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FACTSHEET ON NEXUS DEMONSTRATION PROJECTS

INFORMATION SHEET ON THE NEXUS DEMONSTRATION PROJECTS

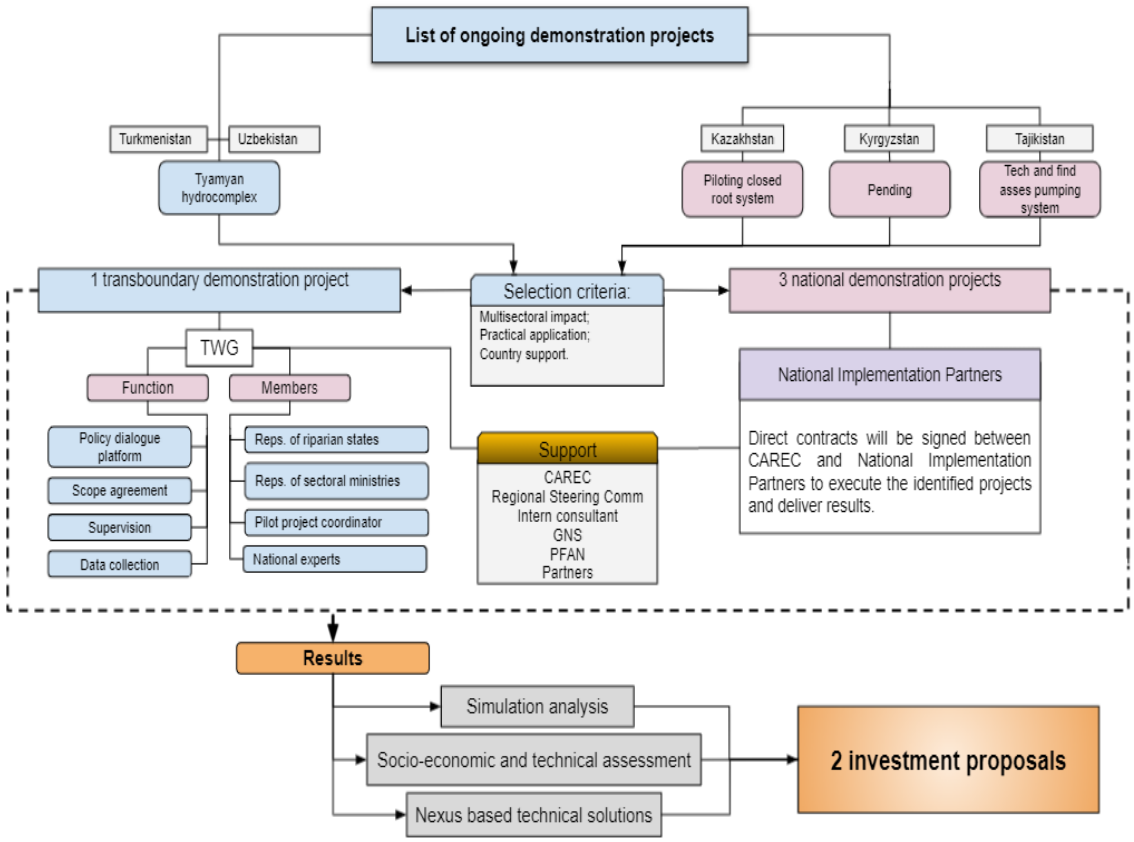
The Central Asia Nexus Dialogue Project: Fostering Water, Energy and Food Security Nexus Dialogue and Multi-Sector Investment[1] (Phase II) (the Project) aims to institutionalize the water, energy and food (WEF) Nexus approach in national and regional governance structures, as well as in investment decision making. The Project is funded by the European Union (EU) and operated by the Regional Environmental Centre for Central Asia (CAREC) in partnership with government authorities and interested development partners. The Project's aim shall be achieved via interventions under three main pillars: i) regional intersectoral dialogues; ii) capacity building; and iii) implementation of 4 (four) demonstration projects in Central Asian (CA) countries.

The demo projects manifest the most important element of the Project and serve the platform for showcasing the Nexus approach in practice through the application of analytical products and finding technical solutions ensuring the WEF security. Based on the undertaken efforts and formulated solutions applicable to the demo projects, the investment proposals will be elaborated as the main Project's output and offered for public, private and/or IFI financing (Fig. 1.).

Remarkably, the four selected demo projects address a variety of WEF security challenges such as afforestation of the Aral Sea's dried bottom, combatting intensive siltation (sedimentation) of reservoirs and ensuring energy efficiency of pumping stations, all equally important for the sustainable development of CA states (CAS). Although the demo projects are carried out at the national level, the entire Central Asian Region (CAR) will benefit from their final deliverables through knowledge and technical solutions' exchange and/or replication.

This document provides the brief and expanded descriptions of the tasks and implementation status of each of the four demo projects to keep the beneficiaries and stakeholders updated.

Figure 1. *Implementation modalities and outputs of demo projects.*



[1] For more information about the Project, please, see here.

Transboundary demo project between Uzbekistan and Turkmenistan "Tuyamuyun Hydroelectric Complex"

Key information:
Requested by: Ministry of Water Resources of the Republic of Uzbekistan and State Committee of Water Resources of Turkmenistan;
Implemented by: national and international expert consultants;
Implementation period: Jan 2020 – Dec 2022;
Location: Lebap and Dashoguz Veloyats, Turkmenistan;
Co-financed by: World Bank, CAWEP Trust Fund, Global Nexus Secretariat, "Central Asian Institute for Ecological Research" (Kazakhstan).

Background: The Tuyamuyun Hydroelectric Complex (THC) is a transboundary water-energy facility located along the Amudarya River at the border between Uzbekistan and Turkmenistan. The facility is located in Turkmenistan, but belongs to Uzbekistan. The land is leased by Turkmenistan based on the corresponding legal agreements. As a strategic facility, THC regulates the Amudarya's lower stream and secures water resource allocation between the riparian countries. As such, it supplies i) water to 425,000 ha of irrigated land in Turkmenistan and 779,300 ha in Uzbekistan; ii) electricity to Uzbekistan; and iii) drinking water to Khorezm Region and Republic of Karakalpakstan (Uzbekistan).

The growing sedimentation of the THC's channel Ruslovoye Reservoir – that has already reached 70% – disables water passage to the other three reservoirs of the Tuyamuyun Hydroelectric Complex for irrigation and drinking needs. By 2040, the Ruslovoye Reservoir is forecasted to get fully silted as per the business-as-usual (BAU) scenario harnessing the WEF security for 5+ mln people in Uzbekistan and Turkmenistan. The state authorities of both countries have been joining efforts to pinpoint and implement cost-effective technical and investment solutions to tackle the sedimentation at the Ruslovoye Reservoir.

Aim: Support the WEF security by tackling the growing sedimentation at the THC's Ruslovoye Reservoir via executing the following tasks:

Task 1: Conduct social and economic assessment of the WEF dependence on the Ruslovoye Reservoir;
Task 2: Estimate the current sedimentation volume, its dynamics during the next 50 years and design technical solutions to clean the silt;
Task 3: Develop technical recommendations on cost-effective sedimentation cleaning supported by cost-and-benefit analysis by consultants "Altus Impact" and "Deltares";
Task 4: Determine the sediment's recycling potential through chemical analysis and lab experiments;
Task 5: Develop the investment proposal on cleaning and/or recycling the sediment.

