Research Report

The Development of Sustainable Water and Sanitation Systems in Rural Areas of the CAREC Region with a Focus on China, Mongolia, Tajikistan and Uzbekistan

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Disclaimer

This research by CARCE Institute, supported by UNICEF financing commenced at the beginning of the COVID-19 pandemic to review the status of water, sanitation, and hygiene (WASH) in four selected CAREC countries, the People's Republic of China (PRC), Mongolia, Tajikistan, and Uzbekistan to explore best practices and solutions in the WASH sector and enhance resilience of countries with fragile infrastructure and poor capacity to cope with future natural or manmade disasters in the long term.

This regional report is prepared by Ekaterina Strikeleva with support from Yannan Jia, Purev Narantsetseg, Shukhrat B. Igamberdyev, Abdulkhakim Salokhiddinov for the national chapters and case studies development, and supervised by the UNICEF-CI Joint Management Team led by CAREC Institute Deputy Director Two Dr. Iskandar Abdullaev.

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Abbreviations and definitions

ADB	Asian Development Bank
Agrovodokanal	Agriculture water administration in Uzbekistan
Aimag	Administrative subdivision (province) in Mongolia
Aksakals	Elders
AMA	Antimonopoly Agency
Bagh	Administrative subdivision below soum in Mongolia
BOT	Build-operate-transfer
CA	Central Asia
CAREC	Central Asia Regional Economic Cooperation
CCP	Chinese Communist Party
CI	Central Asia Regional Economic Cooperation Institute
ConsTaj	Consumer Rights Protection Platform in Tajikistan
CPPCC	Chinese People's Political Consultative Conference
DBP	Development Bank of the Philippines
Dehkan farm	Midsized peasant farm in Tajikistan that is legally and physically distinct from a household plot
DWO	Drinking water organization
EBRD	European Bank for Reconstruction and Development
EC IFAS	Executive Committee of the International Fund for Saving the Aral Sea
EIA	Environmental impact assessment
EU	European Union
Ger	Mongolian traditional portable round tent
GIZ	German Agency for International Cooperation (Deutsche Gesellschaft für Internationale Zusammenarbeit)
GLAAS	UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water

GoRT	Government of the Republic of Tajikistan
Great Khural	Mongolian Parliament
Hashar	Traditional community-level collective action to clean canals, build bridges, etc.
HCF	Healthcare facility
HRBA	Human rights-based approach
IMWG	Inter-ministerial working group
IPC	Infection prevention and control
IWHR	Institute of Water Resources and Hydropower Research
IWMI	International Water Management Institute
IWRM	integrated water resource management
Jamoat	Third-level administrative divisions in Tajikistan, similar to communes or municipalities
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
JMP	WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene
Khokimiyats	Uzbekistan administration
Kolkhozes	Collective farms in Uzbekistan
Lcd	Litres per capita per day
LLC	limited liability company
Mahalla	Rural community/neighborhood
MARA	Ministry of Agriculture and Rural Affairs
MCUD	Ministry of Construction and Urban Development
MECSS	Ministry of Education, Culture, Science, and Sports
MEE	Ministry of Ecology and Environment
MEWR	Ministry of Energy and Water Resources
MHCS	Ministry of Housing and Communal Services

MHURD	Ministry of Housing and Urban–Rural Development
MWR	Ministry of Water Resources
NGO	Non-government organization
NDRC	National Development and Reform Commission
NHC	National Health Commission
NPD	National Policy Dialog
NPV	Net present value
ODM	Official development assistance
O&M	Operation and maintenance
PAC	Public advisory council
PPP	Public–private partnership
PRC	People's Republic of China
PWRF	Philippine Water Revolving Fund
RDWS Project	Rural Drinking Water Safety Project
RE	Renewable energy
SDC	Swiss Agency for Development and Cooperation
SDG	Sustainable development goal
Soum	The second level administrative subdivision below aimag in Mongolia
Sovkhozes	Soviet farms
SPV	Special purpose vehicle
SUE KMK	State Unitary Enterprise Khojagii Manziliyu Kommunali
SWG	Sectoral Working Group on Water Resources
TajWSS	Tajikistan Water Supply and Sanitation Project
TFM	Trust fund mechanism
UN	United Nations
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNICEF	United Nations International Children's Emergency Fund

USAID US	Agency for International Development
USEPA	US Environmental Protection Agency
VFM	Value for money
VO	Village organization
Vodokanal	Utility organization
WASH	Water, sanitation, and hygiene
WB	World Bank
WCA	Water consumer association
WHO	World Health Organization
WMO	Water management organization
WSP	Water safety plan
WTF	Water trust fund
WUA	Water user association
WUC	Water user committee

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Acknowledgements

Preparation of this report was only possible with the generous support and valuable contributions received from many individuals and organizations.

Contributors

The authors would like to thank the following individuals for their support in the preparation of national parts of the report and case studies: Prof. Ding Kunlun (China Institute of Water Resources and Hydropower Research) and Prof. Wu Xiaomei (China Institute of Water Resources and Hydropower Research); Dolgorsuren Byambajav (Worldvision Mongolia), Mr. Batchimeg R. (Ministry of Construction and Urban Development of Mongolia); Mustakim Akhmedov (UNDP Project Tajikistan), Olivier Normand (RWSSP Tajikistan), Orkhan Ali (Oxfam GB in Tajikistan), Mr. R Sattarov (Ministry of Housing and Communal Services of Uzbekistan); Ulugbek Islamov (UNDP project Uzbekistan), Sohibjon Akramov (SDC Uzbekistan), M.Khalmirzaeva (NBT Uzkbekistan).

Overall production and management

The authors gratefully acknowledge critical support provided by CAREC Institute in the overall management of the project: Mr. Dang Haipeng and Mr. Zhang Xiaoxiao.

The authors especially acknowledge Ms. Sae-Ryo Kim (UNICEF China), Dr. Yang Zhenbo (UNICEF China), Ms. Wang Yifei (UNICEF China), Ms. Xu Qing (UNICEF China), Ms. Li Qian (UNICEF China), Mr. Batnasan Nyamsuren (UNICEF Mongolia), Mr. Ammar Orakzai (UNICEF), Mr. Ruslan Ziganshin (UNICEF Tajikistan), Ms. Guo Sufang (UNICEF Uzbekistan) and Mr. Fakhriddin Nizamov (UNICEF Uzbekistan) for their valuable guidance and contributions.

Peer reviewers

The authors also would like to thank the reviewers who provided helpful comments and suggestions: Heeyoung Hong (ADB), Massimo Patrone (ADB), David Molden (International Water Management Institute), Alejandro Jiménez (Stockholm International Water Institute), Evariste Kouassi Komlan (UNICEF Regional Office for East Asia and Pacific), Alexandar Nikolayenko (German International Cooperation), Karina Malczewska (UNICEF Regional Office for Europe and Central Asia).

UNICEF is grateful to Rob Savage for proofreading this report.

Executive summary

Lack of access to safe water and sanitation impacts the living standards of populations and undermines public health. Based on a UN forecast, by 2050 water shortages will become a crucial issue for over 5.5 billion people globally. Public health, especially during the COVID-19 pandemic, depends on available water, sanitation, and hygiene services (WASH), including regular and proper handwashing [1]. This is directly relevant to the target countries of this study China, Mongolia, Tajikistan, and Uzbekistan.

The main goals of this study are to analyze the current situation regarding drinking water supply and sanitation services in rural areas of the study countries, to identify the critical challenges of rural communities in accessing the WASH services, and to provide recommendations for the future development of the WASH sector whilst considering the most vulnerable populations.

This report is unique as it looks at countries not reviewed collectively in any other paper. This study also compares Tajikistan, Uzbekistan, and Mongolia with China allowing them to consider the transfer of knowledge and best practices.

Each of these countries are placing a growing emphasis on advancing their WASH sectors and share multiple similar challenges. The most common challenges are population growth requiring the construction of new systems to allow access to drinking water supply; urban versus rural drinking water supply and sanitation disparities; lack of human capacity for the proper operation of WASH networks; low tariffs and low service fee collection rates for water and sanitation services.

Nevertheless, all the studied countries demonstrate a political will to facilitate access to WASH. All four countries have tangible national implementation plans to support domestic WASH policies; however, none have reached 100 per cent access to WASH services, despite high-level political endorsement and the development of different targeted programmes. A substantial part of the drinking water supply systems in Tajikistan and Uzbekistan were built during the Soviet era, and less than 50 per cent of their rural communities enjoy a piped drinking water supply [2-4]. In addition, population growth and the development of new settlements, which are not covered by the existing systems, require significant investment, primarily from the state budget. Considering their current economic state, it is impossible to cover all these needs in a short timeframe.

To date, of the surveyed countries, only China has demonstrated solid results in providing access to WASH services in rural localities thanks to the implementation of the focused long-term policy, the Rural Drinking Water Safety (RDWS) concept. Starting from 2004, the execution of the RDWS Project enabled China to expand its piped drinking water supply coverage, to as much as 54 per cent of rural communities [5]. By contrast, Mongolia's long-term plans and strategies concentrate exclusively on urban development, despite having the political will and do not encompass access to WASH services in rural areas. Mongolia still demonstrates a rather low rate, only about 5 per cent, of rural piped systems. The remote location of communities and a nomadic way of life prevent Mongolia from deploying a centralized water supply and

predetermine the priority of decentralized schemes. The lion's share of water systems in Tajikistan and Uzbekistan were built during the Soviet era, necessitating a boost of over 50 per cent in the number of piped systems.

Sanitation systems are even less developed than water supplies in the target countries. The most developed system, with 83 per cent urban and 56 per cent rural coverage, exists in China. Uzbekistan's municipal wastewater systems are significantly inferior to those in China, covering only 5.5 per cent of rural communities.

Nonetheless, the study countries show high levels of hygiene provision, including behaviour change and capacity-building along four key tracks: handwashing, menstrual hygiene management, safe water handling, and the safe disposal of excreta. According to JMP data (2019), the most basic level of hygiene conditions is the 'availability of a handwashing facilities on the premises with soap and water.' The share of national populations enjoying access to basic hygiene conditions are quite high, in the 70 per cent to 90 per cent range in Mongolia, Tajikistan, and Uzbekistan. For China access to basic hygiene conditions has not been identified since China does not report this indicator to the JMP system [5].

All of the legal frameworks of the target countries still need to be supplemented with the requisite WASH-related bylaws, methodologies, and rules. Forging mechanisms that allow easy access to subsidies and tax incentives, especially in rural areas.

The development of WASH sectors is highly dependent on funding. The UN Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS) assessed capital investment for building new water and sanitation infrastructure globally to be triple what is currently allocated [6]. The state budget is the main funding source for implementing WASH strategies in the target countries, although it is insufficient to effectively fulfil the desired WASH goals. One of the reasons for this is the high cost of building new systems or financing their reconstruction. In the case of Uzbekistan and Tajikistan, most systems were built more than 40 to 50 years ago and would now require major investment for reconstruction. Implementing drinking water supply tariffs is a common finance mechanism in rural areas, although service fees, except for several pilot projects, fail to fully cover drinking water supply operation and maintenance (O&M) costs. Development projects have attempted to introduce various innovative financial schemes, be they subsidies, loans, bonds, or revolver/revolving funds. However, only subsidies and loans were used as financial instruments in the studied countries, with other mechanisms piloting under different international development projects.

China, Mongolia, Tajikistan, and Uzbekistan have been endeavoring to create enabling business environments to attract private investments to the WASH sector. Indeed, local private entities and local communities are starting to participate in financing and managing rural water supplies, including their rehabilitation, construction, and maintenance, whilst even partially covering future investment costs. Pilot projects exist in all the studied countries but need to be implemented more efficiently. The review in this report shows that such practices are better implemented in China than among the study countries.

The improvement of centralized drinking water supplies and sanitation assumes considerable construction and subsequent maintenance costs and necessitates the identification of simple grassroots management schemes. Target countries have been employing several different management models without a unified framework. The combination of centralized and decentralized systems in the countries can be better managed to identify better approaches for each type of system. Zoning countries' territories by type can become the basis for determining the most suitable WASH services for settlements.

Involving local communities in management and financing mechanisms and fostering collective responsibility and new behavioural norms represents one of the prerequisites for ensuring effective drinking water supplies and wastewater treatment systems, especially in rural territories.

Private companies in the studied countries are legally authorized to cooperate with private lenders and banks to enhance the financial sustainability of potential community-based schemes. Different local level approaches and practices are also piloted under international development projects. The analysis and development of a register of the most successful practices would be conducive to introducing and disseminating such practices domestically and internationally. Currently, private sector engagement mechanisms are only being developed in China (further details are provided in Part 3 of this report).

Since water resources are crucial for developing all economic sectors, the target countries need to render more attention to continual and regular coordination among industries and identify industry-specific benefits. Using water both for irrigation and drinking has certain advantages; however, several risks are associated with dual or multi-purpose systems. Multi-purpose water use schemes need to be supported with clear scientific calculations of available water reserves to meet the needs of both irrigation and drinking water supply. Supporting and strengthening WASH multi-stakeholder networking and establishing intersectoral and interdepartmental platforms is necessary to enhance coordination in the WASH sector and execute national policies and plans.

There is a clear need to develop effective and tailored mechanisms to share WASH knowledge, technology, and experiences. Only China showcases such a mechanism on a national level, with the Institute of Water Resources and Hydropower Research (IWHR) supporting the promotion of water-related advanced features, the drafting of sector-specific regulations, and undertaking thematic breakthrough projects.

The studied countries acknowledge the need for continuous capacity-building, knowledge sharing, and retraining to be included in their national development strategies. This study shows that Mongolia, Tajikistan, and Uzbekistan still lack effective institutionalized frameworks for knowledge, technology, and experience sharing in the WASH sector.

The exchange of knowledge of the most efficient available technologies is another important tool. Building research capacities enables the identification and application of innovative approaches and the consideration of the needs of different territories. So far, among the studied countries, the necessary scientific basis for applying an innovative approach is present only in China.

Regional recommendations and suggestions for developing WASH services in rural areas

The recommendations presented in this report aim to advance the WASH sector in target countries, as well as provide a regionwide view of ongoing challenges:

- Institutional frameworks represent the operational basis for WASH services. Such frameworks are key to ensuring the proper operation and progress of WASH management systems across different tiers. The identification of optimal models, considering country needs and the streamlining of functionality of different agencies, should become the main task for the governments concerned

- Zoning of territories based on promising drinking water supply sources and taking into account local specifics should guide the design of drinking water supply and sanitation systems in rural localities. Based on such zoning, the governments should elaborate long-term strategic plans for developing domestic rural and urban WASH systems

- The development of WASH financial plans is necessary for the successful deployment of public WASH services. The scope of state strategies and policies should include projects to improve service fee collection and reconsider valid tariff schemes. While introducing nationwide pro-poor full cost recovery mechanisms, special emphasis should be placed on supporting vulnerable communities. Countries

already have some mechanisms for supporting vulnerable communities, but these only work as pilot schemes or require clearer implementation and monitoring mechanisms

- The development of regulations and rules, as well as forging mechanisms allowing easy access to subsidies and tax incentives especially for rural areas, constitutes two more necessary conditions of an effective management of WASH systems. Lack of proper mechanisms for the distribution of subsidies and other financial benefits, and poor monitoring of the implementation of these mechanisms will lead to corruption and misallocation, nullifying efforts

- Private sector involvement can become instrumental in ensuring sustainability and enhancing the operation of WASH systems. National governments should concentrate on elaborating clear cut and mutually beneficial mechanisms for engaging the private sector in establishing and operating local level WASH systems

- Recognition of the water-energy-food nexus is another significant stipulation for the sustainable development of territories. Using water both for irrigation and household purposes does have certain advantages; however, several risks are associated with dual and/or multipurpose schemes. Since water resources are crucial for the development of different economic sectors, countries need to pay more attention to regularly coordinating them and identifying sector-specific benefits. The establishment of intersectoral and interdepartmental platforms, both nationally and locally, should become the basis for more effective and transparent management

- Designing capacity-building programmes and staffing plans and strategies for maintaining and retaining professionals should become a priority for the governments concerned. Public water awareness programmes encompassing different aspects, such as hygiene, technology, economy, and the environment will also necessary

- Human resources development is necessary to foster research and innovations in water supply, sanitation, hygiene, and wastewater treatment. The development of effective and tailored knowledge, technology, and experience sharing mechanisms should be the basis for the successful implementation of WASH projects. The studied countries should also give special attention to developing and executing adaptation programmes and/or developing novel scientific approaches and innovations with a special focus on rural development. This can be done via establishing knowledge and experience exchange centres.

Providing access to WASH services in both urban and rural areas is a mandate and responsibility of national governments, with no single international development partner able to undertake all of the required efforts. However, the latter can contribute by providing evidence-based solutions for developing WASH systems, managing and training technical maintenance staff, drafting legal frameworks for simplifying processes, and piloting the best financial mechanisms for the sustainable O&M of WASH systems. Development partners can provide the following support:

- **Legal support:** Identifying legislative gaps at the national level and supporting countries in drafting laws, bylaws, and other legal tools for improving access to WASH. The corresponding contributions should be based on international best practices and undergo country-specific adaptation

- **Scientific support:** Aiding countries in establishing research and development centres engaged in designing, adapting, and promoting technologies, know-how, and best practices in the WASH sector and sustainable O&M of WASH systems

- **Capacity support:** Helping countries in the design of permanent capacity-building and retraining programmes for specialists and technical staff involved in managing and operating WASH systems. These programmes should be placed under the ownership of the governments concerned and become mandatory for all WASH-related specialists. Special attention should be given to ensuring the financial sustainability and operation of programmes without further external support

- **Knowledge and experience exchange:** Assisting countries in creating a platform for exchanging experiences, knowledge and lessons learned, as well as for detecting the required technical, management, and operational knowledge. To identify the willingness of targeted countries for closer cooperation, additional consultations with countries are needed at both national and regional levels. These consultations can also help identify specific needs. Since China is currently leading WASH services development among the studied countries, developed platforms can be based on Chinese experience with the possibility of adding insights from other well-performing countries at a later date

- **Financial support:** Helping countries to develop and test innovative financial mechanisms that can sustain WASH services, as well as involving the private sector with the O&M of WASH systems. Piloting new approaches and developing pioneering practices at community and national levels

Part 1. Regional Overview

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Insufficient access to drinking water and sanitation has a negative influence on living standards and hinders public health protection efforts across the globe. In addition, inadequate access to sanitation causes environmental pollution and water contamination, as latrines and earthen ditches discharge a large quantity of wastewater into water sources. The demand for drinking water and sanitation systems is constantly growing. The UN projects that more than 5.5 billion people around the world will face water shortages by 2050 [1]. This includes those living in CAREC countries.

The COVID-19 pandemic has further exacerbated WASH issues. Clean drinking water and sanitation, as well as safeguarding the health of people, is the foundation for preventing and reducing the spread of infections like COVID-19. It is worth mentioning that given the still unfolding pandemic situation, access to WASH services in public institutions, such as, academic establishments, schools and healthcare facilities has seen a renewed focus by national policymakers and development actors.

Available data reveals infection prevention and control (IPC) limitations at both regional and national levels. The lack of these services propels the spread of diseases such as dysentery, hepatitis A, typhoid, and pertussis. Diarrhoea further aggravates malnutrition and remains one of the core drivers of child mortality worldwide [1]. Protection of public health, especially during a pandemic, depends on the quality of drinking water, sanitation and hygiene. Drinking water can be contaminated with human and animal faeces and/or with chemicals and other substances that adversely affect children's health and growth. As per WHO recommendations, one of the main prevention measures against COVID-19 is regular and proper hand hygiene. Wastewater treatment can also help kill the virus and lower incidence [1].

The pandemic has seen countries paying increasing attention to advancing their WASH sectors and implementing new laws, national policies, and development plans. The human right of access to drinking water and sanitation are at the core of all the studied countries. Despite the commitment to reach WASH development goals, the countries are still experiencing multiple challenges:

- Population growth requiring the construction of new systems to allow access to WASH systems
- Inequalities of drinking water supply and sanitation between urban and rural areas significantly contributing to decreased rural living standards
- Lack of capacity for the proper operation of WASH networks is preventing the effective management of existing systems, leading to insufficient funding for the rehabilitation and restoration of WASH services, as are poor modern management methods. In addition, low salaries dissuade young professionals and qualified staff from entering and being retained the sector
- Financial challenges within the WASH sector are relevant for all countries. These can be split into the following groups:
  - Insufficient funding. Despite all countries planning, developing, and forecasting the achievement of the corresponding targets, the actual financial backing of these efforts is insufficient. In Mongolia, the financial support for WASH action plans is 50 per cent less than what is needed. In China, financial allocations for the WASH sector are significantly higher, enabling the implementation of multiple targeted projects. In addition, owing to the COVID-19 pandemic, financial inflow into the WASH sector has fallen overall
  - Low tariffs and poor service fee collection remain an issue across the studied countries. Revenues from water service tariffs and state budget allocations are not enough for the O&M of WASH systems. Additional financing, from other sources, will be necessary
  - The WASH sector by and large remains unattractive for private entities. Sporadic examples of such involvement with respect to the O&M of urban systems do exist, but the overall percentage is still extremely low

These challenges hit the poorest and most vulnerable population groups the hardest. The absence of adequate access to drinking water and sanitation prevents the poor from receiving quality services, and they are often forced to use unhygienic water sources such as irrigation canals, rivers, and ponds [7].

