, portable measuring devices, and automatic wired and wireless data loggers. HPP staff emphasized that the upgraded system provides fully automated, high-precision measurements while significantly reducing operating costs.

Hydroschemes

Uchkurgan Hydroscheme

Uchkurgan Hydroscheme is a strategic infrastructure facility on the Naryn River. Commissioned in 1967, it supplies water to the North Fergana Canal and provides supplementary flows to the Big Fergana Canal.



Headwater of Uchkurgan hydroscheme

After nearly 60 years of continuous operation, the hydroscheme has entered a long-awaited phase of rehabilitation. I.M. Muminov, Head of the Repair and Construction Division briefed the mission on the operation of the facility and the planned reconstruction and modernization works.

I.M. Muminov, Head of the Repair and Construction Division, BWO Syr Darya

The primary objective of the rehabilitation is to ensure the reliable, safe, and efficient operation of the Uchkurgan Hydroscheme through modern engineering solutions. To date, the project has included:

- engineering surveys and a comprehensive assessment of the current status of hydraulic structures;
- development of technical solutions to improve the facility's stability, efficiency, and operational safety;
- preparation of design documentation in line with national and international standards;
- engineering design supervision during implementation of the rehabilitation work; and
- adoption of innovative solutions to enhance performance and service life of the hydroscheme.

Islamjon Muminov emphasized that the rehabilitation will improve the reliability of the region's hydropower infrastructure, optimize water management and flow regulation, strengthen protection against potential hydraulic risks, and contribute to the sustainable socio-economic development of Namangan province.

Kuyganyar Hydroscheme

Kuyganyar Hydroscheme was constructed and commissioned in 1939. It has a design discharge capacity of 1,210 m³/s and serves to regulate flows into the Kara Darya River while diverting water to the Big Fergana Canal.

A. S. Akbarov, Chief Engineer of the Naryn–Karadarya Hydroscheme Administration briefed the mission on the operation of the facility, distribution of water resources between the Karadarya River and the Big Fergana Canal, the facility's modernization, and implementation of the automated control system.

Headwater of Kuyganyar Hydroscheme

During the discussion, Mr. Akbarov noted that, based on Resolution of the Cabinet of Ministers of Uzbekistan dated 5 November 2018 "On additional measures for implementation of the 'Reconstruction of the Spillway and Construction of a Protective Structure to Prevent Erosion at Kuyganyar Hydroscheme in Andizhan District, Andizhan province' Project", the hydroscheme underwent major rehabilitation and modernization between 2018 and 2020. The measures included:

- replacement of all 22 gates and lifting mechanisms at the hydroscheme and the headworks of the Big Fergana Canal on the Karadarya River;
- rehabilitation of the hydroscheme's tailwater section;
- concrete work on the regulated channel of the hydroscheme;
- construction of a stabilizing drop structure; and
- modernization of the automated gate control system, dispatch control, and electrical equipment.

The final stage of the modernization was the installation of an automated control system by Sigma Avtomatika LLC. The new system provides reliable and safe water management by automatically regulating water levels, monitoring equipment performance, and optimizing water distribution to ensure efficient and secure operation of the hydroscheme.

It was also emphasized that rehabilitation and modernization have ensured its reliable long-term operation, improved resilience to changing flow conditions, particularly floods, and secured reliable water supply to irrigated land in the Fergana Valley.

The Naryn–Karadarya Hydroscheme Administration also hosts a museum dedicated to the history of water development in the Fergana Valley. The mission toured the museum with great interest, exploring its exhibits. They also viewed a documentary highlighting the activities of the Administration.

Museum of the Naryn–Karadarya Hydroscheme Administration

Canals

Big Fergana Canal (BFC)

The Big Fergana Canal (BFC) is a major irrigation canal constructed in 1939 that traverses Uzbekistan, the Kyrgyz Republic, and Tajikistan. The canal has a total length of 350 km and comprises two sections: Upper Naryn section (44 km) and Lower Kara Darya section (301 km), separated by a reach of the Kara Darya River. Of the total length, 283 km lies in Uzbekistan, 12 km in the Kyrgyz Republic, and 62 km in Tajikistan. The canal has a normal discharge capacity of 180 m^3/s and a maximum operating discharge of 211 m^3/s.

Mission at BFC

More than 1,000 hydraulic structures have been constructed along the Big Fergana Canal, including over 50 larger ones. These comprise 9 dams, 258 offtake regulators, 7 spillways, 8 aqueducts, and 101 road bridges. The canal irrigates approx. 500,000 ha of agricultural land, including 66,600 ha in Andizhan province, 12,000 ha in Namangan province, 125,000 ha in Fergana province, about 760 ha in the Kyrgyz Republic, and 10,000 ha in Sughd province of Tajikistan.