Achieved results:

- Final reports finalized (Tasks 1. and 2.);
- The draft of final report by international consultant "Deltares" produced (Task 4.);
- The chemical composition of the sediments from Ruslovoye Reservoir concluded (Task 4);
- The lab experiments on producing the burnt bricks out of sediments of Ruslovoye Reservoir successfully conducted by a Kazakhstan laboratory (Task 4.);
- The data collection and work on CBA by consultant "Altus Impact" initiated (Task 4).

Steps for the next 6 months:

- Develop the CBA on the proposed technical recommendations by Altus Impact (Task 3.);
- Development of the draft investment concept on cleaning the sediments on Ruslovoye Reservoir and is potential recycling (Task 5).

National demo project in Kazakhstan "Afforestation of the dried bottom of the Aral Sea: piloting a closed root system"

Key information:

Requested by: Executive Directorate of the International Fund for Saving the Aral Sea (ED IFAS) in Kazakhstan;
Implemented by: ED IFAS in Kazakhstan;
Implementation period: Nov 2020 – Dec 2022;
Implementation location: Kyzylorda Region, Kazakhstan, premises of the Eco-Aral National Touristic Centre (70 km from Aralsk Town);
Co-financed: IFAS Executive Board (EB IFAS) in the Republic of Kazakhstan.

Background: The area of the Aralkum Desert has reached approx. 6 mln ha, out of which 2.8 mln ha are located in Kazakhstan (Kyzylorda Region) and 3.2 mln ha in Uzbekistan (Republic of Karakalpakstan). Both countries have been actively afforesting the dried bottom of the Aral Sea as part of government programs and donor-supported interventions to curb massive dust transfer across CA and beyond, negatively affecting the environment, public health, and economy in both countries for the last decades.

Today, the Aralkum's afforested area has reaches 200,000 ha in Kazakhstan and 1.5 mln ha in Uzbekistan, including the self-reproducing plantations. The augmenting water mineralization and soil salinity within the dried seabed area, as well as the anomalous air temperature increase all prevent accelerated greening. According to UNDP statistics, the average survival rate of forest plantations in the target zone equals 0% for 25.4 thous. ha, 0-50% for 15.9 thous. ha, and 50%+ for 10.1 thous. ha.

In addition, climate change has been significantly affecting the Aral Sea Region also. Based on the World Bank's data, a 10 to 30% drop in the discharge of the Syrdarya and Amudarya Rivers will facilitate the expansion of the Aralkum Desert area. Innovative methods shall be considered to speed up the afforestation and increase plant survival rate. One of these methods could be the cultivation of tree seedlings using the closed root system method, allowing to boost the survival rate of saxaul species up to 2-3 times compared to conventional planting techniques.

Aim: Pilot the closed root system method of growing saxaul seedlings to increase the survival rate up to 70% by executing the following tasks:

Task 1: Construct 2 (two) greenhouses and 1 (one) shade-house with the total area of 140 m^2 and plant 2,000 black saxaul seeds using the closed root system method for further seedling replanting in the Aralkum Desert in 1 year;
Task 2: Conduct scientific observation of seedling growth and survival rate.

Achieved results:

- 2 saxaul greenhouses and 1 shade-house built, and closed root system seedlings planted;
- Only 20% of the planted seedlings survived due to the hot summer and high-water mineralization in Kamystybas Lake in 2021;
- Survived 200 seedlings planted in the hedged territory in the dried bottom of the Aral Sea.

Steps for the next 6 months:

- Watering and monitoring of the survival rate in the dried bottom of Aral Sea (Task 2. and 3.).

National demo project in the Kyrgyz Republic "Institutionalization of the WEF Nexus approach in the agricultural sector"

Key information:

Requested by: Ministry of Agriculture of the Kyrgyz Republic (MoA of the KR);
Implemented by: national expert consultants;
Implementation period: Jan – May 2021;
Implementation location: national level.

Background: The agricultural sector is key for the overall economic development of the Kyrgyz Republic. Yet, the industry has been developing slower than the national economy at large, and remains uncompetitive. In 2019, agriculture contributed 0.3% to the GDP, whereas the overall economic growth reached 4.5%. Meanwhile, 66% of the country's population reside in rural areas. There are several challenges holding back the sector's further growth.

Kyrgyzstan's agriculture is dominated by small-scale peasant farms (96% market share in 2020). With the limited availability of irrigated acreage, the growing number of small farming households makes the industry inefficient and unappealing for foreign investments. With the slow deployment of technical innovations and high (local) commercial bank interest rates (approx. 16%), the sector is not able to explore its full potential and is hardly able to satisfy the domestic needs. In 2019, the country's agricultural imports prevailed 1.3 times over exports. Another hurdle is the decreasing land productivity that has reached 36% during the last 5 years; meanwhile, the population growth in same period has amounted to 11%. The exacerbating climate change and degrading irrigated farmland also threaten national food security. To advance the agricultural sector, the MoA of the KR initiated the enhancement of the 2021-2025 Agriculture Development Strategy of the KR (Agro Strategy) and requested the Project to provide targeted technical assistance.

Aim: Support the MoA in upgrading/drafting the Agro Strategy with the introduction of the Nexus approach through executing the following tasks:

Task 1: Evaluate the performance of the active Agro Strategy;
Task 2: Enhance the Agro Strategy considering the current macro- and microeconomic and social factors;
Task 3: Introduce digitalization in the agricultural sector.

Achieved results:

- The Project had supported the review of and enhancements to the Agro Strategy in early 2021. However, with the nation-wide unrest and subsequent government reshuffle, the newly appointed MoA's management transformed the revised Agro Strategy into the 2021-2031 Concept of Agrarian Development of the Kyrgyz Republic as per the recommendations of the national Cabinet of Ministers. The draft Concept was later approved by the Government of the KR. Given the vast replacement of the technical staff, the Nexus approach is not fully reflected in the Concept as opposed to the earlier Agro Strategy revised with the Project's assistance (Tasks 1., 2. and 3.);
- The assessment of the Agro Strategy during the review pointed to intersectoral discoordination as a principal cause of the agricultural sector's inefficiency. The approved Concept also highlights the need for a single state body to coordinate, monitor and analyze the efforts within the framework of all state programs and by all partners (Tasks 1., 2. and 3.).

Next steps: The Project team will monitor the Concept's implementation and may consider assisting with designing technical rules and/or other frameworks to support its full-fledged execution.

National demo project in Tajikistan "Improving the electricity consumption control and monitoring system at pumping stations and upgrading a large pumping station in Sughd Region in the Republic of Tajikistan based on energy-efficient technologies"

Key information:

Requested by: Agency for Land Reclamation and Irrigation (ALRI) under the Government of the Republic of Tajikistan (RT);
Implemented by: national expert consultants;
Implementation period: July 2021 – Feb 2022;
Implementation location: Sughd Region (Tajikistan);
Co-financed by: CAWEP Trust Fund, Grundfos (Dutch pumping equipment manufacturer).

Background: Over 90% of Tajikistan's territory is occupied by mountains, which requires mechanically lifting water from rivers and canals to irrigate farmland. The pumping stations across the country pump and lift water to 50%+ of domestic irrigated land generating 80% of the country's agricultural production, and thus secure the functionality of its agricultural sector per se. The industry, in turn, provides jobs to 70% of the population and contributes 20% to the country's GDP.