Considering the importance of providing access to drinking WASH services, the study aimed to investigate the state of WASH management in China, Mongolia, Tajikistan, and Uzbekistan. Over the last 10 years, few assessments and analyses of WASH-related efforts and their sustainability in the target countries have been conducted. The UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS), the WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP), and other studies have demonstrated the current level of WASH services development, access to these services and the enabling environment for local communities.

Projects implemented with financial support by international development partners have also issued a number of reports, Glass Half Full: Poverty Diagnostic of Water Supply, Sanitation, and Hygiene Conditions in Tajikistan [8], Uzbekistan: Preparing Urban Development and Improvement Projects [2], and Gender Mainstreaming in WASH in Schools in Mongolia Promising Practice Brief [9].

From the regional perspective, Tajikistan and Uzbekistan are usually studied together with other Central Asian countries including Kazakhstan, Kyrgyzstan, and Turkmenistan, as part of the Europe and Central Asia subregion or UNICEF reporting regions. Mongolia, by contrast, is usually considered together with Indonesia and Vietnam as part of the East Asia and Pacific subregion of UNICEF. The approach of this report is unique in that it looks at countries not reviewed collectively in any other paper. This study also compares these three countries with China, enabling an assessment of a transfer of knowledge and best practices.

In addition, the study also compared the policies and practices of China with those in the selected CAREC countries on:

- Access to safe drinking water, efficient water application and treatment mechanisms including the water-food-energy nexus approach to ensure water resource sustainability
- Climate resilient water solutions, particularly for the most vulnerable population groups

The study identified the critical challenges in rural and urban localities in accessing drinking water and sanitation. The study also made it possible to elaborate the feasible modalities for selecting mechanisms to support/strengthen community-based water schemes and applying a fair and equal distribution of drinking water and sanitation services in rural areas of the target countries, including modeling efforts to balance water demand and supply

In addition, to better demonstrate practical examples of the application of different possible mechanisms, the study presents several case studies of WASH and investment for sustainable water management solutions that benefit local communities.

This report comprises three parts:

- General overview of the WASH sectors in the selected countries from a regional perspective,
- Country profiles: China, Mongolia, Tajikistan, and Uzbekistan,
- A deeper dive into the most interesting case studies from each of the selected countries.

Methodology

The study covers four countries of the CAREC region, China, Mongolia, Tajikistan, and Uzbekistan.

The study included the development of national reports for each target country. Each national report was based on a literature review, as well as accounts of the experiences of implementing international WASH projects, national reports on WASH, presentations of local and national authorities, national and/or local plans and strategies, research papers, media reports, and other sources. These were conducted alongside semi-structured interviews of project operators. The study gave primary attention to UNICEF projects and UNICEF WASH officers were interviewed.

Owing to COVID-19 restrictions in all the target countries, the case studies presented in the report were developed based on desk reviews and face-to-face or phone interviews of target respondents.

Chapter 1.

WASH: policies, institutions, and practices: review

Access to WASH services in selected countries

All target countries demonstrate a strong political will to enhance access to WASH, public healthcare and improve living standards underpinned by domestic policies and development plans. National WASH policies aim to cover the maximum number of citizens with corresponding services.

The governments' concerned are developing social and economic plans, either short, mid, or long term, to identify and satisfy in country priority needs. The higher the profile of WASH plans under development, the better the chances that politicians will consider them at the highest national level. Since rural area have traditionally receive less attention, many national policies target rural development [7, 10-13].

However, despite the political will and the presence of various programmes, none of the studied countries has reached 100 per cent in providing access to WASH. For instance, a substantial share of the drinking water supply infrastructure in Tajikistan and Uzbekistan was built during the Soviet era, and fewer than 50 per cent of rural communities have a piped drinking water supply [2-4].

The indicators on access to a drinking water supply in each country in question are presented in Table 1. Access to drinking water supply systems in the studied countries differs not only between them but also internally. Usually as result of the disparity between access to a drinking water in urban territories and rural areas (see Table 1).

As practice shows, the implementation of large long-term projects and programmes gives significant and sustainable results in providing rural populations with access to WASH services. To date,

Table 1. Access to a drinking water supply (JMP, 2019) [5]

Country/main indicators	China	Mongolia	Tajikistan	Uzbekistan
% of population with access to safely managed drinking water:				
- urban	92.3%	no data	no data	86.1%
- rural	no data	no data	no data	31.1%
- total	no data	23.7%	47.9%	58.9%
% of population connected to piped systems:				
- urban	92.2%	34.5%	90.8%	88%
- rural	53.8%	5%	54.5%	52%
- total	76.1%	25.1%	64.3%	70%
% of rural population using improved sanitation facilities by type:				
- latrines and other	38%	62%	99.1%	55%
- septic tanks	5.5%	0%	0.1%	<1%
- sewer connection	38.5%	3.1%	0.2%	45%
% of total population using hygiene facilities:				
- with basic conditions (facility with water and soap)	no data	71%	72.7%	90%
- with limited conditions (without water or soap)		7%	22.6%	29%
- no facilities		22%	4.7%	<1%

compared with the remaining selected countries, China demonstrates better results in providing access to WASH services in rural areas thanks to the implementation of a well-planned, long-term policy. Piped drinking water supply coverage has increased as a result of the Rural Drinking Water Safety (RDWS) Project in China and reaches almost 54 per cent by 2017 [5]. In contrast, despite the political will, Mongolia's long-term strategies do not include actions to ensure access to WASH services in rural territories. As a consequence, Mongolia shows an extremely low rate, about 5 per cent, of rural-level piped systems. The lion's share of water systems in Tajikistan and Uzbekistan were built during the Soviet period, necessitating a boost of over 50 per cent in the number of piped systems.

Compared to drinking water supply, sanitation systems are much less developed in targeted countries, because WASH-related programmes and interventions do not always include wastewater disposal. Since drinking water supply is vital for all population groups, governments had initially tried to ensure access to safe water sources, which led to a significant gap between access to drinking water and access to sanitation. At present, China has the most advanced sanitation system among the study countries, 83 per cent urban and 56 per cent rural coverage. For example, the municipal wastewater treatment systems in Uzbekistan are significantly less developed than in China with only 5.5 per cent rural coverage.

According to JMP data (2019), the basic level of hygiene is 'availability of a handwashing facility on premises with soap and water.' The selected countries have high levels of hygiene provision, including behavioural change and capacity-building in the four key domains: handwashing, menstrual hygiene management, safe water handling, and safe disposal of excreta. The rate of populations enjoying basic hygiene averages 70 per cent to 90 per cent in Mongolia, Tajikistan, and Uzbekistan. For China, the access to basic hygiene is not identified since China does not report this indicator to the JMP [5].

All the studied countries still face urban–rural gaps. As presented in Table 1, piped connected systems in China, Tajikistan, and Uzbekistan in rural areas is only half that of urban areas. For Mongolia, the differences are much bigger, not only because of the remoteness of rural areas but also owing to gaps in legislation. For example, 'Mongolian law on utilization of urban settlement's water supply and sewage' is more focused on urban WASH services development with little attention paid to rural areas. These differences influence the standard of living in rural communities and limit their development opportunities.

Current laws and policies

Considering the legal frameworks of the target countries, all still require enhancement. Namely, implementing the necessary WASH-related bylaws, methodologies, and rules.

Within the framework of its national poverty alleviation campaign, the Chinese Government places great importance on water safety and access to secure drinking water. The RDWS concept that guarantees sufficient drinking water for rural residents, as well as its timely and quality provision, so that it does not adversely affect people's health in the long run, was proposed in 2014. The country has since set up quite robust regulations and basic normative standards for rural WASH.

China launched its long-term WASH efforts within the framework of the 11th and 12th five-year plans (2006-2015) and has been continuing them under the 13th five-year plan that started in 2016. The main goal was to expand the centralized drinking water supply and piped water coverage, as well as guaranteed water quality and drinking water supply, under the RDWS.

The political will of the Chinese Government, the long-term nature of the goals and set programmes, the scientific support of executed activities, as well as constant financial support from the state enabled a gradual achievement of the targets. The plans for 2020-2021 are to give access to WASH services to about 96 per cent of the rural population.

Mongolia is also developing its WASH sector. The initial steps were taken in the 1960s with financial support from the USSR. Starting in 1990, the country embarked on several targeted projects supported by an array of development actors, mainly Japan, the World Bank, the ADB, and China. Since then, about 20 major projects have been implemented to build and reconstruct drinking water supply and wastewater treatment systems, as well as enhance access to hygiene. The majority of these projects focused on urban areas, in particular Ulaanbaatar.

Box 1. China: 13th five-year plan [14]

Since 2006, China has been executing its long-term RDWS Project. Its first two phases ended in 2015, and the third phase commenced in 2016. The project aims primarily to increase the centralized water supply, piped water coverage, water quality, and supply guarantee rates. By late 2020, they are expected to reach 88% for rural centralized water supply, 83% for piped water coverage, and 50% for large-scale water supply.

The RDWS consolidation projects during the 13th five-year plan specify three critical tasks:

- Carry out the improved reconstruction and construction of water supply projects
- Enhance the protection of water sources and guarantee water quality
- Complete the building of positive project operation mechanisms

By the end of 2019, over 10 million rural drinking water supply projects had been executed across China as part of the RDWS, with the overall supply capacity reaching approximately 0.9 billion residents.

Mongolia's Constitution recognizes the human right to drinking water and sanitation, and community involvement procedures are stipulated by laws and regulations. In 2014, WASH targets and measures were included in Resolution No. 43 *The Green Development Policy of Mongolia* with the following objectives:

- Provide at least 90 per cent of the population with access to safe drinking water
- Provide 60 per cent of the population with access to improved sanitation facilities by increasing drinking water supply, and improved capacity of sewerage systems

However, an analysis of Mongolia's national WASH targets reveals that the corresponding rural drinking water supply and hygiene targets are not ranked under the national policy [6] and that Mongolia's programmes and plans on developing the WASH sector focus exclusively on urban communities.

Most WASH services in Tajikistan and Uzbekistan were built during the Soviet era, approximately 50 to 60 years ago, with rural WASH services deemed obsolete. The collapse of the Soviet Union strongly impacted the drinking water supply systems of both countries, significant cuts to the sector's funding led to sizable problems. Much of the countries' drinking water supply infrastructure substantially deteriorated, yielding unreliable service provision, high water losses, and aggravating pollution risks. Many districts, households, and businesses currently face frequent disruptions in drinking water supplies and are forced to use alternative water sources.

Tajikistan and Uzbekistan have been consistently reforming their water sectors, focusing on drinking water supply and sanitation, as well as adopting comprehensive measures to ensure rational water use, water quality and safety, whilst introducing modern water consumption accounting schemes.

Tajikistan is mainstreaming Human Rights Based Approach (HRBA) principles into water governance, strengthening transparency, accountability, and participation in drinking water supply and sanitation services management. For example, the national government has endorsed a national-level policy to promote non-state civil society involvement in the management and ownership of rural drinking water supply schemes, including water user associations (WUAs), village organizations (VOs), and limited liability companies (LLCs) [15].

Tajikistan's legislation lays out the overall framework and includes numerous laws, regulations, standards and norms, with government and agency decrees setting specific mechanisms for enforcing certain water-related requirements. The Drinking Water Supply and Sanitation Law was revised in July 2019 to focus more on safe drinking water supply and sanitation, and the requirements for devising water safety plans (WSPs) for drinking and sewage water. However, the implementation mechanisms and procedures still await formulation and deployment at local level [16-17]. Tajikistan also developed and

Box 2. Tajikistan: State Unitary Enterprise *Khojagii Manziliyu Kommunali* [15-17]

SUE KMK is a state-owned entity authorized to perform economic management and to profit from the services provided.

SUE KMK is mandated to provide access to drinking water and sanitation countrywide. SUE KMK is a focal agency acting as the service provider on behalf of the government. It also has a few independently operating municipalities in several major cities. Among other tasks, SUE KMK should be also responsible for the overall governance and management of the WASH sector, but the corresponding mechanism is still underdeveloped.

SUE KMK has six subsidiaries, also state-owned, with the right to economic management.

implemented a national development strategy up to 2030.

Uzbekistan has also set up WASH policies and adopted implementation plans to back them. Uzbekistan's strategic documents target not only access to WASH services, but also environmental protection. The country has amended its urban and rural drinking water policies and action plans by including mandatory requirements for an environmental impact assessment (EIA) of any development, especially water resources management, to address the climate resilience of WASH technologies and management systems [18].

Over the last 30 years, Uzbekistan's national WASH institutional framework has gone through several waves of change, shifting from the Soviet approach to the recently approved contemporary model transferring infrastructure to local governments. This step did help to improve the situation slightly but did not forge the conditions for swift change. Finally, WASH operator organizations were returned to the supervision of the Ministry of Housing and Communal Services (MHCS) in the form of LLCs.

Despite ongoing reforms to WASH services, each country still lacks agencies focusing on rural water supply. In China, the roles and responsibilities of each department and agency are clearly identified. Mongolia, Tajikistan, and Uzbekistan still endure fragmented and dysfunctional regulatory and institutional frameworks, limited sector planning capabilities, weak coordination and oversight, and unclear and ineffective regulatory compliance mechanisms imposed by state agencies.

All the selected countries allocate significant finances to upgrading systems and providing access to drinking water supply, as well as having elaborated WASH sector development strategies. Yet, it is still necessary to design better financial mechanisms and attract investment. China is more advanced, but still needs to improve its financial mechanisms, especially regarding the involvement of the private sector. More detailed information regarding financial instruments is presented in chapter 2.

All the studied countries have different operational models of WASH services at the same time, both centralized and decentralized systems. Centralized drinking water supply systems consist of centralized water intake facilities and water treatment plants. Centralized drinking water supply systems also include water transporting pipes, a pressurized water distribution network, and pump stations. Decentralized drinking water supply systems consist of individual water intake, treatment, storage, and small distribution systems. Decentralized systems sometimes consist of a water well or springs, service water bodies or are delivered by mobile transported water.

Several different community-based schemes are implemented in rural areas in the studied countries. In some cases, these schemes work very well and show sustainable results. But there are still obstacles curbing their broader application, such as the technical capacity of the communities in O&M, or clear regulatory and financial mechanisms. Community-based approaches are presented in more detail in chapter 3 and part 3 of this report.

Box 3. Uzbekistan: Special Republican Commission [18]

Uzbekistan's Special Republican Commission coordinates and monitors the implementation of the Program of Integrated Development and Upgrading Drinking Water Supply and Sanitation Systems. The Commission's main tasks include the following:

- Coordinate and monitor programme implementation
- Approve constituency schemes for developing water supply and sanitation
- Elaborate recommendations on adopting modern, energy-efficient pumping equipment
- Receive monthly WASH infrastructure technical condition reports
- Conduct monthly reviews of the programme's implementation progress

Urban and suburban areas with high population densities and suitable water sources would probably be better served by centralized drinking water supply systems, while for remote rural areas the decentralized systems are more suitable. In this regard, the parceling of the country's territory into 'zones' each with its differing conditions of access to WASH services and drinking water supply sources could become the basis for determining the most suitable WASH services for settlements.

Coordination between different sectors: nexus approach

Since water resources are crucial for the development of all economic sectors, target countries need to render more attention to continual and regular coordination among the industries and identify industry-specific benefits. Undoubtedly, this interaction is more obvious from the point of view of the water-food nexus, especially at the rural community level. For example, in Tajikistan and Uzbekistan, rural systems were traditionally designed as dual purpose, with irrigation as primary and drinking water supply as secondary. In addition, most rural households have land plots and livestock. Hence, rural water systems are supplying water not only for drinking and irrigation.

Several risks are associated with dual or multi-purpose systems. Foremostly, water quality for these two types of use is different, and the absence of drinking water quality assurance may potentially lead to adverse human health impacts. From a legal perspective, irrigation water is not safe for drinking, and yet irrigation water is informally accepted as a corresponding alternative to drinking water, exposing households to the threat of waterborne disease.

Multi-purpose water use schemes need to be supported with clear scientific calculations of available water reserves in order to meet the needs of both irrigation and drinking water supply. However, not all rural localities have such data available, which can lead to water shortages, especially during the vegetation season.

Community service providers do not apply differentiated tariffs for multi-purpose systems and use flat rates regardless of consumption volume and purpose. This impacts overall consumption in the absence of water meters.

The water-energy nexus has two dimensions: (1) power used to support a drinking water supply (water boreholes and pumps) and (2) water used for power generation. In case a system depends on electricity to pump water for further distribution, communities are then dependent on power availability and may have limited or no access to safe drinking water owing to electricity shortages in colder seasons.

As far as the second dimension is concerned, there are a few cases of hydropower generation along rivers and large canals, although there is insufficient data to demonstrate how this energy is used. In addition, the designed capacity of most reported mini-hydro installations used in rural territories only satisfy domestic lighting needs.

Highlights:

- **National WASH policies and plans:** All the studied countries demonstrate the political will to improve access to WASH. All four countries possess implementation plans to translate their WASH policies into action. Simultaneously, sanitation issues have been receiving increasing attention, closing the gap between the indicators of access to drinking water supply and access to sanitation services

- **Access to WASH services in urban and rural areas:** In addition to the varying degrees of access to WASH services among the target countries, the internal gap between rural and urban populations remains an issue

- **Institutional basis for WASH introduction:** Within the framework of ongoing reforms, all the studied countries have been developing and putting into action more effective WASH management models, yet still focus on drinking water supply and less on sanitation. However, in multiple cases line institutions are still duplicating each other in terms of role and function. An issue that requires attention from the governments concerned

- **Interagency coordination:** Water resource use by different sectors of the economy requires constant interagency coordination and application of the nexus approach

Chapter 2.

WASH: financing and economic aspects

Development of the WASH sector depends on sufficient funding. Despite all the studied countries assuming responsibility for achieving SDG 6 Targets 6.1 and 6.2, the financial support to the sector is still insufficient. Financing is required for O&M of existing systems, for rehabilitating and reconstructing outdated systems, as well as for constructing the new systems needed to provide sufficient drinking water and sanitation to constantly growing populations. UN-Water's assessment of the capital investment required to support the construction of new drinking water supply and sanitation networks is three times higher than the currently allocated funding [6].

Based on JMP data (2019), urban populations are supplied with WASH services that are significantly better than those for rural populations, owing to the higher financial support available for urban development. However, given the growing problems in rural areas, the governments concerned are starting to pay more attention to projects and programmes to enhance access to WASH in rural localities. China, Tajikistan, and Uzbekistan have been implementing mid and long-term initiatives specifically targeting access to rural-level WASH services. Although, in Mongolia, the main programmes and projects are still urban-biased.

Box 4. Tajikistan:

The current WASH tariffs in Tajikistan are still averaging between 33.5% and 43.5% of the full cost recovery level. A series of attempts by SUE KMK to approve full cost recovery rates (2.3TJS or USD0.2 per m^3) were denied by the regulating agency, which advocated for gradual tariff rises over time. It is currently hard to assess whether such gradual augmentation will eventually reach full cost recovery in the near future.

Since access to drinking water supply and sanitation constitute basic human life support services, governments assume the responsibility of providing access. In the countries concerned the main money to finance WASH efforts comes from the state budget. However, in all the studied countries this is not enough. In Tajikistan, for instance, the allocated state budget funding is not even sufficient to maintain the already functioning systems, let alone rehabilitation and recovery efforts, or financing the State Unitary Enterprise *Khojagii Manziliyu Kommunali* (SUE KMK) and its numerous affiliates [16-17].

Ensuring sustainability of drinking water supplies and sanitation systems represents another crucial issue for the governments of all target countries. Elaboration and introduction of the most efficient financial instruments considering the specifics of each country is one of the main government goals. In this regard, the countries have been contemplating different approaches and mechanisms.

Box 5. China: 13th five-year plan [14].

Based on the data of the national Ministry of Water Resources, the gross investment for the 13th five-year plan for National Economic and Social Development (2016-2019) reached USD25.57 billion, including:

- USD3.85 billion (15%) allocated by the Central Government, and
- USD21.72 billion (85%) from local investments and self-financed funds.