Headworks of Big Fergana Canal

I. M. Muminov, Head of the Repair and Construction Division, BWO Syr Darya, briefed on the operation of the facility. He noted that between 2018 and 2020, the gates and lifting mechanisms at the headworks of the Big Fergana Canal were replaced. In addition, nine automated water measurement sensors were installed between 2022 and 2024, including two in 2022, four in 2023, and three in 2024. In 2024, an automated transboundary gauging station installed by the Australian company Rubicon was commissioned on the border with Tajikistan.

Tailwater of Big Fergana Canal

He also highlighted that a cascade of small HPPs with a combined installed capacity of 12 MW has been commissioned along the Big Fergana Canal. The cascade is capable of generating up to 72.89 million kWh annually.

North Fergana Canal (NFC)

The North Fergana Canal (NFC) is a major irrigation canal crossing Uzbekistan and Tajikistan in the northern part of the Fergana Valley. Its headworks are located in Uzbekistan and divert water from the Naryn River downstream of the Uchkurgan HPP dam, near the border between the Kyrgyz Republic and Uzbekistan. The canal terminates in Sughd province of Tajikistan. Constructed in 1940, it has a total length of 160 km, including 60 km in Tajikistan, of which 25 km passes through Asht District.

Mission team at NFC

Sh. D. Kazakov, Head of the North Fergana Canal, briefed the participants on water distribution, operation of the canal structures, and the results of the canal's rehabilitation and modernization. He noted that the downstream section of the canal headworks was rehabilitated in 2019–2020. The works included:

- replacement of all six gates and lifting mechanisms at the North Fergana Canal headworks;
- fabrication of stoplogs to facilitate gate maintenance;
- concrete lining of the bed and side slopes of the downstream section; and
- modernization of the automated gate control and dispatch systems, together with replacement of the electrical equipment.

The final modernization stage was the installation of an automated control system providing reliable and safe water management through the automatic regulation of water levels, continuous monitoring of equipment performance, and optimized water distribution along the canal.

Mr. Kazakov also highlighted the large-scale canal lining. To date, approximately 60 km of the canal has been concrete-lined, significantly improving its hydraulic efficiency and reducing seepage losses. According to the Head of NFC, this have resulted in saving of approximately 15% of water.

As on the Big Fergana Canal, an automated transboundary gauging station installed by the Australian company Rubicon was commissioned on the border with Tajikistan in 2024.

Big Namangan Canal (BNC)

The Big Namangan Canal (BNC), constructed in 1974 with a design discharge capacity of 61.9 m³/s, originates in the Kyrgyz Republic and enters Uzbekistan after approximately 15 km. It is a strategically important facility supplying water to more than 47,000 ha of irrigated land across nine districts of Namangan province.

Concrete section of BNC

M. Mirzakarimov, Deputy Head of the Big Namangan Canal, noted that the canal last underwent major rehabilitation in 1984. After decades of operation, the infrastructure had become outdated, and its flow capacity had declined significantly, with the water-use efficiency coefficient falling to 60%.

Mr. Mirzakarimov explained that, according to the targeted program under Resolution No. 672/7 of the Cabinet of Ministers dated 21 December 2023 "On Measures for Water Conservation and Modernization of Water Infrastructure in 2024," extensive canal lining is currently underway. To date, additional 31.2 km of the canal has been concrete-lined.

Key findings of the field mission

An assessment of the Syr Darya River Basin's water infrastructure reveals that the region's states are systematically enhancing the climate resilience of hydraulic structures and strengthening adaptive capacity across the water sector. Reconstructing and modernizing key facilities, such as reservoirs, headworks, and main irrigation canals, alongside deploying automated control systems, digital monitoring, and advanced engineering solutions has significantly improved operational reliability and water distribution efficiency.

Particular focus should be placed on modernization of the Kayrakkum HPP - a benchmark for comprehensive infrastructure upgrades aligned with environmental sustainability and green development. The overhaul has boosted energy performance and operational reliability while reducing environmental impacts. This approach aligns with global trends in sustainable infrastructure modernization and reflects a shift toward more environmentally responsible management of water and energy assets.

The field mission further underscored that, under shifting climate conditions, priority must be given to minimizing water losses, boosting canal efficiency, automating water measurement and distribution, and expanding transboundary hydrological data sharing. Deploying automated gauging stations, digital dispatch systems, and up-to-date monitoring tools significantly improves operational responsiveness, mitigating the risks of flow variability and extreme hydrological events.

Ultimately, long-term resilience across the Syr Darya Basin hinges on sustained regional cooperation, coordinated infrastructure upgrades, and scale-up of innovative technologies. Integrating technical efficiency, environmental stewardship, and digitalization is now an imperative for achieving the region's water, energy, and food security in the context of intensified climate change.

Next steps. The SIC ICWC team is compiling a comprehensive analytical report featuring recommendations for national authorities and international partners. Additionally, photography and video captured during the field mission will be used for a documentary highlighting the current state and strategic significance of the Syr Darya River Basin's water infrastructure.