Agriculture is likewise a major consumer of water and energy in Tajikistan, using 90% of available water resources and 10% of the total electricity supply (for powering pumping stations). On top of that, the pumping stations were mainly built 40-50 years ago, and thus are highly energy intensive. The corresponding investment costs are hardly collected due to low end user solvency. Hence, the Government of the RT has been subsidizing electricity costs during vegetation season.

The escalating use of old and energy-intensive pumping stations threatens the national food security. According to statistics, the annual population growth in Tajikistan is 2.2%. With such a demographic trend, it is expected to reach 11.2 mln by 2030. To respond to the challenge from the technical side, ALRI is considering introducing power metering and energy-efficient technologies at a pumping station in Sughd Region to ensure proper electricity consumption for subsequent nation-wide replication.

Aim: Improve energy-efficiency of pumping stations in Sughd Region of Tajikistan by executing the following tasks:

Task 1: Conduct the analytical review of pumping station operation modalities;
Task 2: Execute technical examination of metering at 173 pumping stations, and design the Concept of digitalizing electricity consumption metering at pumping stations in Sughd Region;
Task 3: Carry out energy and water audits at 2 pumping stations;
Task 4: Draft the investment proposal for upgrading the Golodnostep Pumping Station based on energy-efficient technologies.

Achieved results:

- Analytical review on pumping station operation modalities completed;
- 173 pumping stations fully examined, and the Concept of digitalizing electricity consumption metering at pumping stations in Sughd Region finalized;
- Energy and water audit reports developed by Grundfos;
- 2 investment proposals drafted and potential pumping equipment manufacturers approached.

Next steps:

- Presentation of developed 2 investment proposals to potential investors and IFIs;
- Discussion with the potential investors by ALRI and the project team the investment possibilities on digitalization of the electricity metering at the pumping stations and modernization of the Golodnostep Pumping Station.

Transboundary demo project between Uzbekistan and Turkmenistan "Tuyamuyun Hydroelectric Complex"

Regional perspective

There are 280 water reservoirs in Central Asia (CA) regulating seasonal and yearly river flow. Most of them are multi-purpose and used for hydropower generation, agricultural needs, water supply and flood protection. As of 2012, the total useful storage capacity of the artificial lakes across the Central Asian Region (CAR) amounted to 80.5 km^3, with the largest 16 facilities – including the Kapshagai (Kazakhstan), Toktogul (Kyrgyzstan), Nurek (Tajikistan), Zeid (Turkmenistan) and Tuyamuyun (Uzbekistan) Reservoirs – accounting for 72% of the total active volume.

The CAR's reservoirs are subject to intensive sedimentation exacerbated by the dominating mountainous relief. Consequently, the silting limits the potential benefits from the investment inflow into the sector, thus adversely affecting water consumers, HPP operations, river discharge regulation efforts, as well as prevents accurate water resource accounting and threatens dam safety. Importantly, most of the CA reservoirs have transboundary impacts along the Syrdarya and Amudarya Rivers, as they support two or more riparians in terms of resource generation and allocation. Due to the heavy sedimentation-induced shrinking of reservoir capacity, the water release for municipal and irrigation purposes to downstream countries has been getting increasingly limited.

The CA countries recognize silting as a regional-scale challenge. Accordingly, the representatives of the line ministries of Central Asian states (CAS) acknowledged the issue of sedimentation impacts on the effectiveness of river regulation, as well as endorsed the need to assess and forecast silting processes at the 3rd Regional Working Group Meeting to design the Aral Sea Basin Assistance Program, Phase 4 (ASBP-4) in November, 2019 in Ashgabat, Turkmenistan. The corresponding target interventions were included in the ASBP-4 project pipeline list.

Thus, this action track represents a priority for CAS, and there is a need to advance regional-level collaboration in this area by intensifying the dialogue and organizing meetings on technical solutions to prevent siltation (overflow) of water reservoirs, stimulate sediment clean-up, and conduct comprehensive sediment volume assessment and calculations.

Aim

The Tuyamuyun Hydroelectric Complex (THC) was selected as a transboundary demo project site under Phase II of the EU-funded Central Asia Nexus Dialogue Project following the formal proposition on behalf of the Ministry of Water Resources (MWR) of the Republic of Uzbekistan (RU) and State Committee for Water Resources (SCWR) of Turkmenistan, and supported by the IFAS Executive Committee to advance regional cooperation on transboundary water resource management. At the 1st Meeting of the Regional Steering Committee (RSC) under the Project, THC was mutually approved as a small-scale demonstration project[2].

This transboundary demo project aims to promote regional water-energy collaboration at the facility level with a focus on sedimentation at the run-of-river Ruslovoye Reservoir, one of the four reservoirs within the THC. It is planned to achieve the demo project's aim via executing the following tasks:

- Conduct social and economic assessment of the WEF dependence on the Ruslovoye Reservoir;
- Estimate the current siltation volume and forecast its dynamics in the next 50 years;
- Devise technical recommendations on cost-effective sedimentation cleaning supported by the CBA and international experience;
- Determine the silt's potential for recycling through chemical composition analysis and laboratory experiments;
- Develop the investment proposal on sediment cleaning and/or recycling.

[2] The Minutes of the 1st Regional Steering Committee Meeting are available here.

Since reservoirs commonly face sedimentation due to natural processes, other CAS can benefit from the demo project's deliverables, which can be potentially considered for other reservoirs in the CAR. The showcased collaboration between two riparian countries on addressing a specific transboundary challenge – reservoir siltation – can also be exemplary.

Demo project site

THC is the key facility regulating the Amudarya River downstream flow and allocating water-energy resources between Turkmenistan and Uzbekistan. Built by Uzbekistan in 1979, this large hydropower facility is located on the territory of Turkmenistan, but belongs to the former. The Republic of Uzbekistan also bears the corresponding maintenance and financing costs, including these related to leasing the area occupied by THC from Turkmenistan. The ownership and management of the Tuyamuyun Hydroelectric Complex is articulated by four bilateral interstate agreements signed by Uzbekistan and Turkmenistan[3].

THC incorporates 30 hydro-technical installations (run-of-river HPP (150 MW), channels, water intakes, spillway dams, substations, etc.) and 4 reservoirs – Ruslovoye, Sultansanjar, Kaparas, and Koshbulak – with the total volume of 7.8 bln m^3 and mirror area of 650.1 km^2 (*see* Annex 1. Map of Tuyamuyun Hydroelectric Complex).

Table 1. *Main design characteristics of THC reservoirs.*

Characteristics	Unit	Ruslovoye	Kaparas	Sultansanjar	Koshbulak	Total
Water surface area at normal water surface elevation (NWE)	km^2	303	70	149	128	650
Normal water surface elevation	m	130	130	130	130	130
Dead storage elevation (DSE)	m	120	120	116	120	
Length	km	102	15	24	26	167
Width: max	km	11	9	12	11	
min	km	4	4	8	6	
Depth at NWE: min	m	7.7	13.7	18	14.2	
max	m	20	36	38	41	
Depth at DSE: max	m	10	26	28	31	
min	m	2.8	9.3	10.8	12.7	
Area of shallow waters (2 m) deep at NWE	km^2	93	6	10	7	116
Area of shallow waters at DSE	km^2	59	4	2	9	74
Reservoir's design life (period after which its live capacity will be completely depleted by silting)	year	35-40	100	More than 100		

Source: *Scientific Research Institute of Irrigation and Water Problem under the MWR of the RU.*