Water tariffs

Drinking water supply and sanitation tariffs is one of the mechanisms to finance the WASH sector. However, the service fees are still low and do not cover all the costs associated with the O&M of drinking water supplies and sanitation systems. The governments are considering options to raise tariffs, but the low-income level in rural communities in the countries in question has so prevented this [19-22].

Table 2. Drinking water supply and sanitation tariffs

	China [19]	**Mongolia** [20]	**Tajikistan** [21]	**Uzbekistan** [22]
Water supply	USD0.29-1.47/m^3	USD0.71-1.84/m^3	USD0.10-0.31/m^3	USD0.10-1.22/m^3
Sanitation (wastewater)	USD0.14-0.46/m^3	USD0.58-2.05/m^3	USD0.05-0.17/m^3	USD0.01-0.06/m^3

The introduction of differentiated **Drinking Water Supply Tariffs**, calculating tariffs based on expenses for the O&M of WASH services and further development costs, represents one of the mechanisms to ensure sustainable development of the WASH sector in rural areas. However, to make this model work, it is necessary to engage local communities in decision making. All target countries feature different tariffs based on different types of activity. For example, household rates are lower than those for enterprises. In addition, schools, hospitals, and other socially important facilities enjoy lower rates. As Table 2 shows, the tariffs in Uzbekistan and Tajikistan are more or less the same. The attempts to raise them, for example, in Tajikistan did not succeed owing to the authorized agencies advocating for a gradual tariff escalation over time and justifying it by the social protection of rural residents. Despite having the highest WASH tariffs among the studied countries, Mongolia is still failing to reimburse all the corresponding costs.

China is continuing to build a more reasonable water rate system based on the principle of 'cost compensation and fair burden sharing.' The concept of the 'two-part water price' (basic rate + metered rate) is being actively promoted [23]. A more detailed description is presented in Box 6.

Box 6. China: 'two-part water price' [23].

China has been promoting a reasonable water tariff system as per the 'cost compensation and fair burden sharing' policy. The tariff scheme based on the 'two-part water price' is vigorously promoted while laddering water pricing.

The two-part water tariff consists of basic water price and measured water price, that is, when user water consumption does not exceed the basic water consumption volume, the charge is fixed, and when the consumption by a user exceeds the basic consumption level, the excess is charged according to the metered consumption. The two-part water pricing scheme can provide a basic guarantee for reimbursing normal operating costs of a water supply project, and can to a certain extent, stabilize the revenue of a water supply operator, as well as reduce a project's operating risks caused by random factors. This model has been widely applied to rural water supply projects in Hubei, Anhui, and Gansu Provinces, mainly characterized by low-scale utilization of water supply and large monthly water consumption fluctuations.

However, this mechanism can work only in areas with installed water measuring equipment. Customers without meters are charged based on an unrealistically high assumed level of consumption, removing the incentive for service providers to install meters, as customers almost always consume far less, owing to low water availability, than they are billed for. In localities with adequate water treatment and piped water supply systems, the lack of customer meters encourages overconsumption and wastage of water.

Collection of service fees represents another big challenge in the countries concerned. Even in the case of low tariffs, their recovery does not reach 100 per cent. Even China, the most progressive country in this regard, demonstrates a service fee collection rate of 81 per cent to 91 per cent at most. As we can see in the cases presented in part 3 of this report, increased tariff collection can be achieved through awareness campaigns and a clear understanding of the purpose of these tariffs.

Subsidies and other government preferences

The small scale of rural drinking water supply projects claims low construction and O&M costs for the systems, which makes it possible to calculate low tariffs. Hence, subsidies are used to stimulate rural WASH projects. Subsidies enables the most

vulnerable communities to be supported and, in addition, they support overall sectoral progress. Only China has examples of direct subsidies. For example, in 2019 China's Central Government subsidies of USD 0.21 billion attracted extra funding to support the RDWS efforts in the less developed central and western regions suffering from an excess of fluoride in water. Subsidies are issued by governments and depend on national policies, the level of rural development, and/or collection of drinking water supply tariffs. Tajikistan does not have direct subsidies; however, the national government partially supports socially significant infrastructure by reducing their WASH fees. China also implements the water quota management and over-quota progressive rate schemes applicable to both residents and non-residents. More information about this approach is presented in Box 7.

Local bond schemes represent another stimulation mechanism deserving attention. National and/or local bonds are the bonds issued by national and/or local governments. Normally, this model is utilized to finance state projects, such as roads or schools, as well as infrastructure construction or reconstruction, including water supply and wastewater disposal. China plans to fully deploy this mechanism during the next five years under its 14th five-year plan (2021-2025). Local level governments are guided to make use of domestic political bank loans, as well as local general and special bonds, enabling the funding of rural drinking water supply projects via local general bond financing.

Another financial mechanism to stimulate investment in WASH services is tax remission practices. On the one hand, this can be a direct tax remission for WASH services operators, which will reduce their costs and make the sector more profitable. On the other hand, there may also be a tax remission for enterprises participating in public–private partnerships (PPPs) implementing WASH projects for local communities. However, such mechanisms are still underdeveloped in the studied countries.

Application of innovative financial mechanisms and private sector involvement

Among all the financial instruments, a **revolver/ revolving fund** is a novel and advanced model. Despite it being an effective financial mechanism applicable in cases of financial deficit on behalf of local administrations it is still not applied in the selected countries. The idea behind it is to accumulate financial resources from charging a higher than usual tariff for a certain period of time. Accumulated benefits are invested in large-scale projects with long payback periods. The revolving fund requires the initial capital to upgrade the system. Then revolving funds are replenished by

Box 7. China: water quota management system

Starting from 2000 China began to implement a water quota system in public services including WASH services. The water quota is the standard quantity of water intake per capita. The main goal of the water quota is enhancing water use efficiency and water saving. The Government of China on different administrative levels defines water use targets, adjusts industrial structures, and controls the total water withdrawal quantity. In addition to regulations, a number of economic instruments accompany the introduction of a water quota management system, such as levies and fines. Relevant laws, standards, regulations, and many other provincial level related regulations have been passed in China for the implementation of the water quota management system and over-quota progressive rate system.

The system applies to both residents and non-residents. The adoption of this economic method is conducive to guiding non-resident users, especially high-water consumption industries, to save water and minimize waste. The introduction of water quotas accelerates the development of new technologies to save water resources, including in the WASH sector.

accumulating segments of payments for drinking water supplies and sanitation. After the revolving fund accumulates enough money, the next WASH service can be renovated. While applying this mechanism, it is crucial that all pertaining operations and procedures remain transparent to all stakeholders to ensure mutual trust. An example of the revolving fund application is presented in Box 8.

A similar approach, called Water Trust Fund (WTF) Mechanisms (TFMs), is planned to be applied in Tajikistan. Currently, TFMs have been piloted in only a few rural districts with most funding coming externally, with very few allocations from the state budget channeled to the trust funds.

While the amount of state support is largely considered insignificant compared to estimated needs, the role of water users and water consumers in covering at least a share of costs associated with small and medium-scale rural systems has been growing. Demonopolizing ownership and decentralizing management with respect to drinking water supply and sanitation systems and utilizing PPPs with non-state actors represent the main means of ensuring the sustainability of WASH systems.

Box 8. International experience: Philippine Water Revolving Fund (PWRF) [24]

Location: Philippines, Southeast Asia ***Established:*** 2008

Background: Starting in the 1990s, WASH sector financing in the Philippines proved its insufficiency to cover investment costs, which has subsequently generated increased attention attracting private financing. To be able to mobilize domestic finance, the country has initiated legal and regulatory reforms. In 2004, Executive Order No. 279 modified the financing policies for local water service providers. However, lending from private banks to water utilities was virtually non-existent at that time, as local commercial banks were not familiar with utilities and saw them as weak and inefficient.

Main approach: Issued loans to water service providers, local government units (LGUs) and water districts (WDs), to finance local water and wastewater projects. The PWRF blends official development assistance (ODA) and domestic public funds with commercial financing to lower borrowing rates, and to market water and sanitation projects to private finance institutions (PFIs).

The PWRF Program is diverse in its approaches to overcoming obstacles preventing the flow of commercial finance into the water sector and involves support under three key areas: innovative financing, operational strengthening, and regulatory reforms.

Initial capital: The US Agency for International Development (USAID) and Japan Bank for International Cooperation (JBIC).

Finance mechanism: The PWRF on-lends concessional funding from JBIC through the Development Bank of the Philippines (DBP), blending it with funds from domestic private commercial banks to be lent out in support of water projects. The loans offer favorable concessional terms, specifically an effective interest rate slightly lower than the prevailing market rate and with longer maturities. This helps address the two key barriers for mobilizing private finance: short tenors and high borrowing costs.

Return mechanism: Typically, utilities require a 15 to 20 year repayment term in order to amortize upfront investment in capital infrastructure and ensure affordable water services to households.

Main results: From their inception through 2014, the PWRF has successfully channeled more than USD 234 million in loans to finance 21 water and sanitation projects, with approximately 60% coming from private banks, benefiting over 6 million people in the form of new and/or improved access to piped water.

However, small decentralized systems can be sustainably managed by local communities through the collection of water tariffs. Several examples of such collective models are presented in chapter 3 and in part 3 case studies of this report.

The selected countries have been attempting to create an enabling business environment to invite private sector investments into the WASH sector. Local communities are also encouraged to play a role by forming committees and making their own contribution to various stages of WASH projects. There are cases of local level private entities and local communities participating in financing and managing rural drinking water supply systems, including rehabilitation, construction, maintenance, and even partially covering future investment costs. Yet, except for China, the mechanisms for mobilizing private investment and their involvement in managing and operating WASH services in the studied countries is still evolving, with only a few models undergoing piloting.

In recent years, China has made much progress in creative financing modes. In many parts of China, the construction of large-scale RDWS, sanitation, and hygiene projects are used as the medium for applying financial credit funds and attracting non-governmental capital. Such funds and capital have become a vital funding source for the construction of WASH services, which shows it is a feasible option.

Attracting private sector investments requires a clear understanding of the potential benefits for those participating in constructing and maintaining WASH services. In this regard, it is necessary to develop a system of capacity-building for financial modeling and cost-benefit analysis for state financial departments and for the private sector.

Foreign aid and investments by major international organizations and financial institutions, such as, the ADB, WB, EU, EBRD, the Swiss Agency for Development and Cooperation (SDC), USAID, and JICA, plays a significant role in providing access to WASH in target countries. The CAREC region still needs key investments to advance its WASH sector. For instance, Uzbekistan needs USD 4.5 billion to boost its drinking water supply rate to 98 per cent in urban and 85 per cent in rural areas, as well as the sewage provision rate to 31 per cent by 2030. Mongolia has been implementing a series of projects supported by international development partners aimed at installing water meters and monitoring systems, upgrading wastewater laboratory equipment, water supply and pumping facilities, as well as constructing and reconstructing its wastewater treatment installations, and connecting all this infrastructure via centralized lines. Tajikistan plans to attract about 70 per cent of the required WASH development budget in the form of investment from international development partners.

Box 9. China: application of PPP in rural water supply projects

From 2014, the State Council of China encouraged non-governmental capital to participate in financing water supply projects. The main goal of this initiative was to establish an effective financing mechanism through the introduction of PPP schemes in the rural settlements of Rucheng County, Hunan Province.

During the period of the '13th five-year plan,' Jiangxi Water Investment Group raised USD 116.24 million for urban–rural drinking water supply projects in 38 counties and it borrowed USD 200 million from the World Bank for urban–rural drinking water supply and drainage projects in eight counties. As a result, the 0.22 million rural residents of Rucheng County gained access to safe drinking water. The application of PPP to the project significantly contributed to building local infrastructure, alleviating the debt pressure on local government, and curbing medium and long-term financial risks.

More detailed information is presented in part 3. **China case study: application of PPP in rural water supply projects**

Highlights:

WASH sector financing: Despite providing access to drinking water and sanitation being a priority for the studied countries, the sector-specific financial support available is insufficient. Thus, target countries have been testing different financial mechanisms to back WASH sector development

Drinking water supply and sanitation tariffs: To cover costs, the governments use drinking water supply and wastewater treatment tariffs. However, with the exception of several pilot projects, fees are too low and/or cannot be collected effectively to fully cover the O&M of drinking water supply systems. This is impacted by community members misunderstanding of the need to pay tariffs, a lack of knowledge on tariff calculation, and a lack of transparency of spending collected funds, as well as the absence of water meters in rural localities across the majority of WASH services

Innovative approaches and financial instruments: Governments are trying to develop and apply different innovative financial mechanisms, such as government subsidies, bonds, and revolver funds. However, only subsidizing has been widely applied in target countries. China plans to introduce bond schemes as of 2021 for rural drinking water supply

PPP: Countries have been paying increasing attention to involving the private sector in maintaining and developing WASH services. Certain real life functioning schemes already exist and can be used as pilots. However, this approach is not developed enough except for China, which is pioneering the approach

Attraction of investment: State strategic development plans for the WASH sector cannot be implemented without additional financial support. Mobilizing international investment is still a priority for the national governments. But despite significant donor funds, progress is too slow. The implementation of international projects needs to be more focused on innovative approaches and financial instruments for future distribution and replication of the results

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Chapter 3.

WASH: community-based water schemes

Community-based approaches are at the heart of implementing WASH projects, helping to reach collective responsibility and create new norms around a specific behaviour. Since local communities are the direct users of rural drinking water supply projects, their involvement in decision-making ensures long-term efficiency. Water consumers can also participate in tariff calculation and distribution of financial benefits, which can then help them comprehend the need to preserve natural resources instead of implementing "top-down" government policies.

As described in chapter 1, water schemes are multiple, including centralized and decentralized systems and inter alia community-based water schemes. And all of them exist in the studied countries. This chapter details the management schemes used in the selected countries.

Public schemes are widespread. Centralized systems in Tajikistan, Uzbekistan, and China are dominate WASH project management. Nonetheless, the majority of centralized systems in Mongolia are Soviet built; many of them are dilapidated and require renovation [10, 25]. Public schemes are mainly implemented through state enterprises such as *vodokanals* (municipal and industrial water supply administrations). Establishing service providers in the form of state enterprise enables state support to operational activities and attracts additional investment for sector development. It is crucial for the state to address social issues to establish conditions to support vulnerable population

groups. However, these schemes allow minimal opportunities for engaging local communities in decision-making.

Another interesting approach is a combination of centralized and decentralized management models. China's **responsibility delegation** approach is a mixed model. In the case of large- and/or mid-scale drinking water supply projects managed by professional companies or professional institutions with an established professional management system, small-scale systems nearby can entrust management responsibility to these professional organizations. This management regime enables the management costs of small-scale projects to be kept to a minimum.

The development of centralized systems presupposes significant expenditure for construction and further maintenance. The identification of simple local-level management schemes is crucial, especially for rural areas.

The state is interested in attracting investment into the WASH sector, and therefore places a priority on cultivating favorable conditions to protect water user rights. However, the local management of small-scale systems is impossible without involving local communities to a varying degree. The establishment of such community-based water schemes is essential for addressing social issues, including those associated with vulnerable populations.

There are several types of community-based water scheme identified in the studied countries; however, all are based on the following main principles:

- Mobilizing groups of people to develop and implement WASH-related activities
- Reaching a collective agreement on WASH activities, including financial mechanisms
- Developing a mechanism to involve local communities in decision-making
- Forging new behavioural norms, including developing local community rules, capacity-building, and awareness raising

When introducing any of these types of local scheme, it is necessary to consider not only the existing climatic conditions, the technical specifications of systems, and availability of water sources. It is also vital to understand any existing community behavioural models. For example, in Tajikistan and Uzbekistan, the *mahalla* (village) committee and/or elders' committee plays an important role in local communities. These can be formal or informal institutions capable of not only taking part in drinking water supply system management, but also of mobilizing local communities to perform joint actions or initiating and introducing new approaches. Proper investigation of the local approaches can avoid ineffective approaches while developing WASH services. Utilizing these traditional institutions enables the design of more sustainable systems.

For China, Tajikistan, and Uzbekistan, village committees represent a distinctive settlement-level governance model. These allow households to get involved in the process of formulating policies, which can help to increase government credibility. The village committee acts as the intermediary between the state and the village residents. On the one hand, it promotes and implements state policies, laws, and regulations, formulating corresponding village regulations against a specific community-level background whilst encouraging rural residents to supervise policy implementation, as well as provide feedback.

Community-led schemes operated by WUAs also function in some rural localities. WUAs are quite common among small-scale operating schemes. The main goal of establishing WUAs is to ensure

Box 10. Uzbekistan: village committee [27]

An approach for the local drinking water supply management framework was developed under the SDC-sponsored 'Rural Water Supply and Sanitation in the Ferghana Valley' Project (2013-2018). The main goal of this approach was to help municipalities to build their own drinking water supply. The old or broken water installation underwent rehabilitation, and villages without access to drinking water were connected to drinking water supply networks.

The target villagers learned to build and maintain their own drinking water supply networks over the long-term. Currently, they are ensuring that pumps are in good working order, and monitoring disinfection system, pipelines, reservoirs, and wells. They are also responsible for protecting their drinking water supply networks from freezing.

Institutional framework: The main institution responsible for the O&M of drinking water supply systems is the village committee. The committee comprises the main local stakeholders and enables their participation in decision-making.

Financial mechanism: Residents pay a monthly fee to cover running costs like pump electricity, maintenance, and maintenance company fees.

Information campaign: A lot of attention in the project was given to raising awareness among the villagers on hygiene. Clear and tailored explanations of good hygiene practices, such as handwashing and thorough cleaning of water containers, help prevent widespread diseases, which mainly affected children.

proper management of irrigation systems to supply water to farmland. However, WUAs can also be used for managing drinking water supply systems. For instance, in Tajikistan *jamoats* (districts) and *mahallas* were active participants in the design phase and remain so during the operating phase, contributing to tariff collection, communication of complaints, and mobilization of consumers in various decision-making processes. The model of 'operating under the WUA' fosters effective ownership and accountability among community members.

Housing and communal organization schemes also underwent piloting in several districts. Unlike the previous two models, this one implies the establishment of a service organization under local administration (subdistrict tier authority) and represents a scaled-down model of the *vodokanal.* These organizations are owned by communities with decisions made by district administrations, such as WUAs, village committees or *jamoats,* and hold operation and management powers.

The state is interested in attracting investment into the WASH sector and prioritizes forging favorable conditions to protect the rights of water users. Its subsequent commitments to addressing social issues are particularly beneficial to poor populations.

Recently, the countries in question have been paying increasing attention to engaging with the private sector. Private companies have a legal right to cooperate with private lenders and banks, which enhances the financial sustainability of schemes, provided the necessary funding is available.

However, current legal frameworks in Tajikistan, Uzbekistan, and Mongolia lack support mechanisms to transfer ownership of existing drinking water systems to private entities.

Box 11. Kazakhstan: small-scale drinking water supply systems in rural area [28]

An interesting community-based scheme was approbated and implemented in 12 villages in Kazakhstan. The corresponding drinking water supply system is completely managed on the level of local communities and is autonomous, and the costs for its O&M as well as further development are covered by a set of tariffs. This piloting was supported by several international development partners (USEPA, GIZ, USAID, Norwegian Ministry of Climate and Environment), but all of them used the same approach with the involvement of local community in decision-making during preconstruction and construction phases. Readiness of local residents to participate first in the process of construction/reconstruction and then in maintenance was a mandatory prerequisite for the successful application of the scheme, that is, local communities were obliged to contribute financially to the construction or reconstruction of the system. Financial contributions could be collected both in monetary and in-kind form. At the launching stage, the so-called 'social mobilization of local communities' was held as general gatherings or meetings of villagers, explanatory consultations with aksakals (elders) to get them on board, and an assessment of the financial standing of target communities and their ability to cover future expenses

Institutional framework for O&M of WASH system: Establishment of an institutional framework is crucial for further sustainable use of the system. Water user cooperatives (WUCs) were established in each pilot village, and water distribution agreements were signed with all the villagers. In addition, training sessions were held for the newly established WUCs on tariff calculation, financial management, sanitation, and the consequences of using poor-quality water

Financial mechanism for sustainable O&M: In order to ensure the sustainability of the scheme, the financial mechanism for calculating and approving drinking water supply tariff was designed. The rate is calculated by WUCs and must be sufficient to cover all O&M expenses. The tariff consists of two parts

- Fixed tariff proportion (salaries of WUC employees, technical water supply specialist, head of cooperative, and accountant)
- Variable tariff proportion (power consumption, chemical cleansers), this part is calculated on a monthly or quarterly basis

Contributions to the reserve fund for further developing and upgrading the system, as well as introducing new technologies, this tariff proportion can be included only under the agreement of all system users and is not mandatory. The WUCs accumulate the reserve fund means, which can be spent only upon approval by all users

Creation of new behavioral norms: It is also worth mentioning other positive spillovers of the scheme. These include forging new behavior patterns and mechanisms to support vulnerable groups inside communities, forming the 'culture of paying' for water delivery and wastewater disposal, as well as the culture of careful treatment of public infrastructure. In certain pilot villages, the financial situation of specific households was considered while calculating the tariffs. Thus, tariffs for vulnerable families were reduced at the expense of several richer families willing to pay the difference. However, the model does feature a number of limiting prerequisites

- Only relatively small compactly located villages can be considered for this scheme to avoid extra costs for additional drinking water supply and wastewater disposal infrastructure, and likewise its further maintenance
- Proactiveness of local communities, that is, a willingness to invest in developing and maintaining the system, without which the system may not work
- Availability of initial capital to launch a basic system
- Financial readiness of local communities, benefiting residents should contribute, either in monetary or in-kind form, 10% to 20% of initial construction/reconstruction costs

There is an opportunity to involve professional private companies as contractors in WASH services management in China. In this case, contractors assume the responsibility of managing water supply systems, but to make the scheme attractive for them, the tariffs should be calculated in such a way to enable the contractors to generate a profit.

Despite these different community-based schemes, there are still obstacles curbing their broader application, including the following:

- Lack of technical capacity on O&M. At district level, access to professional engineers is highly limited and almost absent in rural settlements in all the target countries
- Lack of institutional capacity and regulatory mechanisms to foster private sector involvement
- Lack of understanding of financial concepts and instruments (full cost recovery tariffs, access to finance, water fee collection)
- Fragmented approaches applied under different projects and an absence of clear state policies in terms of community involvement, prevent the wide dissemination of best practices within countries
- Lack of information about mechanisms, practices and the benefits of introducing such models

Highlights:

Bottom-up approach: Community involvement in financial mechanisms are important for the effective development of water supply and wastewater treatment systems, especially in rural localities

Introduction of different schemes: Several different management schemes are currently applied in target countries, including community-based schemes. Some of them are very successfully and sustainably implemented in different countries, some are only just pilot projects. Some schemes have financial mechanisms that can fully cover the O&M of the WASH systems. But there is no unified model that can be applied in all countries and under different conditions equally effectively. Specific schemes should be tailored to specific countries and to the specifics of each territories needs

Capacity-building for WASH services management: Capacity-building for local communities is another key condition for introducing and further developing local-level WASH services. Members of local communities need to understand not only the hygiene requirements, but also the management and financial aspects of WASH services, including O&M costs, tariff calculation, fee collection and distribution schemes

Dissemination of best practices: Different local-level approaches and practices are undergoing piloting by international development projects. Analyzing and registering the most successful practices can serve as a basis for their introduction and dissemination both within countries and internationally

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Chapter 4.

WASH: knowledge, technology, and experience sharing

Knowledge is the main determinant of technological development and application of high-tech practices in WASH schemes. There is a need to develop effective knowledge, technology, and experience exchange mechanisms in the WASH sectors of target countries. In addition, knowledge and knowledge-sharing are also necessary for the following:

- Successful implementation of WASH policies and plans
- Ensuring provision of WASH services to communities and rural population
- Applying efficient WASH technologies
- Improving WASH-related responsibilities and behaviour of people and communities
- Understanding social roles of WASH for families and children, in particular in rural areas
- Expanding international cooperation in the WASH sphere

The study shows that insufficient funds and insufficient human resources often represent major constraints in water supply and sanitation surveillance and oversight. The exchange of knowledge and gained experiences are among the main drivers for promoting WASH approaches. This exchange can evolve along the following avenues:

- Introduction of new management approaches
- Application of new technological solutions
- Involvement of the wider community in sanitary and hygiene efforts
- Capacity-building of WASH specialists and the wider public

The selected countries recognize the need for permanent capacity-building and knowledge sharing, stipulated in their national development strategies, as well as pursuing the development of continual capacity-building and retraining frameworks. China has been paying a lot of attention to WASH-related research and has created a special scientific base for the elaboration and deployment of innovations. Beginning in 2000, China's Institute of Water Resources and Hydropower Research (IWHR) has been supporting the domestic water sector. It is currently involved in rural water supply treatment, drinking water disinfection and water quality monitoring, water supply digitalization, automation and standardization, as well as the operation of consistency mechanisms, while likewise extending technical support to certain RDWS related initiatives on behalf of the national Ministry of Water Resources (MWR).

The study was able to flag the absence of effective institutionalized frameworks for Knowledge, technology, and experience sharing in the WASH sectors in Mongolia, Tajikistan, and Uzbekistan. In the two latter countries, WASH services are mainly centralized, and capacity-building activities mostly target the employees responsible for the O&M of large-scale centralized systems. Specifically, Uzbekistan has the National Training Center under the MHCS whose training is mostly aimed at capacity-building in the areas of HR, accounting, chlorination, laboratory drinking water quality, wastewater treatment and pump operation. In addition, Uzbekistan has established the SUI *Communalo'quv* Education Methodology Center primarily dealing with upgrading the knowledge and skills of technicians, plumbers, operators, and mid-tier professionals engaged in water supply and sanitation [Box 12, 22]. This center was opened under the MHCS of the Republic of Uzbekistan.

A deficit of qualified staff is one of Mongolia's main challenges. The current staffing level in rural water supply and urban and rural sanitation is approximately 50 per cent [6]. However, Mongolia demonstrates an interesting example of capacity-building and information sharing. its *Improving WASH in Schools 2020 Project* became a flagship initiative based on

Box 12. Uzbekistan: SUI Communalo'quv Education Methodology Center [22]

The HR department of the SUI Communalo'quv Education Methodology Center is responsible for coordinating all thematic training activities. Every five years, utility personnel are obliged to pass requalification by external committees under the auspices of regulators. The requalification interval for laboratory staff is one year. Health and safety officers are nominated in each district and undergo regular training. The center's annual business plan contains budgeted training lines. Center staff undergo regular training to comply with national regulations. However, capacity development still needs to be improved. For example, neither the center nor any other organization is conducting systemic training needs assessments or skill set reviews

which a general educational WASH program will be developed for every school in the country.

Tajikistan has several policy dialogues and coordination platforms created and maintained to promote WASH sector reforms and information and experience exchange. The most noteworthy of these are the Inter-Ministerial Working Group (IMWG) on Drinking Water Supply and Sanitation and the Tajikistan Water Supply and Sanitation Project (TajWSS) Network of Stakeholders. IMWG and the TajWSS Network are quite effective in terms of information exchange, updating implemented projects by development partners, sharing experiences, best practices and lessons learned on applied approaches and models [29]. These platforms render good networking opportunities for all the WASH stakeholders to ensure successes are replicated and challenges are addressed. Tajikistan's line ministries and agencies have also benefited from the platforms by way of coordinating development project interventions and avoiding duplication of actions and resources on a national level and in target areas.

China is quite serious about supporting its large-scale RDWS Project, fundamentally aimed at WASH sector development. For instance, the IWHR was established to foster the promotion of water-related advanced features, to develop sector-specific regulatory documents, and to take part in breakthrough projects. The institute also supports the implementation of the 11th *Research and Demonstration on Integration Technology for Water Supply Safety in Rural Areas* and 12th *Major Scientific and Technological Project for Ensuring Water Supply Safety in Villages and Towns* five-year plans, which were completed and yielded impressive results [30].

As the analysis shows, the majority of innovative practices are initiated and implemented by international development partners and financial institutions. This becomes possible mostly thanks to targeted technical assistance projects for line ministries, agencies, and service providers. However, there are certain platforms which can serve as a basis for further promotion of new technologies, new management approaches and knowledge sharing.

The exchange of the most efficient available technologies and best practices is an important part of the dissemination of experience. The advantage of a study base not only enables the identification and introduction of innovative approaches, but also the consideration of territorial needs. So far, among the studied countries the necessary scientific framework is well-developed and functioning only in China.

Since each country has its own needs, the application of technologies must be tailored to a specific context. For instance, the winters in Mongolia are harsh and rural WASH facilities and systems can freeze. The country needs environmentally friendly and efficient but also climate-resilient WASH technologies. In addition, Mongolia's rural schools face the challenges of insufficient water supplies and low-quality water.

Consequently, the development of a knowledge, technology and experience-sharing framework at a national level, and specifically for rural water supply should include specific measures to promote health education, popularize drinking water safety knowledge and ensure water conservation advocacy.

Proper financial backing for research and technology promotion is an obvious necessary enabler for the effective introduction and promotion of WASH services, and technology promotion and demonstration should cut across country, province and municipal levels.

Highlights:

Human resources: Availability of human resources is a key condition for mainstreaming innovative management approaches in the WASH sector. The target countries have been acknowledging this factor in their national development strategies and striving to develop the necessary continual capacity-building and retraining systems. However, this process is still evolving for all the countries

Awareness raising: The dissemination of information related to the introduction of innovations, financial instruments, and the importance of sanitation and hygiene is crucial to efficient reforms. As of today, the studied countries have not yet embarked on wide information campaigns, which could help

expedite regular information sharing with respect to introducing reforms and promoting WASH approaches

Scientific base for introducing innovations: The development of a scientific base enables not only the identification and leveraging of innovative approaches, but also administers to the needs of different territories. So far, the necessary science and research infrastructure in the shape of the IWHR exists and operates only in China. IWHR renders scientific support to domestic projects as well as being engaged in developing new target technologies and practices

Establishing a platform for technology exchange: Unified regional and national platforms for exchanging WASH-related technologies have yet to developed. To date there are no unified resources enabling information exchange on the most effective available technologies.

Regional recommendations and suggestions for developing WASH services

Each country is making huge efforts to address their water issues and to combat water scarcity, as well as seeking appropriate solutions to ensure the sustainability of WASH.

At the same time, the domestic prospects of water availability and the scale of upcoming tasks make it necessary to deepen reforms in the WASH sector and enhance water infrastructure through the introduction of modern management methods, financial instruments, and technologies.

Delivering better WASH services and creating the necessary conditions and environment for WASH infrastructure are essential for ensuring quality of life by providing access to WASH in rural and urban areas.

The recommendations presented in this report aim to push forward the development of the rural WASH sector in the target countries and give a regional perspective to the problems that they face. The recommendations are grouped into blocks providing a blueprint for further action:

1. Legal and institutional framework for WASH sector development

Improvement of legislation: Coupled with a lack of budgetary resources, new laws are short of implementation. The development of regulatory documents and rules, forging easily accessible mechanisms, including subsidies and tax incentives, the necessary preconditions for more effective management of WASH services, are required.

Institutional support: Institutional reforms in the target countries are aimed at identifying optimal management models. Establishing institutional frameworks that can guarantee a suitable level of operation and the advancement of WASH management systems at different levels serves as a foundation for the operation of the system as a whole. Identifying such an optimal scheme, with due consideration for country-specific needs, is the main task for the governments concerned. The coordination of efforts by development partners and the systemic and planned introduction of unified approaches will help to establish effective management systems and increase access to WASH services.

Intersectoral and interdepartmental coordination: Recognition of the water-energy-food nexus is a significant condition for sustainable development. Using water for irrigation and drinking supplies has certain advantages, but dual and multi-purpose schemes are associated with a number of risks. Since water resources are crucial for the development of different economic sectors, the studied countries need to pay more attention to constant coordination among sectors and the identification of sector-specific benefits. Establishing intersectoral and interdepartmental platforms, be it nationally or locally, should become the basis for more effective and transparent management. Supporting and strengthening WASH networking among key government agencies, national and international NGOs, the private sector, international development partners, and other actors is necessary for enhancing coordination in the WASH sector and executing national policies and plans.

A Unified approach to WASH management in rural and urban areas: Urban–rural water supply management systems should be optimized, and equal rights should be ensured for urban and rural populations. Urban–rural water supply projects should be planned, constructed, managed, and put into service from national down to provincial with the same level of attention. Developing long-term strategic plans and schemes for improving water supply in cities and towns and rural settlements, and zoning territories according to promising water supply sources should provide the background for designing suitable water supply and sanitation solutions for communities.

2. Financial aspects of WASH sector development

WASH sector financing: Sufficient financing of the WASH sector is vital for effective policies and actions. Enhancing transparency and accountability of WASH financial management and detecting optimal and/or possible financing sources for ensuring WASH services are a necessity. The development of specific WASH financial plans for identifying potential sources is key to the successful deployment of state WASH services.

Tariffs for water supply and sanitation: As this study shows, a financing deficit occurs owing either to low tariffs or poor fee collection. Often, communities or water users are not able and/or willing to pay full cost recovery rates. This attitude towards the payment of tariffs arises because of the misunderstanding around the necessity of payment, and the widespread absence of water meters in rural localities. State agencies and development partners should assess ability and willingness to pay in rural areas, as well as develop plans for step-by-step tariff augmentation and the introduction of measures to enhance tariff collection. While executing projects aimed at improving service fee collection and revising current tariff rates it is necessary to support vulnerable communities by introducing nationwide pro-poor, full cost recovery mechanisms. This will also encourage water users to be more economical and seek additional ways for applying water-conservation technologies. For example, only in China, subsidies are awarded by the Central Government to support rural water supply projects in poverty-stricken communities.

Innovative approaches and financial instruments: Since covering all the required costs from the state budget is impossible, there is a strong need to design clear cost recovery mechanisms and tariff calculation schemes as well as attract private investment into WASH services. Government subsidies, loans, bonds, and revolver funds are among the potential capital procurement instruments. Business planning processes require general revision by introducing mid-term planning. State financial departments should undergo capacity-building on financial modeling and cost-benefit analysis.

Subsidies, including cross-subsidies, pro-poor tariff policies, and tax remission practices represent another toolkit for expanding WASH sector financing opportunities. Their proper application also requires updating regulatory documents and rules and creating easily accessible subsidy mechanisms and tax incentives.
Establishing designated funds, such as WTF in Tajikistan, or piloting revolver funds can also be instrumental in accumulating finance.

3. Capacity-building for WASH services management

Capacity-building for local communities In addition to operating staff, each user has to possess WASH knowledge and understand his/her personal responsibility while using water supply systems, sanitary, and hygiene services.

Motivation and engagement of highly qualified staff in designing and managing WASH services depends on remuneration and career opportunities.
The development of regular capacity-building programmes and well-founded staffing strategies for the purpose of retaining professionals should become a priority for the governments in question.

4. Knowledge and information sharing

Water supply and sanitation systems require accelerated development and upgrading based on strategic targets. Organizations providing WASH services should progress rapidly, including expanding and modernizing their technological and laboratory base, to meet growing demand. Human resources development is necessary to foster research and innovations in the field of water supply, sanitation, hygiene, and wastewater treatment.
From there, the formation of certain public attitudes and behaviours, the promotion of innovations and cutting-edge technologies and information dissemination are the prerequisites of successful WASH project implementation. Water awareness programmes across all aspects for the wider public must also be undertaken.

Access to information for the wider community on urban and rural water supply conditions, sanitation and treated wastewater, water quality, tariff calculation, budgeting and expenditure for the

O&M of WASH services is essential. Mainstreaming and awareness raising cannot be underestimated, especially in rural areas. Rural development projects should maintain their advocacy efforts to enhance good governance, consumer rights protection mechanisms, and tariff collection, as well as inform on tariff calculation considerations. Establishing a virtual CAREC-based WASH center for knowledge exchange and capacity-building to support the development of WASH services in CAREC member countries can be the best solution for the collection and dissemination of best practices and know-how. Setting up a joint WASH database for the CAREC region under this virtual centre will enable effective solutions to be found.

Research on WASH-related issues, piloting the most effective approaches to systems management and information dissemination is essential for the successful operation of any research entity. This study shows that currently China has the most developed systems for conducting WASH-related research and the dissemination of information. China can be further engaged in experience dissemination, international cooperation, and communication with other countries in terms of community-level water supply technologies at low management complexity and cost.

International cooperation, including cooperation with different development partners is important for WASH sector development. Joint project implementation by governments and development actors specifically focusing on collecting accurate information on successes and lessons learned with respect to business models applied under community-based water schemes will facilitate enhancing the overarching policy environment for scaling up such efforts. Mongolia's WASH school partnership network, for instance, enables building the education sector's capacity to implement national WASH norms and requirements. Designing pilot projects to test new management approaches and financing instruments, as well as raising public awareness, should become the foundation for subsequent WASH-related reforms.

5. Innovative approaches in WASH management

Target countries should prioritize reviewing and identifying the best WASH practices suitable for specific local conditions along with developing traditional schemes. More emphasis should be placed on community/village water supplies within the framework of national and/or provincial technology demonstration initiatives.
The introduced systems should be based on easily replicable models and principles, as well as being low-cost to enable their wider and quicker upscaling. It is necessary to consider different innovative approaches to introducing, managing and using WASH services.

Local-level introduction of innovations and technologies: The need to apply tailored, efficient WASH technological solutions suitable for the country's context. For example, Mongolia's harsh climate imposes certain requirements on WASH service designs. The introduction of innovations can be based on the adaptation and piloting of international experiences as well as high-tech solutions developed within the target countries. Therefore, the primary focus within the target countries should be supporting the development and execution of adaptation programmes and/or the development of new scientific approaches and innovative technologies suitable for rural development.

Public-Private Partnerships: PPPs enable the building of more sustainable mechanisms for WASH services management and financing. While the model is underrepresented in rural areas, development partners and authorities, both national and local, should place more emphasis on developing regulatory mechanisms and incentives facilitating their application. The sharing of experiences and insights in utilizing various PPP regimes, as well as their adaptation to individual in-country contexts can lead to the discovery of the most effective WASH management options for each specific country.

The engagement of the private sector in the O&M of WASH services is so far rudimentary in the selected countries. Yet, it can become a mechanism for enhancing the sustainability of WASH services and boosting service quality.

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Part 2. Country Profiles

National Report for China

By Yannan Jia, National Consultant

Introduction

Under the national poverty alleviation campaign, the Chinese government has attached great importance to ensuring that the public have a safe drinking water. In 2017, 87.8 per cent of citizens had access to improved drinking water. This sees China achieving the water SDG targets six years ahead of schedule. Furthermore, environmental sanitation goals are on schedule [1].

The difference between rural and urban localities with access to drinking water and sanitation services is not significant. As Table 3 demonstrates, according to China's Rural Drinking Water Safety Information Management System data, centralized water supply systems cover 92 per cent of urban and 87 per cent of rural population. Access to sanitation is lower than access to a drinking water. The proportion of the rural population with access to improved sanitation facilities with sewer connections is only 38.5 per cent [1].

Table 3. Access to drinking WASH in China [2]

Main indicators	Urban	Rural	Total
% of population with access to safely managed drinking water	92.3%	no data	no data
% of population connected to piped systems	92.2%	53.8%	76.1%
% of population using non-piped systems	5.7%	34.1%	17.6%
% of population using contamination-free drinking water sources	92.3%	no data	no data
% of urban areas properly connected to centralized water supply systems	92.3%	87%	
% of population connected to municipal wastewater systems	83.7%	56.1%	
% of population using improved sanitation facilities by type: - latrines and other - septic tanks - sewer connections	 14.5% 3.3% 79.4%	 38% 5.5% 38.5%	 24.4% 4.2% 62.2%
% of total population using hygiene facilities: - with basic conditions - with limited conditions (without water or soap) - no facilities	no data	no data	no data

Despite the government's significant efforts aimed at the WASH sector development, there are still several unresolved issues. Firstly, as of 2017, one third of all schools in China did not have proper water supply or sanitation facilities. Secondly, overall, the WASH maintenance system is not yet mature, with pricing and collection mechanisms for water and sewage treatment not yet fully established.

Since 2015, the RDWS Project has been linked with the anti-poverty campaign and has attracted significant attention.

Chapter 1.

WASH: policies and institutions

Historical overview

The development of WASH services in rural areas of China started in the 1950s with separate systems operating in different regions. In the 1970's a special state fund was established for the development of WASH services and in 2000 the objective of providing rural communities with access to WASH services was included in the national planning system and a large-scale, national program on WASH development was launched.

Drafted in 2004, the RDWS concept includes four indicators: water quantity, water quality, degree of water use, and water supply guarantee rate. This concept is implemented in three ways: extending urban sewage systems, constructing new centralized water supply projects and constructing new decentralized water supply systems. To accomplish the concept goals, since 2006 the Chinese government has implemented three five-year plans to carry out specific RDWS projects covering the Xinjiang Production and Construction Corps, as well as towns, villages, schools, state-owned farms, and forestry farms in 30 provincial-level constituencies.

Between 2000 and 2015, the share of China's population using at least basic drinking water services rose from 78 per cent to 96 per cent and urban versus rural divergences were basically eliminated [3]. From 2006 to 2015, the government focused on increasing the centralized water supply rate, piped water coverage rate, water qualification rate, and water supply guarantee rate. By late 2015, most of the goals set under the RDWS Project were met.