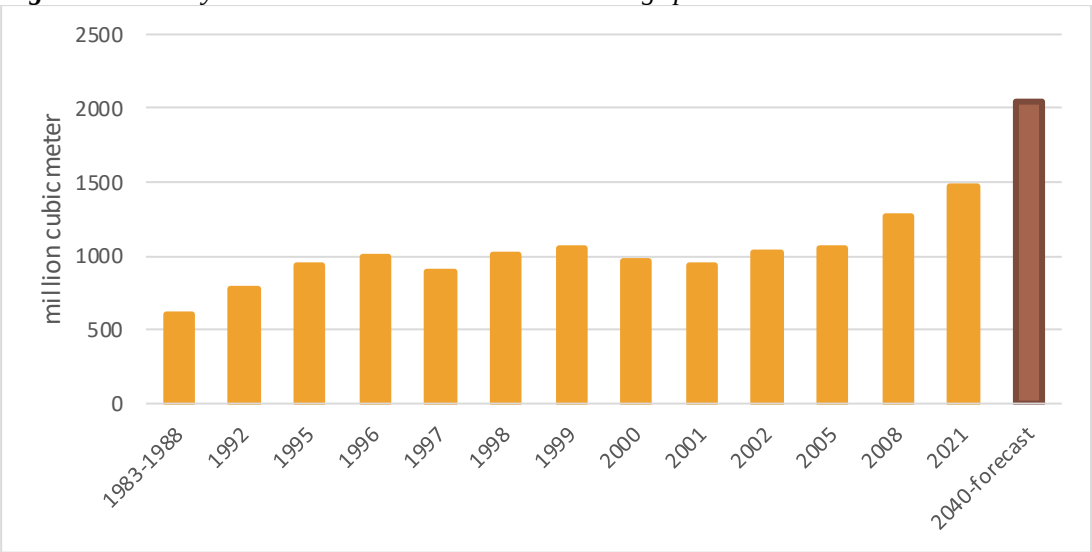
THC plays an indispensable role in water management between the two countries concerned. As such, it ensures i) water supply to 779,300 ha of irrigated farmland in Uzbekistan and 425,000 ha in Turkmenistan; ii) power supply to Uzbekistan (450 mln kW/h per year); and iii) drinking water supply to Khorezm Region and Republic of Karakalpakstan (Uzbekistan); iv) highway and railway communications across the Amudarya River; as well as regulates v) seasonal hydro regime of the Amudarya; vi) water discharge for the Tachiatashsk Hydro Complex (Uzbekistan); and vii) provides protection against stream-bank erosion of the Amudarya below the facility.

In addition to high investment needs for infrastructure upgrades, THC experiences intense sedimentation of its key run-of-river Ruslovoye Reservoir on the Amudarya River. The mountainous relief and high-

[3] "On cooperation on water related issues" of January 16, 1996; "On paid land use" of April 17, 1996; "On crossing Uzbekistan and Turkmenistan national borders by the staff servicing near-border facilities" of November 19, 2004; "On cooperation on operating and repairing the facilities located in the transboundary territories of Uzbekistan and Turkmenistan" of March 10, 2008.

water turbidity in the Amudarya speed up the silting processes. Based on the latest sedimentation estimates carried out in 2008 by the Bathymetric Center (local Uzbekistan company), the siltation volume in the reservoir has reached 1,270 mln m^3. Due to sedimentation, the Ruslovoye Reservoir has already lost 33% of its useful capacity. In practice, the reservoir's operation per se will be under serious risk if the sedimentation volume reaches 50% (Fig. 1.). According to preliminary estimation, the reservoir will be fully silted by 2040 as per the business-as-usual scenario, harnessing the WEF security for over 5 mln residents in Uzbekistan and Turkmenistan.

Figure 1. *Ruslovoye Reservoir sedimentation volume during operation.*

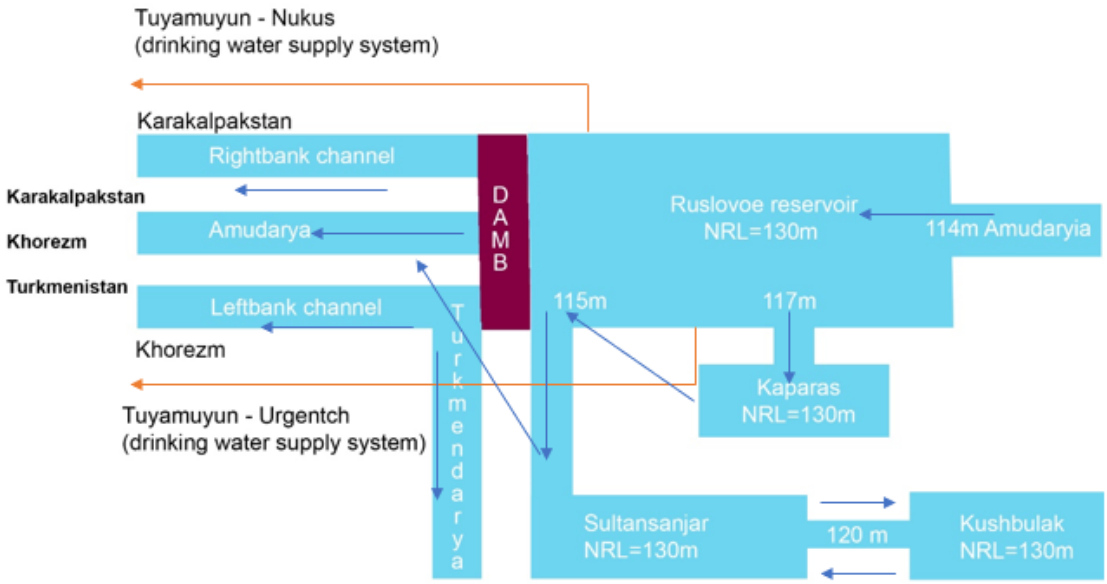


Source: *Scientific Research Institute of Irrigation and Water Problem under the MWR of the RU.*

At present, due to the increased sedimentation rate of the THC's core facility – the Ruslovoye Reservoir – neither Uzbekistan nor Turkmenistan is able to fully utilize the water resources of the Amudarya River to cover their power and irrigation needs. Silt cleaning at the reservoir has not taken place since its commissioning. In fact, this is the case of not only this demo site, but a very common challenge for the rest of the reservoirs across Central Asia performing the main role of river flow regulation and flood control.

Another critical aspect is that the Ruslovoye Reservoir serves the entry point for the Amudarya's water released further to the THC's downstream reservoirs, namely Kaparas, Sultansanjar, and Koshbulak. These three reservoirs supply water for irrigation and drinking purposes. As such, the Ruslovoye Reservoir plays an enormous role in water supply and its sedimentation-induced diminishing capacity means allocation of less water to a wide spectrum of customers, as well as inefficient use of massive and capex-intensive THC facilities (Fig.2.).