During the execution of the 13th five-year plan (2016-2020), it was planned that at least 85 per cent of rural communities would have access to a centralized water supply, and at least 80 per cent access to tap water. The new five-year plan (2021-2025) is now ready for implementation.

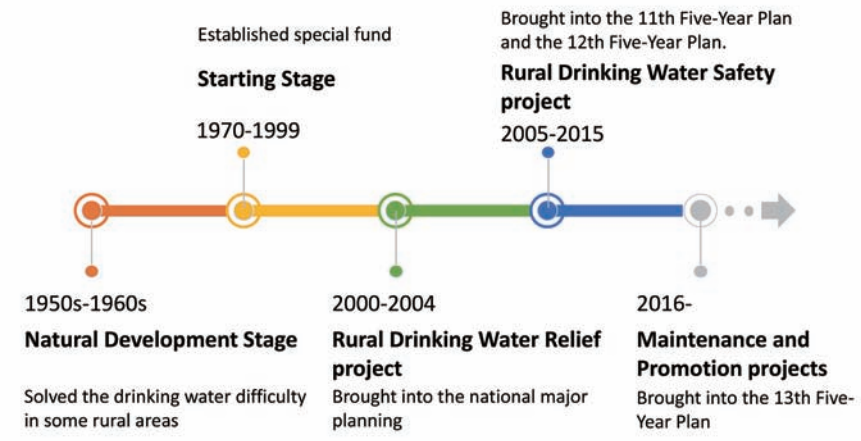

Figure 1. Development history of China's rural water supply

Current laws and policies

The core national-level documents regulating the development for the operation of WASH services include the *Water Law of the PRC, the Water Pollution Prevention and Control Law of the PRC,* urban water supply regulations, *Measures for the Administration of Urban Water Supply Prices, Measures for the Administration of Water Supply Prices of Water Conservancy Projects, and Measures for the Sanitary Supervision and Administration of Drinking Water.* 21 provinces and autonomous regions have provincial-level regulations on urban and rural water supplies, as well as rural water supply administrative regulations and administrative measures.

The government has adopted a series of rules and regulations mainly on RDWS accountability specification and assessment and has proposed methodologies for achieving the project's main tasks and goals. In addition, the Chinese Government has been making an extra effort to analyze the ongoing legal framework of rural drinking water projects to identify necessary amendments and additions.

The *Administrative Measures for the Construction of RDWS Projects* issued by the National Development and Reform Commission (NDRC), MWR and other concerned line ministries specifies the regulatory mechanisms for responsibility, distribution, project implementation, funding management, as well as post-construction management of target initiatives [4]. In terms of sanitation, the toilet revolution has galvanized government action since 2018. Access to appropriate WASH services was improved thanks to the *Healthy Village Standards and Healthy Township Standards* policies [1].

To better regulate rural water supplies and consumption, and promote the sustainable development of rural water supply, the MWR also developed *Regulations on Rural Water Supply, Notice on the Construction of the Administration Accountability System for RDWS*, and *Measures for the Assessment of RDWS Enhancement*. These regulations propose to include rural water supplies into the national economic and social development plan, as well as placing responsibility for ensuring RDWS execution in specific regions with local government heads.

In addition, China has formed a basic framework of normative standards applicable to rural water supply, including four direct standards and over 20 applicable standards.

Aside from the large-scale RDWS Project, multiple efforts are ongoing to assist technical projects, such as the *National Science and Technology Support Program, National Key Research and Development Program, Major Special Project for Water Pollution Control and Treatment, and Funding Project for Transformation of Agricultural Science and Technology Achievements.*

Organizational chart of WASH services in China

The main national departments and agencies involved in the implementation of five-year plans include the following:

- National Development and Reform Commission (NDRC),
- Ministry of Water Resources (MWR),
- National Health Commission (NHC),
- Ministry of Ecology and Environment (MEE),
- Ministry of Housing and Urban–Rural Development (MHURD).

Whereas the construction and management of rural water supply projects fall under the authority of the national Water Conservancy Department, sanitation facilities are administered by the Ministry of Agriculture and Rural Affairs (MARA), MEE, and MHURD [5-7].

Table 4. Key WASH stakeholders in China

Organization	Key mandate
National Development and Reform Commission (NDRC)	- Formulating and organizing the implementation of national economic and social development strategies, mid and long-term plans and annual plan - Overall coordination of national special planning, regional planning, spatial planning, and national development planning - Drafting laws and regulations related to national economic and social development and drafting departmental regulations
Ministry of Housing and Urban-Rural Development (MHURD)	- Regulating and guiding the construction of villages and towns nationwide - Formulating and guiding the execution of village and small-town construction policies - Guiding the preparation of village and town planning - Guiding the improvement of the living environment of small towns and villages
Ministry of Water Resources (MWR)	- Ensuring the rational development and utilization of water resources, guiding water resources protection - Coordinating and guaranteeing water for daily life, production, and operation, and maintaining the environment - Guiding water conservation and conservancy - Guiding the construction and management of RDWS projects and rural water resources. - Supervising the implementation of RDWS, sanitation, and hygiene efforts across the nation - Guiding efforts related to water-efficient irrigation
Ministry of Agriculture and Rural Affairs (MARA)	- Supervising rural sanitation efforts across the nation - Administering the drafting of relevant agricultural and rural laws and regulations, and formulating departmental regulations - Coordinating and promoting the development of rural social undertakings, rural public services, rural infrastructure, and rural governance - Leading efforts to improve the rural living environment
Ministry of Ecology and Environment (MEE)	- Establishing and improving the fundamental environmental protection framework - Coordinating, supervising and regulating major ecological and environmental issues - Supervising and administering efforts to ensure the attainment of national emissions reduction targets

Organization	Key mandate
Ministry of Science and Technology	- Formulating and facilitating the implementation of strategies and policies for innovation-driven development, and plans and policies for science and technology development, and the attraction of foreign talent - Coordinating the development of national innovation system and reform of the national science and technology management system - Liaising with relevant government departments to improve incentive mechanisms for technological innovation
Ministry of Finance	- Formulating and implementing strategies, plans, policies and reform programmes on public finance and taxation - Drafting laws and regulations on fiscal, financial and accounting management - Managing the Central Government's fiscal revenue and expenditure - Preparing and executing the Central Government's annual budget and its fiscal accounts
National Health Commission (NHC)	- Drafting laws and regulations for national health policies, as well as laws and regulations, policies and plans for the development of public health services - Formulating and implementing departmental rules and standards - Coordinating and planning resource allocation for health services - Offering guidance for formulating and implementing regional health planning - Drawing up and implementing policies and measures to promote equality, inclusiveness and convenience of basic public health services, and extension of public resources to the grassroots level
State Council Leading Group Office of Poverty Alleviation and Development	- Drafting laws and regulations, policies and plans for poverty alleviation and development - Devising appropriation plans for central poverty alleviation funds - Organizing target research and assessment - Coordinating and addressing the key challenges under poverty alleviation campaigns - Leading nationwide poverty alleviation campaigns
China Association for Engineering Construction Standardization	- Formulating, implementing, and managing standards for engineering construction
China Institute of Water Resources and Hydropower Research (IWHR)	- Working on rural water supply treatment, drinking water disinfection and water quality monitoring, water supply informatization, automation and standardization, and operating consistency mechanism under water supply projects, while providing technical support for some RDWS-related work by MWR - Setting up projects for the demonstration and promotion of RDWS, sanitation and hygiene technologies
RDWS Centre (under MWR)	- Executing research and providing a wide range of technical support, including, macro-policy research on RDWS, sanitation and hygiene, technology promotion training, technical consulting, technology development, and research on standards applicable to RDWS, sanitation and hygiene evaluation and water quality monitoring.

Organization	Key mandate
Municipal and county governments	- Applying and executing RDWS-related practices/efforts.
Provincial governments	- Overall supervision of RDWS projects with the industry responsible for construction supervision, and water suppliers (water plants) responsible for operation and management.
Industry	- Executing construction under RDWS projects.
Water suppliers (water plants)	- Operating and managing WASH services.

The roles and responsibilities of each department and agency are clearly defined (Table 4). The MWR and the Ministry of Land Resources jointly drafted the regulations on the land required for the construction of RDWS projects. The NDRC, Ministry of Finance, and State Taxation Administration together implement a series of favorable policies on power usage for rural water supply and taxes.

Nevertheless, China still lacks a designated agency focused on rural water supply, which leads to low quality construction projects.

China also pays a lot of attention to water related scientific research and a special scientific agency was launched in 2000, the IWHR, which is tasked with developing and deploying innovations.

Chapter 2.

WASH: financing and economic aspects

China has been undertaking efforts to form a rural infrastructure investment system based on clearly defined and consistent powers and responsibilities. The Central Government supports overall provincial planning and county-level accountability. It also, alongside, social capital is responsible for investment in rural water supply, sewage, and other infrastructure development.

Since the 1980s, China has been utilizing international loans and grants to develop rural drinking water projects on behalf of UNICEF, the World Bank, the UK's Department for International Development, and the International Bank for Reconstruction and Development. International loans and grants are allocated to areas related to rural water supplies, such as public health and poverty alleviation.

Since 2005, when China rolled out the construction of large-scale RDWS, sanitation, and hygiene projects, centralized and local financing have been the largest investment sources, followed by self-financing, with social funds accounting for a rather limited share. From 2005 to 2015, gross investment to RDWS, sanitation and hygiene projects reached USD40.93 billion, USD26.51 billion (64.8 per cent) from the Central Government, USD13.39 billion (32.7 per cent) from local investments and USD1.03 billion (2.5 per cent) from self-financed funds and social funds [7].

In 2016, China launched its 13th five-year plan for national economic and social development. This included the introduction of new creative financing modes. In many parts of the country, the construction of RDWS, sanitation, and hygiene projects is backed by financial credit funds, attracting non-governmental capital and private investments. During 2016 and 2019, gross investment had reached USD25.57 billion, including USD3.85 billion allocated by the national government and USD21.72 billion from local investments and self-financed funds [8].

Water tariffs

To ensure a sustainable project operation after completing construction, China has been stepping up the process of implementing a reasonable water tariff scheme as per the 'cost compensation and fair burden sharing' policy. The idea of the 'two-part water price' is vigorously promoted while laddered water pricing is used for large-scale water supply efforts. The two-part water price is a pricing method consisting of two components: basic and measured water price. When a water user's water consumption does not exceed the basic water consumption level, the charge is a fixed value; but when the water consumption of the same user exceeds the basic volume, the excess part is charged according to metered measurements. The two-part water price can provide the basic guarantee for the normal operating costs of a water supply project and stabilize the financial income of water supply units, whilst reducing project operating risks caused by random factors. This pricing scheme is widely applied under rural water supply projects in Hubei, Anhui, and Gansu Provinces, mainly in projects with low water supply utilization and large monthly water consumption fluctuations. The main tariffs of the WASH sector are presented in Table 5.

The water quota management model and over-quota progressive rate scheme are also part of the overarching water-pricing framework [8]. Relevant

Table 5. Water tariffs for WASH services in China [9-11]

	Fixed tariffs (per capita/month)	Variable tariffs for households		Commercial tariffs		
		Water supply	Waste-water services	Water supply	Wastewater services	Social institutions, (schools, hospitals) WS+S
Rural	Used by 10%-20% of water supply projects	Quantitative water pricing usually used, ~USD0.29/m^3, < USD0.80/m^3	Insufficient data	Refer to urban water tariffs	Refer to urban water tariffs	Same as household water
Urban	Seldom used	Over-quota progressive rate system (multistep water pricing) used, ⩾ USD0.39/m^3, USD1.47/m^3	⩾ 0.14 USD/m^3	< USD1/m^3	⩾ USD0.21/m^3, < USD0.46/m^3	Same as household water

laws, standards, regulations, and multiple provincial-level related regulations have been adopted in China to implement the water quota management and over-quota progressive rate schemes applicable to both residents and non-residents. The adoption of this economic method is conducive to guiding non-resident users, especially high-water consumption industries, to save water and curb the waste of water.

Mechanisms of water supply fee collection reflect the development level of the county and the availability of water-measuring equipment. The collection of water supply tariffs varies in different rural localities and is based on meter readings or a flat fee.

The water supply fee collection rate under rural water supply projects varies based on their scale. For projects of over 1,000 consumers (rural residents), the collection rate is 91 per cent, and with fewer than 1,000 consumers it is 81 per cent [12].

Within the framework of the 14th five-year plan implementation, the government plans to significantly decrease investment from the state budget and increase investment through the collection of water supply fees. To achieve this, MWR General Office has developed and published the Notice on Implementing Rules for Accountability System of Water Supply Tariffs Collection requiring that the water supply tariff collection rate should reach 95 per cent across the nation by December 2021 [8].

Subsidies and other government preferences

Since most of the rural water supply projects are small-scale, they result in low water supply tariffs. Subsidies represent a stimulus intended for the maintenance of RDWS, sanitation, and hygiene projects, especially those in central and western constituencies and poverty-stricken areas. Subsidies are awarded by the Central Government and depend on the actual collection of these water supply fees. The financing on behalf of the Central Government has allowed additional subsidizing of rural water supply projects in poverty-stricken communities. County-level governments are requested to set up designated RDWS, sanitation, and hygiene project funds. The financial subsidies by the Central Government go predominantly towards engineering maintenance in underdeveloped territories.

The NDRC is allocating appropriations from the Central Government to the RDWS, sanitation, and hygiene enhancement programmes focusing on initiatives associated with the poverty alleviation campaign. The corresponding financial departments supervise the allocation of funding for RDWS, sanitation, and hygiene O&M. In 2019, USD0.21 billion was allocated to help fund target efforts in central and western constituencies, as well as poverty-stricken localities (USD13.88 per capita).

Application of innovative financial mechanisms and private sector involvement

In recent years, China has made significant progress in creating various financing regimes. In many parts of the country, RDWS, sanitation, and hygiene projects serve as a medium for applying financial credit funds and attracting non-state capital. During the 13th five-year plan, Jiangxi Water Investment Group, for example, raised USD116.24 million for urban–rural water supply projects in 38 counties, alongside a USD200 million loan from the World Bank for urban–rural water supply and drainage projects in eight counties.

During the same period, China Water Affairs Group Ltd invested USD0.19 billion to boost the construction of the urban–rural water supply project in Xinyu [13]. There are other notable examples. Gansu Provincial Government entered into a strategic cooperation agreement with the China Development Bank under a loan application on behalf of Gansu Water Affairs Company Ltd to fund the urban–rural water supply development in 17 counties. In Anhui Province, Fuyang, Suzhou, Bozhou, and Huainan applied for approximately USD0.58 billion of financial policy loans for their RDWS, sanitation, and hygiene projects [14].

To attract more private capital, PPP has been widely utilized by many local governments and smaller projects have been integrated into larger ones. This approach enables lowering the overall financing requirement and likewise alleviating the financing challenges under each respective small-scale project. At the same time enterprises can take charge of financing and executing construction works and generate a reasonable profit.

To implement the 14th five-year plan (2021-2025), the MWR is currently drafting the *National Rural Water Supply Guarantee Program* where, in addition to Central Government and local investments, local governance units are guided to make use of domestic policy-related bank loans and local general and special bonds. This will allow rural water supply projects to be executed via financing from local general bonds.

Chapter 3.

WASH: community-based water schemes

The Government of China has been demonstrating the political will to focus on community-based schemes. Five community water supply management models are operating across the nation:

Professional companies: township water supply companies are founded in localities to fully manage multiple small-scale rural water supply projects. Although organized as conventional enterprises, such entities are financed by the government. The advantage of this model is that target projects remain under constant management and supervision allowing the timely resolution of issues on site.

Professional institutions: counties with relatively larger-scale projects adopt a management model with professional institutions who take direct charge. These are established and financed by local governments. They are responsible for the overall planning of county-level maintenance costs and subsidy appropriation, as well as administering piped supply networks and metering facilities, formulating water pricing policy, training staff, and supervising projects.

Responsibility delegation model: in case a region has large or mid-scale water supply projects with an established professional management system, nearby smaller projects can be placed under their management. This regime enables the minimizing of the management costs of small-scale projects.

Water supply associations: represents another type of WASH services management system based

on community involvement. Local governments establish a water supply association to manage small-scale rural water supply projects. This management model is intended to resolve water use conflicts between villages and enhance project management in different localities. The regime requires good organizational and coordination capacities on behalf of local governments and association staff.

Contractor-based management model: transferring the management rights from property owners to contractors in the form of a contract without changing the project ownership. This model enables the clarification of management responsibilities and likewise addresses issues of insufficient project maintenance and poor service quality. The regime requires clear water-pricing policies to be set by local governments, so that it is possible to run projects with a certain profit margin and effectively supervise the contractors.

Currently, proposals to build a three-tier community water supply management model are under discussion. The establishment of such management schemes should be based on feedback from villagers via village committees.

The function of the village committee cannot be ignored. It is responsible for reporting existing problems with community water supplies. The government can consider the opinion of the village committee when formulating policies, this can help to increase government credibility. Under the three-tier management regime, the village committee plays the role of a liaison between local governance and villagers. On the one hand, it promotes and implements government policies, laws, and regulations. On the other hand, it also formulates corresponding village regulations in accordance with the specific community's situation and encourages villagers to supervise policy implementation and provide feedback.

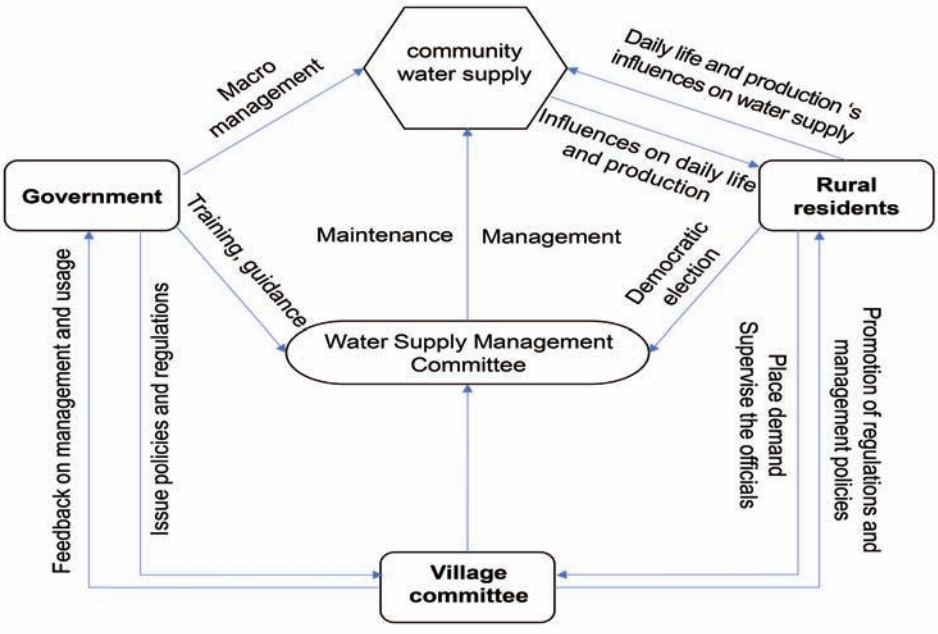

Figure 2. Three-tier community water supply management model

Chapter 4.

WASH: knowledge, technology, and experience sharing

China has been engaged in China-ASEAN 10+1, the Lancang-Mekong Cooperation, and other multilateral cooperation frameworks. Adhering to the principles of extensive consultation, joint construction and sharing, the country working to share its WASH experience.

China is making continued efforts to improve research and technology innovations in water supply and sanitation. The RDWS Centre, a research facility affiliated with MWR, has been engaged in rendering a broad range of technical support: macro-policy research on RDWS, sanitation and hygiene, technology promotion training, technical consulting, technology development, and research on standards applicable to RDWS, sanitation, and hygiene evaluation, and water quality monitoring. This research center has made a significant contribution to the drafting of standards and regulations, as well as the actual implementation of target policies with its in-depth studies on technology and society.

In China, RDWS, sanitation, and hygiene require different sectors to cooperate and promote efficient exchange and sharing of knowledge, technology, and experience. The national MEE can focus on promoting knowledge on water conservation and water source protection, while training farmers in the proper application of chemical fertilizers and pesticides to reduce pollution. MWR can focus on the promotion of knowledge of water resource conservation, water saving and RDWS, sanitation and hygiene projects O&M, while dealing with the nexus of domestic and production water use. MARA can focus on mainstreaming knowledge on the proper disposal of wastewater, garbage, and faeces, while improving the overall sanitation conditions of rural communities. The NHC can focus on promoting the WASH associated knowledge.