Figure 2. *Water allocation among 4 THC reservoirs.*



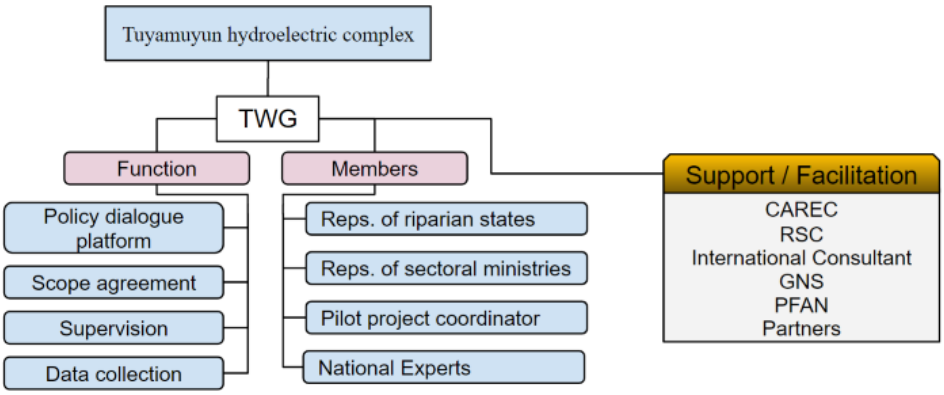
Source: *Scientific Research Institute of Irrigation and Water Problem under the MWR of the RU.*

While the countries recognize the urgency for silt cleaning at national level, it requires joint transboundary efforts. The proposed demo project offers a unique opportunity to support the transboundary dialogue in the CAR and demonstrate the costs and benefits of efficient resource allocation between countries through physical estimates and efforts.

Implementation modalities

The implementation of this demo project involves two riparian countries: Uzbekistan and Turkmenistan. To ensure the policy dialogue and ownership between the two states, the Project established the Technical Working Group (TWG) comprising 8 representatives of line ministries of Uzbekistan and Turkmenistan and THC technical staff. Two demo project coordinators were hired inside the target countries to support the demo project implementation by liaising with state bodies and coordinating the works among the THC administration, TWG members, and national experts. Meanwhile, the Project's RSC (18 members) consisting of key sectoral representatives of 5 CAS provides the policy platform, where TWG shares its experience, as well as informs on the implementation process and deliverables related to reservoir siltation issues throughout other CA countries (Fig.3.).

Fig. 3. *Implementation modalities.*



Demo project tasks

To achieve the claimed aim, under the supervision of RSC and TWG, demo project coordinators and the Project team, the national and international consultants have been executing the tasks described below; some of them are co-financed by the interested donors to ensure synergies and cost efficiency.

Task 1. Social and economic assessment of THC (completed)
The national experts were tasked to conduct the social and economic assessment of THC and the territories it supports (Khorezm Region and Republic of Karakalpakstan in Uzbekistan, and Dashoguz Veloyat in Turkmenistan), which included (i) social and economic analysis; (ii) assessment of institutional and legal frameworks related to THC operation; (iii) stakeholder analysis; (iv) analysis of WEF resources management and allocation among economic sectors and riparian countries; (v) investment needs analysis; and (vi) evaluation of facility management challenges from national and regional perspectives.

The assessment provides a holistic view on the facility; CAREC Project team will further use it for developing the investment-ready-proposal.

Task 2. Sedimentation measurements and analysis at the THC Ruslovoye Reservoir (completed)
The Scientific and Research Institute of Irrigation and Water Problems under the MWR of the RU – onboarded from April 2021 to February 2022 – was tasked to (i) estimate the siltation volume at the Ruslovoye Reservoir (area of 373 km^2) as advised by THC specialists; ii) make forecasts of anticipated siltation dynamics at the Ruslovoye Reservoir during the next decades (2020-2071); iii) estimate the current annual losses of active volume of the Ruslovoye Reservoir and make the corresponding forecasts for the next decade under the BAU scenario; and iv) estimate the sedimentation impacts on the water resource allocation for energy and irrigation needs of Uzbekistan and Turkmenistan (the decreased volume of water resources should be valuated in monetary terms, including the anticipated loss for the next decade under the BAU scenario as per Task 2.(iii).

The hired company will devise the technical recommendations on the cost-effective technical solutions for silt cleaning at the Ruslovoye Reservoir and/or targeted technical measures to mitigate sedimentation processes.

This task is co-financed by the "Laboratory of Innovative Solutions for the Water Sector of Central Asia" Project under the World Bank's Central Asia Water and Energy Program (CAWEP).

Task 3. Climate vulnerability and risk assessment of THC and supported territories (completed)
The international consortium of consultants (SIM, HYDRO, HydroNova) was tasked with conducting the climate vulnerability and risk assessment of the THC and the territories it supports (Khorezm Region and Republic of Karakalpakstan in Uzbekistan, and Dashoguz Veloyat in Turkmenistan) under the BAU scenario in accordance with the method of Climate Risks and Vulnerability, based on the GIZ Guidebook on Climate Risk and Vulnerability Assessment.

The consultants assessed/analyzed: i) temperature/precipitation and possible humidity projections and vulnerabilities of current agricultural crops and management systems; ii) salinization risks due to the introduction of irrigation and increasing evaporation; iii) evaporation and water losses from the Ruslovoye Reservoir based on the potential evaporation and reservoir bathymetry as per SRTM DEM; iv) changes in the runoff coming from the upper catchments (in Afghanistan and Tajikistan) to assess the changes in future water availability for the Ruslovoye Reservoir. Based on the identified climate vulnerabilities and risks, the consultants shall propose the adaptation measures/options for the water-energy-food sectors.

This task is co-financed by the World Bank's "Climate Change Adaptation and Mitigation Program in the Aral Sea Basin" Project (CAMP4ASB).

Task 4. Review of international silt treatment experiences (completed)
The task entails the involvement of 2 international consultants to explore the technical solutions to combat/clean the intensive sedimentation at the Ruslovoye Reservoir based on global practices. Specifically, the consultants shall propose several technical and innovative silt cleaning solutions with detailed justification of why a particular technology/approach is recommended for the Ruslovoye Reservoir.

The technical solutions recommended by the international consultant and national consultant under Task 2. will undergo the cost-and-benefit analysis to showcase the efficiency and returns associated with each of the solutions.

This task is co-financed by the "Laboratory of Innovative Solutions for the Water Sector of Central Asia" Project under the World Bank's CAWEP, and the Global Nexus Secretariat.

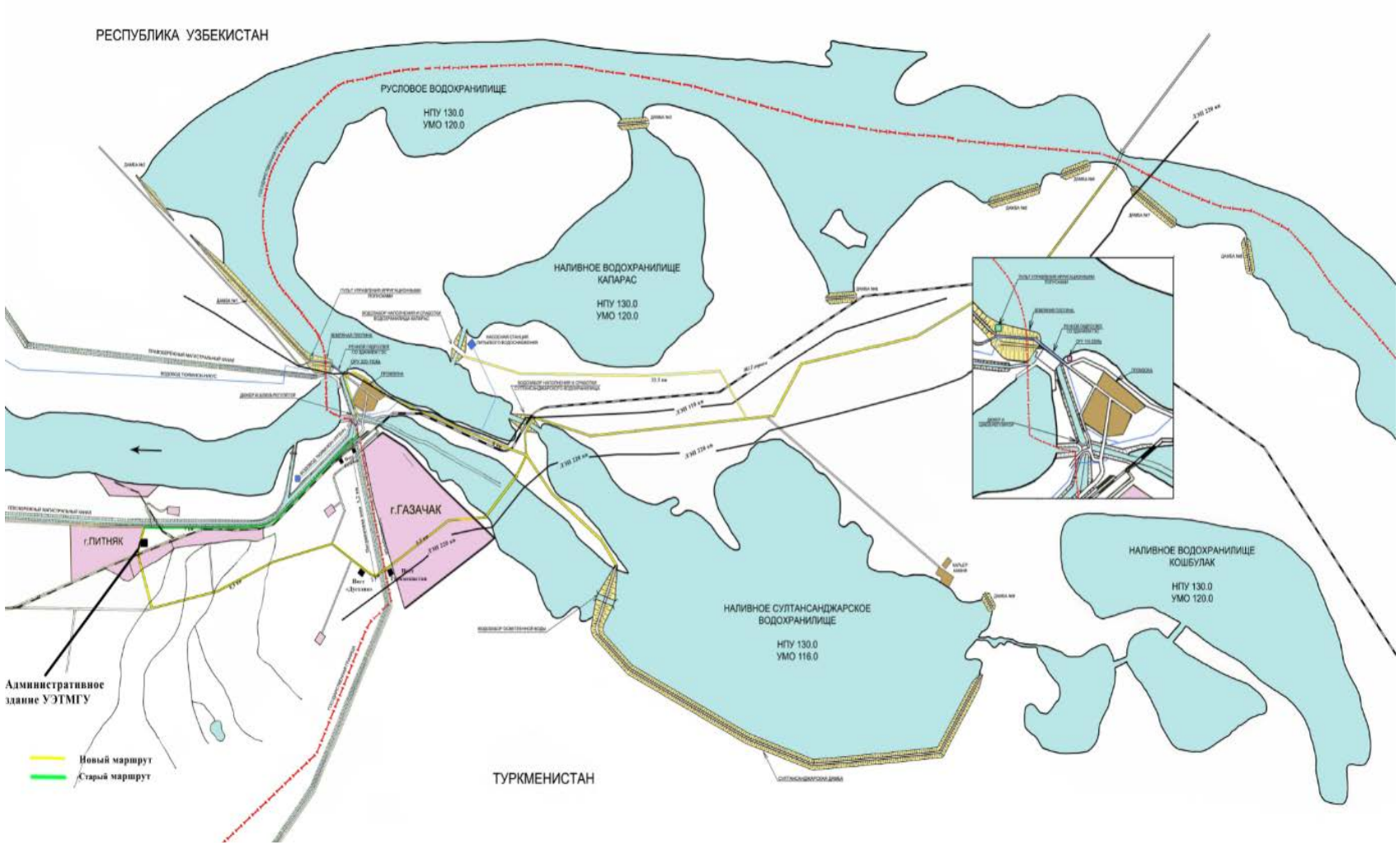
Task 5. Exploring sediment recycling opportunities (launched)
This task includes identification of silt composition at the Ruslovoye Reservoir through biochemical analysis at a certified local laboratory. Based on the analysis outcomes, the consultant shall develop a list of potential products that could be developed/recycled from the silt with scientific justification.

In addition, the laboratory of the Central Asian Institute for Ecological Research (Almaty, Kazakhstan) volunteered to conduct the experiments on manufacturing market products from the silt of the Ruslovoye Reservoir, inter alia bricks, glass, and fertilizers, for further demonstration to the Project stakeholders.

The findings and/or outputs of the above-mentioned tasks will assist in formulating the investment proposal for THC (Task 6.).

Task 6. Develop an investment proposal for THC (second half of 2022)
An investment proposal to respond to the sedimentation at the THC will be elaborated in cooperation with state authorities and national experts with the consulting support on behalf of international experts.

Annex 1. Map of Tuyamuyun Hydroelectric Complex.



Demo project in Kazakhstan "Afforestation of the dried bottom of the Aral Sea: piloting a closed root system"

Background

The Central Asian states (CAS) experience the devastating consequences of the rapid depletion of the Aral Sea, which has shrunk to 10% of its volume. The process led to the formation of the Aralkum Desert (approx. area of 5.5 mln ha) overloaded with toxic sands and other pollutants. The new desert adversely affects the social-economic activities, as well as causes environmental damage, such as desertification, land degradation, sand and salt storms, and droughts in the CAR. The directly affected territories include Kyzylorda Region in Kazakhstan; Dashoguz Veloyat in Turkmenistan; and Republic of Karakalpakstan, Khorezm, Bukhara and Navoi Regions in Uzbekistan.

Regardless of location, every year approx. 100 mln tons of dust formed in the Aralkum Desert get carried by the strong east-west airstream across the Aral Sea Basin additionally accelerating glacial melt in upstream countries. CAS have acknowledged the low possibility of recovering the Aral Sea and directed their efforts on mitigation measures. To this end, afforestation of the dried bottom is considered one of the viable ways to halt desertification and reduce exposed toxic soils and pollutants. During the last several decades (1990-2020), over 190,000 ha of desert were afforested in Kazakhstan, and over 1 mln ha in Uzbekistan. Turkmenistan planted another 20,000 ha and plans to afforest 10,000 ha more in the Aralkum Desert. Saxaul roots are capable of fixing around 4 tons of sand, and thus prevent heavy sand and dust storms (SDS). To support saxaul forest expansion, Kazakhstan has also formally banned saxaul logging and commercial sale until the end of 2023.

However, afforestation of the Aralkum Desert is progressing slowly due – among other factors – to the low adaptability of saxaul species to arid climate. During their first year of life in desert conditions, the newly planted saxaul seedlings/saplings demonstrate the survival rate below 40%. Additional financial and human resources are wasted to re-plant the same zones of the dried sea bottom for the second or third time. In this regard, CAS support the innovative solutions and experience exchange on mitigating SDS and land degradation on the dried bottom of the Aral Sea.

Aim

This demo project aims to support the afforestation on the dried bottom of the Aral Sea through an innovative approach. Specifically, the intervention is designed to test the closed root system method of growing black saxaul seedlings. This approach has been never applied in Central Asia, although, according to scientific observations, it ensures a better survival rate.

Demo project tasks

Task 1. Construct and put into operation a small saxaul nursery in Aral District, Kyzylorda Region, Kazakhstan

The ED IFAS in Kazakhstan will allocate a land plot of 2,250 m^2 at the premises of the Eco-Aral Scientific and Touristic Centre in Aral District, Kyzylorda Region, and build 2 (two) saxaul greenhouses and 1 (one) shade-house. 12 staff will be hired to build the saxaul nursery. The water and electricity bills will be co-financed by ED IFAS.

The saxaul seeds will be planted as per the closed root system methodology developed by ED IFAS researchers: 5-10 saxaul seeds will be planted in 1 container with several bottom holes filled with a mix of 1/3 soil, 1/3 decomposed dung and 1/3 coarse sand; the containers will be put in several trenches (35 cm deep, 3-5 m long, and 60-70 cm wide), and regularly watered (Image 1.). An agricultural specialist will monitor and manage the growth process; 1 technical staff will help with watering and other plantation works.

The water intake will be done from the nearby Kamystybas Lake via a mobile pumping station. A plastic water pipeline (length of 50 m and diameter of 50 mm) system will be installed in-between the trenches hosting the containers with saxaul seedlings.

Task 2. In one (1) year, ED IFAS specialists will plant the survived seedlings in the Aralkum Desert, will take care of them during the initial several months, and monitor their survival onwards.

Image 1. *Closed root planting of saxaul.*

Source: *ED IFAS.*

National demo project in Tajikistan "Improving the electricity consumption control and monitoring system at pumping stations and upgrading a large pumping station in Sughd Region in the Republic of Tajikistan based on energy-efficient technologies"

Background

The national demo project "Improving the electricity consumption control and monitoring system at pumping stations and upgrading a large pumping station in Sughd Region in the Republic of Tajikistan" proposed by the Agency for Land Reclamation and Irrigation (ALRI) under the Government of the Republic of Tajikistan (RT) and national Ministry of Energy and Water Resources (MEWR) was approved for implementation at the 1st Meeting of the Project's Regional Steering Committee (RSC) of October 27, 2020[4].