Extra attention must be paid to training O&M personnel, including drawing up rules and regulations with respect to annual training hours and competence assessments. For the staff of community water supply projects, it is necessary to design straightforward training materials supplemented with field lectures, observation studies and video training modules.

WASH: National recommendations

The research findings make it possible to propose the following recommendations:

1. Legal and institutional basis for WASH sector development

China still faces the urban–rural gap as well as regional development disparities. Urban and rural water supply projects should be planned, constructed, managed, and commissioned uniformly from national down to provincial, so that urban and rural areas can have similar levels of WASH service and service quality.

The Central Government should lead the optimal management system, with departments engaged in water resources, sanitation and civil engineering assuming the main responsibilities, whilst other

relevant departments undertake the tasks under their mandates, backed with inclusive societal participation.

2. Financial aspects of WASH sector development

RDWS, sanitation, and hygiene projects target different sectors and require a great deal of funding for construction and O&M. In future, non-state capital will need to play a greater part. Central and local governments should provide more subsidies to RDWS, sanitation, and hygiene efforts. More initiatives should be deemed eligible for target support and the corresponding procedures should be simplified. Meanwhile, local financing platforms should be better utilized for financing RDWS, sanitation, and hygiene projects.

3.Capacity-building for WASH services management

The Government should place more emphasis on community water supplies under national and provincial-level technology demonstration projects. Easily replicable community water supply regimes should be installed in regions to maximize replication.

It is also necessary to enhance technical support for community water supply and sanitation projects through training and implementing technology standards, as well as raising awareness amongst rural populations to help close the urban–rural gap and alleviate regional development disparities.

4. Knowledge and information sharing

More investment should aim at scientific research and technology promotion, especially in regions with limited technological support and management, low basic-level technical strength and management. Technology promotion and its demonstration should be organized at province, city, and county levels with the funds allocated for such initiatives included in central and local budgets.

The Central Government should consider establishing national, provincial, and municipal information monitoring platforms. Information technology, including the Internet of Things, should be implemented to improve management efficiency. It is necessary to include Knowledge, technology, and experience sharing into national rural water supply planning. As is adopting specific measures to actualize health education, popularize drinking water safety knowledge and advocate for water conservation.

Strengthening information sharing and technical cooperation domestically and with Central Asian countries is also required. For water related cooperation, the dissemination of materials can cover such topics as water extraction from infiltration galleries and radial collection wells, new powered water supplies for pastures, and automatic water supply supervision and control to improve technical systems tailored and adaptable to various water sources and water shortage conditions.

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National Part of the Report for Mongolia Development of Sustainable Water and Sanitation Systems in Irrigated Areas of Rural Mongolia

By Purev Narantsetseg, National Consultant

Introduction

Mongolia is an independent and land-locked country bordering on China and Russia. Essential to healthy wellbeing, water, sanitation and hygiene represents the core sector indicating the overall living standards and development of economic, human, social, and healthcare sectors. The provision of reliable WASH services impacts public health, life quality, and productivity. Poor services exacerbates the spread of diseases such as dysentery, hepatitis A, typhoid, and pertussis. Enhancing drinking water quality is crucial for disease prevention and remains a major improvement target [1].

In 2019, the total water consumed in Mongolia amounted to 555.7 million cubic meters, with 77 per cent for production, 19 per cent for drinking, and 4 per cent for other services [2]. In the same year, the number of households using a drinking water supply reached 486,400 (a 4 per cent increase against the previous year); and 1,985 water supply stations (a 1.7 per cent increase against 2018) were operating across the country [3]. In 2019, 200 water and sewage service licenses were issued to owner-operators.

As per Mongolia's water database, 95 per cent of the total population use groundwater for drinking

and other household purposes, and only 5 per cent use surface water. The quality of groundwater from certified sources is suitable for drinking and living purposes [4].

Fully fledged implementation of the domestic WASH policies and plans, enhancement of WASH estimates and advancement of basic services, improved facilities and safely managed services manifest the prerequisites for accelerating Mongolia's WASH interventions and increasing the quality of public WASH services [5].

According to Table 6, only 23.7 per cent of the total population have access to safely managed drinking water and piped systems are available only in 5 per cent of rural communities. For sanitation, only about 29.4 per cent of urban and about 3 per cent of rural populations have access to sewer connections. National hygiene estimates demonstrate that the proportion of the population enjoying facilities with basic conditions is approximately 70 per cent, including 49 per cent in rural areas.

The main challenges of WASH services in Mongolia include the following:

- Limited quality of WASH infrastructure. It is necessary to deliver better WASH services to the population and improve WASH indicators, in particular for rural communities
- Low use of improved WASH facilities, especially in rural communities, and inadequate WASH facilities leading to unsafe drinking water supplies and sanitation aggravate waste, pollution, and disease
- Based on Table 6, Mongolia is missing data on many indicators negating the efficiency of target WASH-related decisions, it is necessary to expand water sources, and water resources monitoring and protection efforts, assess WASH networks and protect water deposits and water supply sources.

Table 6. Access to drinking WASH in Mongolia [6]

Main indicators	Urban	Rural	Total
% of population with access to safely managed drinking water	no data	no data	23.7%
% of population connected to piped systems	34.5%	5%	25.1%
% of population using non-piped systems	63.1%	54.2%	60.3%
% of population using contamination-free drinking water sources	no data	no data	81.3%
% of urban areas properly connected to centralized water supply systems	no data	no data	no data
% of population connected to municipal wastewater systems	no data	no data	no data
% of population using improved sanitation facilities by type: - latrines and other - septic tanks - sewer connections	 66.7% less than 1% 29.4%	 62% 0% 3.1%	 65.2% less than 1% 21.1%
% of total population using hygiene facilities: - with basic conditions - with limited conditions (without water or soap) - no facilities	 81% 6% 12%	 49% 10% 41%	 71% 7% 22%

Water quality manifests yet another big issue for Mongolia's WASH sector. Enhancing drinking water quality is of great importance for combating disease and represents a paramount development objective [1]. Inadequate latrines and urinals in peri-urban communities are sources of waste, wastewater, pollution, and multiple infections.

Since 2014, Mongolia has been implementing the *Soum Center Reform Program*, including the rural water supply and sanitation facility project supported by UNDP grants and ADB soft loans [7]. The project was able to generate 80 billion MNT (USD40 million) ① of investment to support the construction of engineering infrastructure in 16 *aimags* (administrative subdivision).

① USD1 = 1,995 MNT (as of 1 December 2015). Available at: mongolbank.mn

Chapter 1.

WASH: policies and institutions

Historical overview

In Mongolia, it is necessary to focus on three historical periods of its advancement. The first phase of WASH development started in 1959 and lasted until 1970 and saw the establishment of the Water Network Utilization Authority and the development of the first map-scheme of Ulaanbaatar's city drinking water supply. At that time, the former USSR supported Mongolia and developed its WASH services. The centralized engineered water supply and sewage system was launched in the capital in 1959. The first sanitation and sewage, and the first part of the wastewater treatment system were completed in 1963 [8].

The second phase lasted from 1971 till 1990 and was hallmarked by a significant expansion of domestic WASH services. As during the first phase, the Soviet Union served as the main supporter. In the course of this period, drinking water exploration capacity was built and the number of ground wells supplying the central water station reached 27, with 23 additional new wells constructed. Ulaanbaatar's sanitation sewage system grew, with the newly constructed 14km pipeline and 50 new wells. Drinking water increased to 70,000 cubic meters and the sanitation sewage system and wastewater treatment capacity to receive and process wastewater reached 230,000 cubic meters [8].

The third conditional phase began in 1990 and was characterized by the execution of projects with financial support by various development partners, mostly the Government of Japan, the World Bank and the Government of China. During this time, approximately 20 projects have been implemented constructing and reconstructing water supplies and wastewater treatment facilities, as well as enhancing access to hygiene mainly in urban communities and particularly in Ulaanbaatar. None of these efforts covered rural localities [8].

Current laws and policies

Mongolia's Constitution recognizes the human right to a water and sanitation, with second-tier laws and regulations determining community-engagement procedures. Analysis of the national WASH indicators shows that the country's rural drinking water and hygiene targets are not ranked under the target national policy [9].

Overall, the domestic WASH services are regulated by the *Water Law*, *Environmental Law, Urban and Settlements Water Supply and Sewage Utilization Law*, *Hygiene Law* and other relevant legislation, regulations, and standards. The Water Law was adopted by the Mongolian *Great Khural* (Parliament) on 17 May 2012 for governing the relations in the sphere of protection, rational use, and restoration of water resources and basins. The Urban and Settlements Water Supply and Sewage Utilization Law, adopted by the Mongolian Great Khural on 6 October 2011, regulates all supply and sewerage procedures and efforts. This law also governs the issues associated with the ownership and operation of engineered facilities designed for supplying urban settlement users with clean water as per standard requirements, as well as disposing of and treating wastewater.

In 2014, WASH targets and measures were incorporated in Resolution No.43 of the *Green Development Policy of Mongolia for 2014-2030* aiming to actualize a '...development model that ensures the improved well-being and prosperity of Mongolian citizens by safeguarding the sustainability of ecosystem service, increasing the effective consumption of natural resources and ensuring economic growth that is inclusive and environmentally sound.' The document specifies the following key targets:

Provide at least 90 per cent of the total population with access to drinking water
Provide 60 per cent of the total population with access to improved sanitation facilities by increasing water supply and sewerage system capacity and productivity

Promote the introduction of technologies for treating wastewater at permissible standards and the reuse recycled water while limiting the use of groundwater for industrial purposes

In 2016, under Resolution No.35, the *Action Plan for the Green Development Policy* was approved and implemented.

The plan comprises the key target strategy, to protect water, water resources, and water deposits, and ensure their efficient use. The strategy's successful execution requires efforts to enhance and broaden water monitoring and analysis networks. In turn, this will facilitate the proper protection of river sources and enlarge state administered special protection zones around water sources. The implementation of the SDGs and domestic green development policies, enforcement of relevant laws and regulations, execution of action plans, development of *soum* (second-tier administrative subdivision) centres and construction programmes or projects to advance rural water supply and sanitation facilities led to Mongolia's WASH figures improving from 2015 to 2018:

- National basic drinking water estimates improved by 0.7 per cent reaching 82.5 per cent; unimproved drinking water service were reduced by 1.9 per cent
- Rural drinking water improved by 5.2 per cent reaching 58.1 per cent; unimproved services were reduced by 4 per cent
- National basic sanitation service improved by 11 per cent reaching 69 per cent; unimproved sanitation services were reduced by 8.3 per cent
- Rural basic sanitation services improved by 9.6 per cent reaching 50 per cent; limited sanitation services decreased by 4.9 per cent
- National basic handwashing hygiene improved by 10.6 per cent, reaching 81.8 per cent
- Rural basic hygiene improved by 24.1 per cent reaching 73 per cent

On 13 May 2020, Mongolia's Great Khural adopted Resolution No.52, 'Vision 2050', and officially approved the corresponding national long-term development policy. The resolution includes three main annexes and describes further steps to improve access to WASH:

1. Mongolia's long-term development policy 'Vision 2050'
2. Action plan 2021-2030, reflecting the long-term development policy 'Vision 2050'
3. Monitoring, analysis, and assessment criteria, and targets under the long-term development policy 'Vision 2050'

Organizational chart of WASH services in Mongolia

Mongolia's water sector and water resources management has a specific institutional architecture presented in Table 7.

Table 7. Key WASH stakeholders in Mongolia [10-13]

Organization	Key mandate
Mongolia's Great Khural (Parliament)	- Overall governance of all issues related to water resources and basin protection, as well as rational use and restoration of water resources as per Mongolia's Constitution, Water Law, and other relevant legislation - Setting water resource use and water pollution fees - Endorsing river discharge modifications and transfers (only for major rivers)
National Security Council	- Governing all issues of water resources and basin protection, rational use and restoration as per Mongolia's Constitution, Water Law, and other relevant legislation - Monitoring the implementation of integrated water management plans and enhancing coordination among relevant line ministries on cross-sectoral aspects of water management

Organization	Key mandate
Ministry of Nature and Environment	General governance of natural resources, including the following primary responsibilities: - Creating and implementing water-related programmes, including water resources, water measurements and levels, assessing ecological-economic value of water resources, water quality monitoring and analysis, water storage remediation, water infrastructure, sustainable use, and other water-related guidelines - Approving standard guidelines for drafting water basin management plans - Granting and suspending rights for water exploration and research to/from professional organizations - Implementing international agreements on transboundary water resources - Deciding on river discharge modifications and transfers - Monitoring the preparation of national water information and databases - Approving and implementing methods and guidelines for estimation and valuating water resource damages - Organizing research and exploration for water resources, and establishing potential reserves for utilization - Monitoring decisions and licenses for water uses by water basin administration, *aimags* and city departments - Designing water quality and wastewater standards - Approving research and exploration activities, drilling wells, establishing and using hydro infrastructure
Water Agency	Overall management of national water resources: - Operating and maintaining state-owned and funded hydro infrastructure, including head and newly constructed installations - Managing and monitoring foreign and domestic hydro projects - Calculating water resources, conducting water registration, monitoring and analysis, restoring water resources within basins, implementing water exploration analysis plans, expert-assessing of rivers and basins, water use and water resources management
Ministry of Health	- Supporting and protecting the national healthcare system, ensuring the implementation of Mongolia's SDG 2030 efforts - Delivering health service and assistance to the population, improving the quality of social health and medical care and services - Building national prevention, diagnosis, and treatment capacities
Ministry of Education	- Reviewing and prioritizing requests for funding to improve school WASH - Collecting school lists from *aimag*'s and Ulaanbaatar education departments - Launching bidding procedures associated with schools - Developing/approving funds and plans, as well as overseeing construction and the major rehabilitation of school buildings, including WASH facilities, in consultation with *aimag*-level educational departments - Monitoring and evaluating WASH facilities in schools

Organization	Key mandate
Ministry of Finance	- Reviewing, prioritizing, and approving funding requests - Launching bidding procedures for all WASH-related activities - Monitoring and evaluating WASH facilities
Water Committee	Includes representatives of line ministries, the General Agency for Special Inspection, the National Security Council, the Vice Mayor of Ulaanbaatar and the Water Agency - Monitoring the implementation of integrated water resource management plans and enhancing coordination among relevant line ministries on cross-sectoral aspects of water management
Water Service Regulatory Commission	- Setting water and wastewater tariffs for all *aimags* and Ulaanbaatar City - Issuing special water use licences to legal entities
Water Laboratory (under Mongolia's Water and Sewerage Administration)	- Conducting water sampling and analyses as per Mongolia's National Standard (MNS) 0900:2018 to check suitability of water quality and composition for WASH.
Governors and environmental officials	Local governors - Approving water basin management plan proposals - Coordinating efforts by water basin organizations - Designing projects and deciding on project financing - Approving and monitoring implementation of projects at the provincial level - Launching bidding procedures for all WASH-related activities Environmental officials - Monitoring the implementation of the Water Law and maintaining local water databases - Approving contracts of water basin administrations with customers with a daily consumption of 50-100 cubic meters.
Inspectors	- Monitoring the implementation of the Water Law in catchments and ensuring compliance (via inspections) - Monitoring water use and pollution by water users and consumers - Enforcing penalties for water use violations

As Table 7 indicates, there are multiple overlaps in the responsibilities of Mongolia's state agencies, resulting in inefficient provision of WASH services throughout the country.

In addition, Mongolia's WASH services are facing a significant lack of qualified staff. The current staffing levels in rural drinking water supply and urban and rural sanitation entities is only 50 per cent [9].

Chapter 2.

WASH: financing and economic aspects

According to the national government and the WASH budget indicators in the 2017 UN-Water GLAAS Report, in 2015 Mongolia's WASH budget amounted to USD237 million, and the national annual WASH expenditure to USD298 million. By funding sources, Mongolia's households paid USD62 million (or 20.8 per cent) and the state USD237 million (or 79.3 per cent) of the target annual expenditure in 2015 [9].

In 2018, charged water amounted to 132.33 million cubic meters, an increase of 9.96 per cent compared to 2017 [14]. In 2019, the revenue from water and sewage utilization and services grew by 46.5 per cent over 2015 and by 10 per cent over 2018. The same year, the corresponding expenditure increased by 51.5 per cent compared to 2015 and by 15 per cent compared to 2018 [15]. Based on the 2017 GLAAS Report, the average water supply and sanitation expenditure share in GDP was 0.2 per cent.

Despite Mongolia's elaborated WASH development plans, financial support available for their execution is insufficient, only up to 50 per cent of the required amount [16].

Water tariffs

Financing for water supplies and sanitation services comes via a variety of channels, including central, mezzo, and local governments, state/local owned enterprises, households and communities.

Table 8. Tariffs for drinking water supply and wastewater services for urban areas in Mongolia② [17]

	Fixed tariffs	Variable tariffs for households			Commercial tariffs			
		Households with meters	Households without meters	Water distribution kiosks	Entity	Alcohol, water production and car wash	Wool, cashmere, leather, livestock gut processing	For social institutions, (schools, hospitals)
Water supply	3,000 MNT/l (USD1.05/l)	2,023 MNT/l (USD0.71/l)	2,963 MNT/l (USD1.04/l)	2,593 MNT/l (USD0.91/l)	3,932 MNT/l (USD1.38/l)	5,242 MNT/l (USD1.84/l)	3,989 MNT/l (USD1.40/l)	3,932 MNT/l (USD1.38/l)
Sanitation (waste water)		1,652 MNT/l (USD0.58/l)	2,222 MNT/l (USD0.78/l)		3,419 MNT/l (USD1.20/l)	4,416 MNT/l (USD1.55/l)	5,840 MNT/l (USD2.05/l)	3,419 MNT/l (USD1.20/l)

② USD1 = 2,849 MNT (as of 23 November 2020). Available at: mongolbank.mn

Mongolia has a system to collect water supply tariffs. All water users, including households, contribute to drinking water and wastewater treatment operations (Table 8). Locally owned state enterprises can contribute to the WASH sector from internally generated revenue and tariffs. After that, the fees come from centralized and decentralized water supply, sanitation, and wastewater schemes.

However, the revenue that WASH services providers generate from service delivery is insufficient to cover O&M costs. Households are likewise unable to pay a single-instalment fees for piped connections to centralized water networks. Overall, local authorities are expected to contribute to the WASH sector from internally generated revenue and fees; however, these too are low, and raising and approving tariff rates is a complicated political process [9, 18].

Application of innovative financial mechanisms and private sector involvement

Mongolia pays a lot of attention to attracting investment to the WASH sector, be it urban or rural. A series of projects supported by international development partners have been implemented focusing on the installation of water meters and monitoring systems, upgrading wastewater laboratory equipment, water supply, pumping stations and wastewater treatment reconstruction, construction, and connection to centralized lines. The Asian Development Bank (ADB) is the main financier of Mongolia's urban development and construction, water supply and wastewater treatment efforts. Between 1996 and 2020, the ADB financed urban development and technical assistance projects worth USD311.58 million. The financing framework includes multi-stage financial instruments (52 per cent), loans (38 per cent), grants (6 per cent), and technical assistance (6 per cent) [19].

There is a need for the private sector to participate in WASH projects and execute WASH-related action plans on a national level, as well as in urban and rural territories.

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Chapter 3.

WASH: community-based water schemes

Several management systems exist in Mongolia simultaneously. Most urban localities currently have centralized water supply and wastewater collection systems:

- 39.4 per cent of the population are connected to centralized piped networks
- Most of the rural *soums* and *baghs* (third-tier administrative subdivisions often without a permanent administrative center) are not connected to centralized piped networks
- 40.9 per cent of urban populations are connected to municipal wastewater systems
- 3.5 per cent of rural populations, including *soums* and *baghs*, are connected to municipal wastewater systems [1]

Urban citizens are approximately 65 per cent of the total population of Mongolia, with Ulaanbaatar accounting for one third. Owing to their small size and long distances, rural areas are usually located between settlements. Ensuring that WASH services supplies to, or, within remote and isolated *soums* and *baghs* situated at large distances from each other is challenging. Community-based decentralized WASH management systems typically take the form of household-level installations. At present, rural settlements have no centralized sewers and rely mostly on decentralized onsite household wastewater disposal facilities.

ADB has been supporting community-level engagement in rural development actions. For instance, under the Community-Driven Development for Urban Poor in the Ger Area Project (2007-2012). Its core aim was to empower local communities through increased participation in local governance and involvement in the design, implementation, and management of community demand-driven infrastructure and income-generating projects in selected *ger* (traditional portable round tent) localities. Geographically, the project covered Bayankhongor, Choir, and Erdenet, and established about 300 WASH subprojects in three target locations, with most focusing on infrastructure and social services such as the construction of water kiosks and/or water supply stations.

Current national-level mechanisms to support local community and citizen engagement in enhancing water supplies and sanitation management are stipulated by national policy and legislation. Rural WASH school and WASH household practices were introduced with financial support on behalf of ACF, UNICEF, KOICA and the ADB, as well as on state or government budget allocations. For example, the UN's Joint Programme on Water and Sanitation and UNDP's Local Development Support Programme secured USD4 million for water and sanitation efforts aimed at strengthening public health by facilitating access to safe drinking water sources, expanding sanitation facilities, and improving hygiene [20, 21]. The private sector has also supported a number of target rural initiatives across the country.

The WASH in Schools Program successfully provided WASH services in *ger* and rural areas of Mongolia. Supplying WASH services in schools, kindergartens, and dormitories has been a top priority for the national Ministry of Education, Science, Culture, and Sport. Initially, the program was financed by ACF and UNICEF. More recently, target construction efforts at schools and kindergartens have been funded from the state budget. Thanks to the WASH Schools Program, 105 schools and *ger* communities received improved access to drinking water and sanitation [22].

As a result of these projects and international support efforts, over the course of the last decade over 65,200 localities (more than 0.02 per cent of the total population) were provided with a drinking water. Nevertheless, community-based water schemes are still insignificant when considering the scale of the country [22].

Chapter 4.

WASH: Knowledge, technology, and experience sharing

Knowledge is of great importance in forging favorable policy and a regulatory environment to deliver WASH services to each individual and community. Strategically, Mongolia aims to encourage education, science, and technology to serve as catalysts for green development, and to promote cultural values and livelihoods that are in harmony with nature [23].

Russian technologies were used to enhance drinking water supply, sanitation, and wastewater treatment, and were able to provide a sufficient level of cold and hot water, heat, and sewage services that complied with urban standards. Mongolia's cold climate and harsh winters present a major technological challenge. To be able to develop its WASH sector, the country needs suitable, freeze-proof, water supplies and wastewater technical solutions. For example, burying pipes and installations at sufficient depth, heating pipes and circulating hot water. Knowledge is the main determinant of technological development, real-life application of high-tech practices, as well as predetermining the outcome of a particular technology. Knowledge, technology and experience-sharing are essential for Mongolia to execute its WASH policy, implement targeted action plans and, ultimately, ensure provision of WASH services to the population. In addition, it is also necessary to consider the needs of the geographic location of rural settlements and the distances between them.

Hygiene education under the WASH in Schools Programme represents a good model for sharing WASH knowledge on a national level. Between 2014 and 2020, a pilot WASH project was implemented in schools and kindergartens for 101 *soums* from 17 *aimags* of Mongolia [22].

Publishing and ensuring access to WASH reports on drinking water quality and sanitation is another way of sharing knowledge and experience among professionals and the public. For instance, the UN and UNICEF websites and e-publications serve as independent and easily accessible sources of WASH knowledge (https://www.who.int).

Engineering and technological expertise is limited in small rural communities and settlements. Arming WASH engineers with the knowledge and the capacity for working in rural territories is a prerequisite for the progress of Mongolia's WASH sector.

WASH: National recommendations

In Mongolia, the WASH sector still faces huge, complex and unresolved strategic tasks to improve drinking water supplies and sewerage, as well as wastewater treatment, both technically and institutionally. Delivering better WASH services and creating the necessary preconditions and environment for WASH infrastructure is essential for improving life quality for Mongolians.

1. Legal and institutional basis for WASH sector development

- Research and exploration work to identify and confirm reliable water resources is necessary, in particular in *soums* without reliable water supply

- Mongolia's Water Resources Protection Strategy is the main development tool for ensuring the healthy life and livelihood of the population. To accomplish this, it is necessary to ensure the successful and efficient execution of the Water

Policy and Strategy

- It is likewise necessary to extend the protection and monitoring efforts for water, water sources, and water resources, as well as take action to assess networks covering all water deposits to guarantee efficient water use
- Supporting and improving WASH networking among key government agencies, national and international NGOs, the private sector, donors and other partners is required to enhance coordination within the WASH sector and implement target national policies and plans
- Supporting successful, optimal, and effective institutional framework will ensure the safe management and provision of WASH services by improving water supply and sanitation infrastructure and expanding the network of improved hygiene facilities in urban and rural territories

2. Financial aspects of WASH sector development

- It is vital to apply new development concepts and standards (people-first PPP) for the improved delivery of WASH services to the population, including via developing infrastructure and enhancing national, urban, and rural WASH indicators to exceed 90 per cent in the long-term
- Efficient financial assistance is important to stimulate proper WASH development and service delivery. Attracting investors to the sector is extremely important for its further progress
- Creating and enhancing effective WASH public financial management can improve WASH financing overall
- It is also necessary to design and implement a target WASH financial plan comprising a designated WASH monitoring system in urban and rural communities

3. Capacity-building for WASH services management

- Supporting and strengthening community participation in rural development is necessary to ensure local development support programmes, involving citizens and community participation in drawing up and executing local water safety programmes and plans in urban and rural areas to advance local and national WASH services
- The WASH in Schools Partnership network could help to build the capacity of the education sector to implement national WASH standards and requirements
- Community-based efforts on water, sanitation, hygiene, and networking, including government agencies, national and international NGOs, the private sector, donors, users/citizens, and other partners, are important to ensure access to WASH services for the entire population, including vulnerable groups and communities in rural areas
- PPP development at national and local levels is crucial for delivering higher quality WASH services to users, as well as WASH infrastructure development

4. Knowledge and information sharing

- International and national sources and networks could be instrumental in sharing and obtaining WASH knowledge. Analyzing and applying international best experiences could facilitate the design of domestic WASH services and plans, as well as policy implementation
- Using correct, efficient, and effective WASH technological solutions suitable to Mongolia's harsh climate and local needs is important for the sustainable delivery of WASH services, in particular in the rural territories of Mongolia
- It is likewise vital to design and implement special WASH capacity-building programmes to back the implementation of WASH plans and policies
- Sharing best WASH knowledge and experiences among professionals, as well as disseminating knowledge, official reports, and information would facilitate the process as whole

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National Part of the Report for Tajikistan Development of Sustainable Water and Sanitation Systems in Irrigated Areas of Rural Tajikistan

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Introduction

Tajikistan is a mountainous, landlocked, low-income country with a food deficit and a population of some 9.1 million (26.4 per cent urban, 73.6 per cent rural). It is also the fifth most water-rich country in the world, yet today about half the population do not have access to safe drinking water. The annual population growth of approximately 2.5 per cent puts additional pressure on domestic water assets [1].

A series of common sector challenges, systemic underperformance, management constraints, lack of sustainability and service failure, effectively low water fees, poor maintenance and decaying efficiency, chronic underinvestment, water losses, deteriorating service quality, low willingness to pay and affordability issues, and lack of technical and management capacities; all constitute a vicious circle.

As Table 9 shows, on a national scale only 48 per cent of the total population enjoy access to safely managed drinking water. As to sanitation and hygiene, the JMP data indicates that the population's share with access to at least basic sanitation (improved and not shared) has increased from 89.7 per cent to 97 per cent during 2000 to 2017. The JMP data 2017 for handwashing facilities, that is, a basic facility with water and soap, 72.7 per cent national, which includes 87.2 per cent urban and 67.4 per cent rural [2-4].

Table 9. Access to drinking WASH in Tajikistan [4]

Main indicators	Urban	Rural	Total
% of population with access to safely managed drinking water	no data	no data	47.9%
% of population connected to piped systems	90.8%	54.5%	64.3%
% of population using non-piped systems	5.9%	24.1%	19.2%
% of population using contamination-free drinking water sources	no data	no data	72.8%
% of urban areas properly connected to centralized water supply systems	83%	31%	
% of population connected to municipal wastewater systems	no data	no data	
% of population using improved sanitation facilities by type: - latrines and other - septic tanks - sewer connections	 45.7% less than 1% 53.7%	 99.1% less than 1% less than 1%	 84.7% less than 1% 14.7%
% of total population using hygiene facilities: - with basic conditions - with limited conditions (without water or soap) - no facilities	 87.2% 11.1%	 67.4% 26.9%	 72.7% 22.6% 4.7%

The discrepancy between access to water and sanitation in urban and rural areas remains significant. Most of the external support via foreign aid and investments was provided for urban and semi-urban systems by major international organizations and financial institutions such as the ADB, WB, EU, EBRD, SDC, USAID, and JICA. In doing so, the majority of efforts followed the principles of economies of scale and per-capita cost effectiveness of investments and recovery. As such, most of the rural infrastructure has largely been neglected.

Chapter 1.

WASH: policies and institutions

Historical overview

Most of Tajikistan's drinking water supply and sanitation systems were built during the 1960s and 1980s. In accordance with the Soviet-style type of management, all WASH-related targets were set by the central government, and all WASH-related costs for rural communities were covered by the sovkhozes and kolkhozes of respective territories. Since gaining independence in 1991, the subsidies from the Soviet economy have halted. In technical terms, by the level of their current depreciation most rural WASH services are deemed obsolete, which is the primary reason public institutions are not keen on carrying out a regular formal inventory of rural water supply and sanitation infrastructure. SUE KMK indicates that, whereas in urban and semi-urban areas only 68% of installations and networks are in working condition, 7 per cent are functioning only partially and 25 per cent are dysfunctional. In rural settlements less than 40 per cent of systems are currently operational, 44 per cent are working partially and 16 per cent are out of order. For sewerage systems, 50 per cent are dysfunctional in urban and peri-urban localities and 85 per cent in rural localities. Population growth has also resulted in the construction of new settlements in less-habitable territories where drinking water is not available and/or hardly accessible [5].

Following land reforms and restructuring it has become evident that the farming entities that had replaced Soviet and collective farms are not capable of managing and maintaining infrastructure. Coupled with the lack of ownership by new farming units and state budget constraints, the available state support towards WASH sector management and regulation has been limited only to preservation of the institutional framework of operating organizations, with a miniscule part of this support targeting rural WASH services inside and adjacent to administrative district centres.

Current laws and policies

The WASH sector in Tajikistan is principally guided by the three most important overarching legal documents: The (a) Constitution, (b) Water Code, and (c) Law on Drinking Water Supply and Sanitation (Sewerage). While these legal instruments stipulate the overall framework, there are numerous other laws, regulations, standards and norms, along with government and agency decrees that identify specific mechanisms for implementing and enforcing water-related legislation.

The Drinking Water Supply and Sanitation Law and the Water Code were revised in July 2019 and April 2020, respectively. The new edition of the former includes several important clauses, for example, on rendering more attention to sanitation and sewerage, requirements for drafting WSPs for drinking and sewage water, demonopolizing and decentralizing systems management, as well as additional mandates for local authorities and the promotion of PPPs.

Another important piece of legislation that was revised to support the norms and provisions of the Water Sector Reform Programme is the Law of the Republic of Tajikistan on associations of water users. Its amended edition adopted on 2 January 2020 specifically addresses WASH norms accommodating the applicability of WUAs for drinking WASH schemes.

Tajikistan has also developed several WASH sector specific strategies, programmes, concepts, regulations and bylaws, laying the foundation for the sector's advancement. Inter alia, they include the National Development Strategy for the Period up to 2030, 2016-2020 Mid-Term Development Programme, and Programme on Improvement of Safe Drinking Water Supply for the Population of the Republic of Tajikistan for the Period 2007-2020. The implementation of the latter is in its final year,

and currently the Government of the Republic of Tajikistan (GoRT) is working on the next phase of the program for 2020 to 2030.

With the water sector reform still under way, to ensure alignment with the integrated water resource management (IWRM) principles it is vital to support WASH-related legislation improvements, and institutional development and restructuring. The gap between theory and practice remains wide, as legal upgrades are typically way ahead of their on-the-ground actualization.

Several state norms and standards for the construction and upkeep of WASH facilities are regulating this sector. The Soviet-era master documents were designed in the period 1982 to 1988, and it was only after about 20 years that they were altered to adapt to the new social and economic reality of the independent Tajikistan. Despite the fact that multiple updated 'national' standards and norms were adopted during the period 2004 to 2007, with the WASH sector management, regulation, and construction standards continuing to evolve, many other legal acts and bylaws still require revision [6].

Organizational chart of WASH services in Tajikistan

Institutional support is necessary on all fronts and tiers of the governance system in Tajikistan. SUE KMK serves the focal entity, acting as the service provider on behalf of the GoRT except for a few independently operating municipalities in several major cities (Dushanbe, Khujand etc.). On paper, SUE KMK is also responsible for WASH-related policymaking and governance, yet in practice this function is limited mostly to asset management. The current institutional framework comprises a plethora of bodies and organizations possessing specific mandates on policymaking and regulation in the WASH sector. Table 10 lists the key line ministries and agencies, state enterprises and local authorities, as well as outlining their core roles with respect to the WASH sector.

Table 10. Key WASH stakeholders in Tajikistan [7]

Organization	Key mandate
Ministry of Energy and Water Resources (MEWR)	- Developing and implementing state policy and regulation in the sphere of energy and water resources - Developing national strategies and programmes - Initiating legal improvement initiatives in coordination with other line ministries and agencies.
Ministry of Health and Social Protection	- Providing sanitary and epidemiological services ensuring a safe sanitary and epidemiological environment - Monitoring drinking water quality in centralized and decentralized water supplies - Awareness raising among the population and providing training on public health issues
Ministry of Education	- Conducting information campaign, as well as developing education and communication materials - Approving learning materials for schools, colleges, and universities - Participating in construction of WASH facilities in HCFs and educational institutions - Promoting and regulating WASH standards in HCFs and schools
Ministry of Economic Development and Trade	- Coordinating activities on planning and forecasting rational use and protection of water resources
State Committee on Investments and State Property Management	- Implementing state policy and regulations on investment, managing state property, and leading and implementing privatization of state property, including drinking water supply systems

Organization	Key mandate
State Committee on Land Management and Geodesy	- Selecting land sites suitable for construction, filing land management cases in cooperation with clients, and issuing land use certificates based on decisions of district municipalities
State Committee for Architecture and Construction (under GoRT)	- Developing construction norms, standards, and regulations - Approving project design documentation for construction and commissioning - Regulating administrative procedures for construction permitting - Controlling and overseeing construction activities
Agency for Standardization, Metrology, Certification and Trade Inspection (under GoRT)	- Organizing and implementing product certification - Ensuring state control and oversight of standards and technical regulation compliance, measurement assurance - Enforcing mandatory certification to ensure safety of human health, property, and environmental protection
Antimonopoly Agency (under GoRT)	- Developing guidelines for price (tariff) setting and/or price ceilings for drinking water supplies, determining procedures for price regulation of services (including in the WASH sector), and agreeing tariffs for paid services
Chief Geology Department	- Researching and determining water resources (surface, ground, underground) - Performing state control of surface water
Committee for Environmental Protection (under GoRT)	- Performing state control for protection and rational use of water resources - Restoring and reproducing water resources - Designing and executing measures aimed at water conservation and water quality - Determining special water use requirements
Chief Department for Safety Control in Industry and Mining	- Using therapeutic, mineral, thermal, and freshwater resources - Conducting water chlorination at water treatment plants and in water preparation systems (in towns of republican and regional significance) - Ensuring water supply circulation
State Unitary Enterprise "Khojagii Manziliyu Kommunali"	- Performing regulation, asset management, and ensuring service provision in cities and towns, district centres, and rural settlements
Vodokanals	- Rendering water-related service in cities and towns
Jamoats	- Performing the role of rural utility organizations/service providers through management of WASH facilities as per their ownership status. *Jamoats* also participate in developing management schemes for rural WASH services under their ownership, but in the capacity of third-party regulatory authority

As of today, duplication of roles and authority gaps have not yet been fully addressed, several organizations have regional subsidiaries/affiliates remaining under double subordination, namely, both to centralized agencies and local district administrations/regional municipalities. Such is the case for regional and district-tier departments of SUE KMK, reporting both to their headquarters and local administrations. Vodokanals (water administrations) also report directly to city or town administrations.

Chapter 2.

WASH financing and economic aspects

Within state budgeting, the WASH sector has traditionally belonged to the social block (sector), and the Constitution and other designated legislation (Water Code, Law of the Republic of Tajikistan On Drinking Water and Water Sewerage), sector financing has been the primary responsibility of the state. State financing of the WASH sector (0.2 per cent) is insufficient to maintain even already functioning systems, let alone rehabilitation and recovery efforts, or to finance the SUE KMK and its numerous subsidiaries/affiliates across most districts of the country [8].

The state has embarked upon sector-specific reforms with the primary objective of creating an enabling environment for self-financing. Some important objectives included (a) gradual transition to new full or near-cost recovery tariffs, (b) long-term loans from international finance institutions, (c) widespread introduction of water meters, (d) PPPs in service provision and maintenance, (e) greater participation of households in service financing, and (f) provision of 'safety nets' for the poor.

The government has launched and has been supporting multiple initiatives to finance the WASH sector, such as the National Programme, TFMs, and improved tariff policy. While these steps did bring some positive outcomes, the actual financing did not achieve the expected targets. The financing under the National Programme reached only about 60 per cent of the required amount, with a large share of funding falling on cities and towns. TFMs were piloted in only a few rural districts with most funding coming from external sources. State budget allocations were channeled only sparingly to the trust fund. Further TFM replication, beyond pilot areas, is neither foreseen nor yet institutionalized at national level.

In accordance with the Programme for Improvement of Access to Safe Drinking Water for the Population of the Republic of Tajikistan for 2007-2020 [9], USD1 billion (3.3 billion TJS) is necessary to enhance nationwide access to safe drinking. This is to be obtained from the following sources:

- State (national) budget: 15 per cent of the total amount
- Local budget (districts, administrations and authorities): 10 per cent
- State and non-state service providers, including community contributions: 5 per cent
- Investment and foreign aid: 70 per cent

Simultaneously with the SUE KMK initiative, in 2010 the government approved the Reform Concept [10] for the housing and communal services sector for 2010 to 2025 for which USD2 billion was estimated to be deployed from similar sources. Through this concept GoRT stressed the need to demonopolize ownership and management of drinking water supplies and sanitation systems, as well as to establish PPPs with non-state actors.

Unfortunately, to date these programmes and concepts have not yet yielded the expected results. Based on reports by the National MEWR, implementation of the program has not exceeded 40 per cent in any particular year, averaging below 30 per cent [11]. As of January 2019, only about 20 per cent of the estimated budget was spent, with the majority (71.2 per cent) comprising grants, credits, and loans (28.8 per cent). The largest share of investment from development partners was channeled to develop drinking WASH services in cities and towns, some USD114.7 million or 84 per cent of the total investment into the sector. In contrast, rural communities received USD22.1 million, 16 per cent of the total amount. About 14 major WASH investment projects were implemented, with the largest contributors coming from the EBRD (USD87.6 million), the World Bank (USD26.5 million), the Swiss Government (USD13.6 million), the EU (USD4.97 million), the ADB (USD4.92 million), JICA (USD3.6 million), and the SECO/Aga-Khan Foundation (USD2 million).

Water tariffs

There are two major issues in Tajikistan. Firstly, the current fees are too low, averaging between 33.5 per cent and 43.5 per cent of the full cost recovery of SUE KMK operations. The mean tariff for all state-owned SUE KMK systems is estimated at 1.09 TJS/USD0.11 per cubic meter. However, based on calculations, this tariff is significantly below the full cost recovery margin, averaging at 4.0 TJS/USD0.39 per cubic meter. A series of attempts by SUE KMK to approve full cost recovery tariffs were rejected by the authorized agencies, which advocated for gradual tariff escalation over time. Secondly, the fee collection rate is low. Despite being modest, the tariff collection rate, especially from private households and state institutions, is poor. Based on the SUE KMK report, by 2017, owing to insufficient fee collection, the entity faced a deficit of approximately USD4.1 million [12]. The main tariffs of the WASH sector are presented in Table 11.

The role of water users and water consumers is becoming increasingly important for at least some share of small and medium-sized systems, as well as decentralized standalone schemes in primarily rural areas.

Table 11. National tariffs for drinking water supply and wastewater services in Tajikistan [13]

Currency	Drinking water supply services (per 1m^3)			Wastewater (sanitation) services (per 1m^3)		
	Private households	Commercial entities	Public/social institutions	Private households	Commercial entities	Public/social institutions
TJS	1.09	2.02	3.48	0.55	1.09	1.88
USD ③	0.10	0.18	0.31	0.05	0.10	0.17

③ USD equivalent calculated based on exchange rate effective as of 16 November 2020 (rounded estimate). Source: National Bank of Tajikistan (official website). Available at: https://nbt.tj/tj/kurs/kurs.php

Subsidies and other government preferences

Subsidizing is not yet applied in the WASH sector in Tajikistan. Owing to state and local budget constraints, the authorities have not been able to provide sufficiently targeted subsidies to poor families or compensations to operators. The state had to decrease social subsidies in 2012 and strengthen taxation to compensate in part for the consequences of the ongoing socioeconomic challenges.