This demo project is executed under the EU's "Central Asia Nexus Dialogue Project: Fostering Water, Energy and Food Security Nexus Dialogue and Multi-Sector Investment" (Nexus Project) with the support of the World Bank's CAWEP "Laboratory of Innovative Solutions for the Water Sector of Central Asia" Project (S4W Living Lab).

The main objectives of the demo project are to ensure water-energy-food (WEF) security by improving the electricity consumption control and monitoring systems at pumping stations in Sughd Region of Tajikistan, and develop technical and investment proposals for upgrading the Golodnostepskaya Pumping Station (Zafarabad District, Sughd Region) based on energy-efficient technologies and innovative solutions.

To fulfill the objectives of the demo project, 5 national specialists – a water economics expert, a land reclamation and irrigation expert, a hydraulic engineering expert, an energy expert, and engineering expert – will execute the corresponding works under the direct coordination of the expert group (EG) leader. It is expected that the expert group leader will also carry out the functions of the land reclamation and irrigation specialist.

The demo project includes 5 tasks. Task 2. will be performed under MEWR supervision, and Task 3. under ALRI supervision. The EG leader will coordinate the efforts by EG members and ensure proper communications among the World Bank, CAREC, MEWR and ALRI, as well as will be responsible for high-quality and timely execution of all tasks as per the corresponding expert ToRs.

Demo project rationale

Irrigated agriculture represents one of the main real economy sectors of Tajikistan ensuring food security and employment in rural areas – about 80% of agricultural production comes from irrigated agriculture, and 70% of the country's active population are engaged in farming. Overall, agriculture contributes about 21% to Tajikistan's GDP. In addition to the strong socio-economic role, agriculture is also a major domestic water and energy consumer.

The mountainous terrain of the country dictates the heavy use of pumping stations to supply irrigation water to over 60% of irrigated acreage. The irrigation infrastructure – built in the 1950-70s – is worn out and characterized by high energy intensity. As per ALRI estimates, every year Tajikistan's irrigation and reclamation systems on average use 1.41 bln kWh of electricity (approx. 10% of the total domestic power consumption) during the growing and inter-cropping periods.

Sughd Region takes a leading place in the national economy and accounts for 18.2% of the total area, 31.3% of the population, 36.4% of the industrial output and 36.5% of the agricultural output of the RT. 90% of irrigated farmland in Sughd Region depend on pumped irrigation (Fig. 1.). The region consumes about 1 bln kWh of electricity, i.e. 80% of the country's total energy consumption for irrigation purposes. The water is withdrawn from the Syrdarya River located lower than the irrigated fields.

[4] The EU supports the demo project under the Water-Energy-Food Nexus in Central Asia (carececo.org).

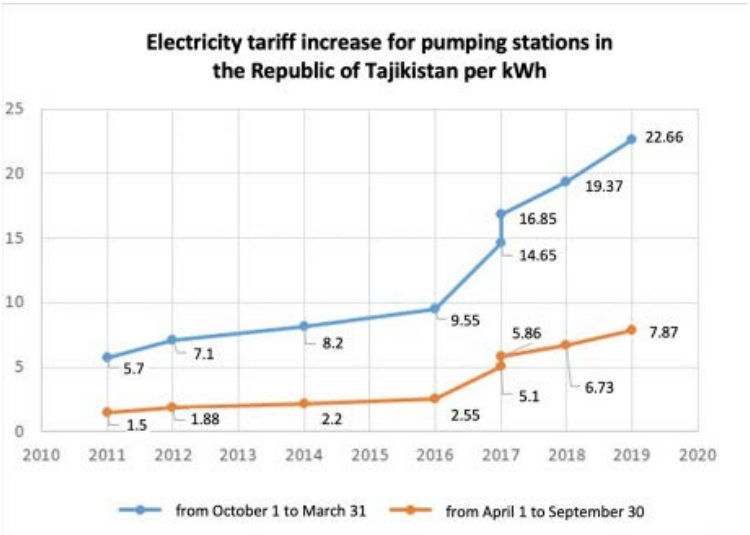
Figure 1. *Administrative division of Tajikistan.*

Despite the fact that pumped irrigation is more energy-intensive compared to gravity irrigation, in 2019 the total contribution of Sughd Region agriculture to Tajikistan's GDP amounted to 9.79 bln somoni (862.3 mln US dollars) and 10.82 bln somoni (952.5 mln US dollars) in 2020, significantly exceeding the same indicators for other constituencies and districts of national subordination. Since the amount of agricultural contribution depends on water supply, in the absence of timely action, it will decrease annually.

Due to low solvency of end users, the government has been subsidizing electricity tariffs. For example, during the growing season (April 1-September 30), 1 kWh costs 7.87 dirhams (0.69 US cents), and 22.66 dirhams (2.0 US cents) during the non-growing season (October 1-March 30), whereas the water tariff for farmer users is 2 dirhams (0.17 US cents) per 1 m^3.

The electricity tariff has been growing since 2011, but the same year the water service tariff was 1.77 dirhams per 1 m^3 including VAT, and in 2018 it went up to 2 dirhams per 1 m^3 including VAT. Meanwhile, the electricity tariff increased from 1.5 up to 7.87 dirhams per 1 kWh for the growing season, and from 5.7 up to 22.66 dirhams per 1 kWh for the non-growing season (Fig. 2.).

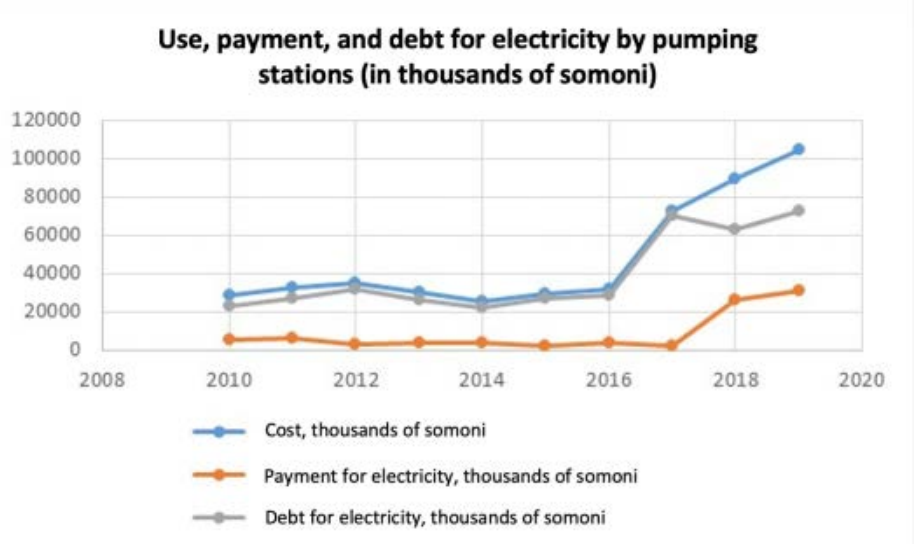
Figure 2. *Electricity tariff for pumping station in Tajikistan.*



Source: *The Agency.*

Over the past 10 years, on average the harvesting of electricity bills has amounted to only 22.7% of the actual electricity consumed, with most of the debt falling on Sughd Region. Since 2017, the national Ministry of Finance has allocated a part of ALRI's budget to cover electricity costs directly. Yet, as can be seen in the following figure, this is not enough (*Fig.3.*).

Figure 3. *Electricity use, payment, and debt by pumping stations in Tajikistan.*



Source: *The Agency.*

Water production costs continue exceeding the cost of delivering irrigation water to farmers by a factor of four (4), since that same water has to be pumped to the right elevation via cascading pumping stations. Including the pumping station operating costs in the tariff will significantly raise the cost of water and will have a double negative impact on farmers' ability to meet payments.

This situation has led to the fact that ALRI is suffering large losses associated with the payment of electricity bills to the Barqi Tojik OJSC (state national energy company), and cannot adequately ensure the sustainable operation of large pumping stations across Tajikistan. In addition, the sector has been experiencing problems with obtaining operational data on the targeted power use at large pumping stations, making it even more difficult to calculate the total power consumption.

In light of this, the most energy-consuming pumping stations in Tajikistan's Sughd Region were suggested for the priority implementation of pilot electricity control and monitoring systems.

Furthermore, in order to upgrade large pumping stations based on energy-efficient technologies and innovative solutions, it is necessary to develop proposals for applying cutting-edge technologies at large pumping stations in Zafarabad District of Sughd Region.

Task 1. Conduct national-level analytical review of pumping station operations (completed)

The EG leader will assign the questions (as per Annex 1.) among 4 (four) engaged experts in accordance with each specialist's expertise and capacity.

Once the hydraulic engineering expert receives the questions, he/she will elaborate them and submit to the EG leader, who will then compile all the inputs from 4 specialists into one draft report (holistic assessment/analytical review).

The expert will also have to suggest other issues for consideration in the analysis based on his/her expertise.

Task 2. Conduct metering audit of the pumping stations in Sughd Region and develop the Concept of automated electricity consumption control and monitoring system for the pumping stations in Sughd Region (completed)

The energy and engineering experts will carry out the technical by-pass of 173 pumping stations in Sughd Region to study the characteristics of their electricity metering (*see* the List of 173 pumping stations in Annex 2.). The full list will be divided between these 2 experts by the EG leader.

A) Technical audit of electricity metering at 173 pumping stations in Sughd Region

The specialists will study the existing electricity metering processes at 173 pumping stations in Sughd Region and identify their main technical characteristics for deploying the Online (Automated) Power Consumption Monitoring System - Pumping Stations (OPCMS-PS), specifically:

- Identify which of the 173 target pumping stations have power metering systems installed and which lack them. In parallel, the experts shall identify the type(s) of installed power metering units. To perform this task, the specialists will travel across Sughd Region and examine each pumping station individually. During the audit, the experts will take the readings from each installed metering unit and use the data as a baseline for comparing resource efficiency without and with the introduction of OPCMS-PS (if endorsed by ALRI);
- Determine the technical functionality of installed power metering units and assess the technical capabilities of the metering type/brand as well as their suitability to support the OPCMS-PS at the pumping stations. According to ALRI, at present different types of metering units are operating at the target pumping stations, thus not all of them will be able to support/correspond to the technical parameters for OPCMS-PS integration;
- Assess the existing electricity consumption control and monitoring systems at the target pumping stations (labor efficiency, metering data collection, staff time expenditure associated with metering data collection, challenges faced during metering data collection).

The above-mentioned results will determine the dependence of power consumption on water supply for the suspended areas, like Sughd Region, located in the lower Syrdarya River reaches.

Following it, the experts will devise the Concept of automated electricity consumption control and monitoring system for 173 pumping stations in Sughd Region, as well as analyze institutional and technical modalities related to launching the OPCMS-PS by performing the specific works below.

Goals, objectives, and criteria of creating OPCMS-PS:

- Required technical means at pumping stations to deploy OPCMS-PS (application of computer technologies, level of automation of managerial work, labor efficiency, analysis of time expenditure by pumping station staff, characteristics of each pumping station's readiness to be included in OPCMS-PS);
- Provision of technical means for metering and metering data transmission from pumping stations (compiling a list of required equipment);
- Expected technical and economic results of deploying OPCMS-PS (performance indicators, economic benefits, OPCMS-PS costs and benefits, sources of economic efficiency, expected cost-effectiveness);
- Prepare a scheme for transmitting electricity consumption data from pumping stations to the dispatch center of Sughd Region Department of Land Reclamation and Irrigation and ALRI, data processing and analysis; draft the corresponding manual;
- Preliminary estimation/identification of the expected costs (hardware and software) associated with launching OPCMS-PS (costs and payback period, sources of economic efficiency, detailed calculation of energy savings due to OPCMS-PS deployment);
- Develop technical specifications taking into account innovative solutions and technologies for designing and implementing OPCMS-PS;
- Devise a list of recommended actions for launching OPCMS-PS based on ALRI's regulations, technical capacities, staff qualifications/training needs, etc.);
- Draft an investment project proposal for implementing OPCMS-PS.

The land reclamation and irrigation specialist shall take over the last 2 work items, and the water economics specialist shall support a few economic estimation work items as per the corresponding ToRs.

Task 3. Draft proposals for upgrading the Golodnostepskaya Pumping Station in Sughd Region based on energy-efficiency technologies (completed)

This task aims to investigate the opportunities for introducing energy-efficient technologies at the target large pumping station to achieve more rational power and water use. This task's final outcome will be the investment proposal to upgrade the cascade of the Golodnostepskaya Pumping Station in Zafarabad District of Sughd Region based on modern energy-saving technologies. The water economics expert, land reclamation and irrigation expert, and hydraulic engineering expert will perform the following tasks:

- Review existing energy-efficient pumping units and electric motors taking into account modern technological and electrical equipment manufactured in different countries, as well as its requirements, performance and dimensions to assess the feasibility of installing it at existing pumping stations;
- Identify and evaluate potential equipment suppliers, and the possibility of installing their equipment at existing pumping stations based on its dimensions, compatibility with the equipment not requiring replacement, for example, transformer substations, closure gates, pressure pipes, etc.;
- Designate the indicators/criteria to evaluate the level of achievement of the upgrading objectives, for instance, pumping station staff productivity, volume of electricity savings, increase in water availability and yield, return of land to agricultural circulation, employment in agriculture;
- Draft recommendations on selecting modern technological and electrical equipment to ensure energy-efficient operation of large pumping stations by reducing power consumption at a designated water intake. While devising the recommendation, the experts shall consider the need for an automatic control system and target measures to protect the pumping station against sudden power outages;
- Develop an investment project proposal for upgrading the Golodnostepskaya Pumping Station in Zafarabad District of Sughd Region.

In the course of elaborating the investment project proposal, the specialists shall follow the model provided by the Project team. It is expected that the investment project proposal will include several thematic chapters, which may be also used as stand-alone documents.

Task 3. will be performed by the land reclamation and irrigation specialist, hydraulic engineering specialist and water economics specialist. ALRI shall lead the implementation of this Task.

Task 4. Discussion of the results (completed)

The Project expert will participate in all intersectoral group meetings to present/discuss the draft results and actively engage in preparing the meetings of the National Commission on Irrigation and Drainage (NCID) of the RT. Before agreeing on the documents for the NCID, the expert will assist ALRI in conducting internal discussions and revisions with NCID representatives. It is expected that the expert will keep the minutes of the meetings held under this task as per the corresponding ToR for further sharing with the World Bank and CAREC.