Application of innovative financial mechanisms and private sector involvement

The sustainability of rural water supply in Tajikistan depends foremostly on two major sources, also identified by the government in designated legislation, (a) state support in any form including direct financing, subsidies and concessions and (b) payments by water users in the form of investments and water fees.

GoRT launched and supported multiple initiatives to finance the WASH sector including, (1) the USD1 billion from the National Programme, (2) TFMs, and (3) an improved tariff policy. While these initiatives did bring certain positive outcomes, financing levels did not achieve the anticipated targets. The financing of the National Programme, for instance, did not exceed 60 per cent, with the lion's share of funding targeting urban localities. TFMs were piloted in only a few rural districts with most funding coming from outside sources. Allocations from the state budget were channeled only sparingly to the trust fund.

Meanwhile, more local private entities and local communities are contributing towards financing and managing rural water supply systems, their rehabilitation, construction, and maintenance and even covering part of the future investment costs. In various ways, rural communities and/or water users are self-organizing either into community-level non-profit associations or acting as private sector agents such as commercial LLCs in an attempt to ensure the sustainability of drinking WASH services across rural Tajikistan.

Chapter 3.

WASH: community-based water schemes

There are several management systems operating in Tajikistan currently. Public schemes represent the most common WASH services delivery model utilized by SUE KMK and its local (district) subsidiaries: *vodokanals* and *Tojikobdehot* (the rural water supply agency). Establishing service providers in the form of state enterprises enables state support of their operational activities. The state is interested in attracting investment into these sectors, and therefore prioritizes cultivating favorable conditions to protect water user rights. Its subsequent commitments to addressing social issues are particularly beneficial to the poor. However, many barriers stand in the way of efficient resource allocation, including, but not limited to, the ambiguity of sector state administration, poor institutional capacities and the deficit of budgetary support for development efforts.

A number of water supply and sanitation schemes are widely practiced across rural Tajikistan. Community-led WASH schemes typically assume the form of WUAs, Water User Committees (WUCs) or village or communal organizations under *jamoats*, and LLCs as private agents by mandate who are responsible for O&M. All these models enjoy the legal authority to own and manage small-scale infrastructure with sector-specific rules and regulations [5]:

- **Community-based schemes** and operated by WUAs were established in some rural areas. Under this model, households register as WUA members and each has a vote to elect WUA board members. However, in general, WUAs were initially established to manage irrigation. In the WASH sphere, WUAs are observed to be common among smaller-size operating schemes. In such instances, *jamoats* and *mahallas* (village/community councils) remained active participants in the design and operating phases, contributing to tariff collection, the communication of complaints, and engaging consumers in the decision-making processes.

- Community-based schemes also include the VO model with WUC within its structure. The nature and mode of its operations is similar to that of WUAs.

- Another piloted model is the housing and communal organization established under *jamoats*, a scaled-down model of district-tier *vodokanals* and operated by SUE KMK.

- **Private schemes** LLCs possess a legal right to cooperate with private lenders and banks over the course of their activity, as well as approach private lenders to fund O&M efforts. While the LLC framework can be efficient and cost-effective in managing financial resources, the plans for expanding this model may be hindered by the lack of human resources. Despite their investment and service delivery potential, ownership rights over infrastructure are not clear in the case of privatized LLC schemes. The current legislation lacks a legal mechanism to support the transfer of ownership of existing drinking water systems to private entities.

Community-based water schemes face: (a) largely insufficient technical and institutional O&M capacities, (b) low-grade corporate management, and (c) poor financial literacy, that includes an understanding of full cost recovery tariffs, access to finance, and water-fee collection. Professional engineers are highly limited at district level and virtually unavailable in rural settlements. In this regard, development practitioners have often suggested that rural WASH operators have contract-based relations on O&M with SUE KMK, seen as a PPP arrangement. While this model has not yet come to fruition in rural Tajikistan, development actors and authorities, both national and local, are encouraged to apply the corresponding regulatory mechanisms. Unfortunately, all district-level branches of SUE KMK service systems are located only in respective district centres. Despite the remote location of multiple systems under SUE KMK ownership, they are neglected in terms of O&M most often owing to resource constraints on behalf of their official owner.

Chapter 4.

Knowledge, technology, and experience sharing

Today, several policy dialog and coordination platforms are promoting the necessary sector reforms, and in particular aiding the coordinated implementation of the ongoing Tajikistan Water Sector Reform Programme. One way or another, each of them also serves the purpose of knowledge, technology, and experience sharing. The platforms includes: (a) National Policy Dialogue (NPD) on Integrated Water Resources Management and Drinking Water Supply and Sanitation, (b) IMWG on Drinking Water Supply and Sanitation, (c) TajWSS Network of Stakeholders, and (d) Consumer Rights Protection Platform (ConsTaj).

The platforms, NPD, IMWG, and TajWSS Network, are effective foremost in terms of information exchange, updates on projects implemented by development partners, sharing experiences, best practices, and lessons learned on applied approaches and models [14]. Through these venues GoRT was able to distribute target zones among development actors, projects to foster IWRM reforms, as well as pilot interventions in five different river basins: the IWRM and river basin management in Syr Darya, Kafirnigan, Vakhsh, Pyandj, and Zeravshan.

Technology transfer is perhaps the weakest point of these platforms. Targeted technology transfer platforms could be initiated in Tajikistan with the following potential focuses: (a) billing mechanisms for WASH services, (b) sanitation and hygiene promotion, (c) development of rural sewage systems, (d) solid waste management in health facilities, (e) effective O&M arrangements for rural service providers.

Information dissemination is another issue that needs improvement in Tajikistan. Although in existence, the majority of online resources are administered by line ministries and state agencies who lack the proper updates. Their corresponding websites comprise basic information about mandates and relevant key policy documents of entities, but do not foster knowledge and experience sharing.

WASH: National recommendations

With the ongoing reforms, support for legislation improvement, and institution building and reorganization, it is important to align water resources management with IWRM principles.

1. Legal and institutional basis for WASH sector development

While new and amended legal acts such as the Water Code, Drinking Water and Sanitation Law, and the Law on WUAs were endorsed by GoRT to support the Water Sector Reform Programme, the corresponding implementation support and mechanisms are still missing:

- Defining a focal state agency and defining its key mandate in the WASH sector, including clear functions pertaining to policymaking, regulation, and service provision, not conflicting with the roles of other line ministries and agencies, is necessary. Institutional restructuring of SUE KMK to six provincial-level hubs with service delivery responsibilities, except regulatory functions, represents a segment of the reforms supported by EBRD funding through credits and loans

- It is likewise necessary to design procedures for handing over WASH services regardless of the ownership model and operational management rights

- Devising procedures for the discontinuation, restriction, and termination of access to the WASH sector. Enforcement measures to support due payment for water services to improve fee collection is also required

- It is also necessary to design step-by-step implementation mechanisms to enforce the newly adopted norms and standards, governance procedures, and service provision standards

Institutional support is required on all fronts and layers of the governance system. Development agencies in partnership with GoRT could develop comprehensive capacity-building programmes to support MEWR and SUE KMK on a systemic basis. Capacity-building support should cover both hardware and software dimensions. These will enable the growth of the necessary institutional, organizational, technical, O&M, and material base, as well as infrastructure capacities of the key state agencies and entities concerned.

2. Financial aspects of the WASH sector development

Further WASH sector development requires the deployment of the necessary financial mechanisms, including the following:

- Development of state WASH financing programmes and strategies beyond 2020 based on realistic targets
- Development of clear guidelines for full cost recovery tariffs in the WASH sector, and state promotion of full cost recovery tariff schemes designed both by state and non-state actors
- Nationwide promotion of metered water connections to ensure effective implementation of pro-poor and full cost recovery mechanisms. This will also encourage water users to save water and seek ways of applying water-efficient technologies
- State agencies and development partners should further assess ability and willingness to pay in rural localities across Tajikistan. The absence of subsidies, including cross-subsidies, pro-poor tariff policies and tax remission practices could also become instrumental in aiding vulnerable population groups
- Devising procedures for establishing WTFs to carry out subprojects on the rehabilitation, reconstruction of old, and construction of new drinking water supply and sanitation systems

3. Capacity-building for WASH services management

- Build the capacity of national WASH agents systemically based on a clear vision articulated through a comprehensive capacity-building program
- Capacity-building of local communities for more effective WASH services development is needed in the following aspects: (a) technical and institutional capacity on O&M, (b) organizational management, and (c) financial literacy, a greater understanding of full cost recovery tariffs, access to finances and water fee collection. In addition, access to professional engineers is vital; these are highly limited at district level and mostly unavailable in rural settlements.

4. Knowledge and information sharing

- Several policy dialog and coordination platforms were created and currently operate to promote necessary sector reforms and share knowledge, technologies, and experiences
- It is necessary to establish a special technology-transfer platform for practitioners. Such a platform may be used for sharing any documented experience on technological improvements in the WASH sector and to enable possible further replication. According to development partners and GoRT, MEWR, specifically, mandated for policymaking and regulation and could chair the platform with SUE KMK as co-chair as the lead service provider for state-owned WASH enterprises
- Improving the policy environment for collecting accurate information on successes and lessons learned, applied business models for community-based water schemes, and for upscaling target efforts
- Promoting effective business models for setting up rural WASH services to promote the PPP policy. The corresponding pilot projects could be designed to feed further into the reform agenda

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National Part of the Report for Uzbekistan Development of Sustainable Water and Sanitation Systems in Irrigated Areas of Rural Uzbekistan

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Introduction

In economic terms Uzbekistan is one of the fastest-growing countries in Central Asia. The Republic of Uzbekistan has been consistently implementing water use reforms, including targeting water supply and sanitation, adopting comprehensive measures for rational use of water, ensuring its quality and safety, and introducing modern, innovative, systems for water consumption accounting.

New water management infrastructure ensuring effective water use regulation is in place, and proactive efforts to attract the private sector into water supply and sanitation are underway. However, owing to various reasons serious challenges remain both for development and maintenance. During the transition period, against the background of a new economic, social, environmental, and political reality, the WASH sector has endured fragmented and dysfunctional regulatory and institutional frameworks, limited sector planning capabilities, weak coordination and oversight, and unclear and ineffective regulatory compliance mechanisms. WASH services delivery institutions have performed poorly. Funding constraints have also been acute, exacerbated by low tariff rates and fee collection

efficacy, limited public funding, limited stakeholder involvement and a virtually absent private sector. Significant inequalities also exist in the provision of WASH services, particularly between urban and rural areas.

As Table 12 shows, on a national scale 59 per cent of the total population (over 34 million) have access to an improved, safely managed, and accessible on-premises water supply. Compared to water supplies, sewage systems are much less developed in the country. Built in the 1970s and 1980s in urban communities and largely abandoned since then, the sewerage infrastructure is in poor condition and continues to deteriorate. Wastewater treatment plants are also highly degraded, in many cases even nonfunctional, leading to contamination of surface water sources. About 50 per cent of urban and 5.5 per cent of rural populations across Uzbekistan are connected to municipal wastewater networks. The remaining population relies on rudimentary installations such as pit latrines and earthen ditches, these practices threaten public health and hygiene. Discharging a vast quantity of wastewater into rivers, impoundments, agricultural areas, and groundwater sources causes environmental pollution and river water contamination.

National hygiene estimates demonstrate that the share of the domestic population using facilities with basic conditions exceeds 90 per cent. However, there is a significant discrepancy between urban and rural areas in access to a drinking water and sanitation [1, 2].

Table 12. Access to WASH in Uzbekistan [1, 3]

Main indicators	Urban	Rural	Total
% of population with access to safely managed drinking water	86%	31%	59%
% of population connected to piped systems	88%	52%	70%
% of population using non-piped systems	11%	44%	28%
% of population using contamination-free drinking water sources	92%	88%	90%
% of urban areas properly connected to centralized water supply systems	89.3%	69.4%	
% of population connected to municipal wastewater systems	50%	5.5%	
% of population using improved sanitation facilities by type: - latrines and other - septic tanks - sewer connections		 55% less than 1% 45%	 77% less than 1% 23%
% of total population using hygiene facilities: - with basic conditions - with limited conditions (without water or soap) - no facilities			 90% 29% less than 1%

At present, centralized water supply systems are available in 119 cities and towns (100 per cent) and 8,200 rural localities (76 per cent) across the country. The total volume of water consumed per day amounts to 7 million cubic meters, with a daily consumption per person of 128.2litres. This includes 38 per cent from surface and 62 per cent from ground sources. The total length of water pipelines and water supply networks is over 65,000km [4, 5].

Drinking water sources for unconnected households include public standpipes, pumps in private yards, both are used in district administrative centres but they are mainly for rural areas, rivers, ponds, irrigation canals, mainly for rural communities, as well as bottled water and purchased filtered water. Poor residents have meager alternatives and are often forced to use unhygienic sources such as irrigation canals and rivers or ponds typically containing low-quality water [19].

Nevertheless, jointly with international partners, the national government has made considerable progress in enhancing the performance of the WASH sector in the last decade. Thanks to recent efforts on behalf of water utilities, 88 per cent of the population are supplied with water. The installation of water meters has received a lot of attention in all recent projects and a rough estimated average of 40 per cent of the water sold is now measured. The relatively small volume of water sold per capita, an average of 61litres/day, shows that water is now used more efficiently [2, 8, 9, 10].

Chapter 1.

WASH: policies and institutions

Historical overview

Most of Uzbekistan's centralized water supply systems were constructed during the Soviet era. Over the course of the last 30 years, the national WASH institutional framework has gone through several changes, shifting from the Soviet to the recently approved contemporary model. Under the former approach, all WASH related targets were set by the central government, and all WASH related costs, such as construction and O&M, for rural communities were covered by respective *sovkhozes* and *kolkhozes*. After the collapse of the Soviet system and the dissolution of the *sovkhozes* and *kolkhozes*, rural WASH services were left abandoned for several years. As a result of insufficient funding and human resources, drinking water supply systems deteriorated, resulting in unreliable service, high water losses and pollution risks. At present, energy consumption in the WASH sector is high. 44 per cent of total operation costs and technical water losses reach as much as 40 per cent. In many constituencies, households and businesses are hampered by frequent water supply disruptions, forcing them to resort to alternative non-secure water supply sources [7, 8].

At a later stage, WASH services were transferred to the ownership of local governments. This step did help to improve the situation slightly but did not bring about quick changes. Finally, in 2019 the WASH service providers were returned to the supervision of the national MHCS in the form of the joint stock company, the *Uzsuvtaminot* JSC, created on the basis of state unitary water supply enterprises and part of MHCS, transforming them into LLCs [9].

Current laws and policies

The last four years have seen the fulfillment of the nationwide water sector reform, focusing on the development and revision of WASH policies and plans, and the establishment and revision of national performance targets and indicators, as well as the establishment and reorganization of WASH agencies across different tiers.

Uzbekistan has established WASH policies and plans. The *Conceptual Directions of WASH Development for 2020-2035* are stipulated in Resolutions by the President of the Republic of Uzbekistan No. PR-5883 *On measures to improve water management, quality and reliability of drinking water in the Republic of Uzbekistan* on 26 November 2019; No. PR-4947 *Strategy of actions for further development of the Republic of Uzbekistan* on 7 February 2017, as well as other policy documents. Recently, public involvement in policymaking has been receiving increasing attention. While drafting regulatory documents, they are posted on official government websites to enable public and multi-stakeholder review and discussion.

A special National Commission to coordinate and monitor the implementation of the *Integrated Drinking Water Supply and Sanitation Systems Development and Upgrading Program* was set up and is currently operating. Based on its domestic policies, the country has also embarked on prioritizing and strengthening climate resilience within the framework of WASH. By introducing mandatory EIA requirements for any development projects, especially dealing with water resources management, Uzbekistan has forged its own policies and plans to promote the climate resilience of WASH technologies and management systems. The *Global Status Report 2019* states that external support agencies in Uzbekistan are likewise prioritizing climate change adaptation in their WASH strategies and activities [2].

The *Strategy on water supply and sanitation development of the Republic of Uzbekistan for the period up to 2035* is under development. The strategy will include consolidated parameters from the *Program of integrated development and upgrading of drinking water supply and sanitation systems*,

including the construction and reconstruction of WASH facilities using loans from international financial organizations [5].

By the same token, Uzbekistan has been striving to ensure the safety of managed services and other new elements of SDGs under national WASH targets by projecting water quality and average per capita water consumption. Specifically, 240lcd (liters per capita a day) in urban areas, 160lcd in urbanized rural communities, and 115lcd in rural settlements. Water quality is regulated by the *National Water Quality Standard* requirements [10, 11].

Organizational chart of WASH services in Uzbekistan

About 6,000 water supply and sanitation service providers are currently operating in the country [19], including nine interregional water pipelines, over 2,300 urban and rural water supply and sanitation facilities, about 5,000 rural systems, and about 1,000 rural networks. Wastewater treatment facilities were mostly built 30 years ago. Reinforced concrete and metal structures are worn out, and communication and automation systems often do not function. Cleaning technologies are outdated and inefficient. Official agencies managing water supply and sanitation services are under the jurisdiction of MHCS, regional and district *khokimiyats* (administration), line ministries, large corporations, interdepartmental organizations, and associations, as well as *agrovodokanals* (agricultural water administrations). More detailed information is presented in Table 13.

Table 13. Key WASH stakeholders in Uzbekistan

Organization	Key mandate
Cabinet of Ministers	- Setting sectoral policy and endorsing major investment decisions
Republican Commission on coordination and monitoring the implementation of the Program of integrated development and upgrading of drinking water supply and sanitation systems	- Coordinating and monitoring the implementation of the Program, timely commissioning of water supply and sanitation systems/ facilities - Approving territorial schemes for developing water supply and sanitation considering settlement-specific urban planning documentation - Elaborating recommendations on the adoption of modern energy-efficient pumping equipment at water intake facilities, pumping stations, and water distribution centres - Monthly hearing of reports by the State Committee on Geology and Mineral Resources on the results of technical evaluation of wells and water intake facilities, as well as effective use of underground water resources - Monthly review of the programme implementation progress
MHCS	Overseeing water supply and sanitation, including: - Implementing the unified state WASH policy and ensuring cross-sectoral coordination - Designing and executing target programmes - Developing and implementing modern forms and methods of housing and communal services considering the best practices of developed foreign countries - Setting the WASH tariff policy for the provision of water supply, sanitation, and making proposals for capacity-building for WASH personnel, jointly with Ministry of Finance

Organization	Key mandate
Inspection for Drinking Water Control (under MHCS)	- Ensuring compliance with WASH regulations, norms and standards - Conducting technical audits of WASH infrastructure, including energy efficiency - Ensuring compliance with technical specifications and conditions for network connections, and preventing unauthorized connections - Monitoring proper state and use of infrastructure, including the efficacy of preventive measures and compliance with water loss norms and - Monitoring condition and use of ground water wells irrespective of ownership
Ministry of Finance	- Traditionally playing a strong role in financing decisions and in strengthening the financial sustainability of the WASH sector - In coordination with MHCS, setting the WASH tariff policy
Ministry of Investment and Foreign Trade (jointly with MHCS)	- Forming the list of projects to improve WASH services and conducting corresponding feasibility studies to prevent low-profit projects and projects with loan coverage by service fees below 50%
Tashkent City and provincial governments	- Jointly with *Suvoqava* LLC branches, bearing responsibility for drinking water and sanitary services delivery in respective constituencies
Ministry of Water Resources (MWR)	- Jointly with the Council of Ministers of the Republic of Karakalpakstan, and *khokimiyats* of provinces and Tashkent City, ensuring priority water supply from natural and manmade reservoirs to water supply and sewerage enterprises, provided the production of water reserves is secured
Ministry of Health	- Controlling the quality of water supply - Jointly with the State Committee on Ecology and Environmental Protection, monitoring and preventing discharge of contaminated industrial wastewater into municipal sewerage systems or open water sources, and banning activities of enterprises regardless of their departmental affiliation and ownership in case they do not provide primary wastewater treatment, until the execution of instructions to eliminate the identified violations
Ministry of Education	- Developing higher and secondary education on WASH, international cooperation and utilizing foreign experiences and modern international standards and practices
State Committee on Geology and Mineral Resources	- Ensuring that hydrogeological surveys to determine water reserves to supply water to cities, towns, district administrative centres, and rural localities are included in annual targeted programmes approved by corresponding government resolutions - Conducting hydrogeological surveys within the framework of the annual Program for Construction and Reconstruction of Drinking Water Supply and Sewerage Facilities

Organization	Key mandate
State Committee on Ecology and Environmental Protection	- Performing state environmental control over the state of ecosystems, and surface and underground water resources - Designing, approving, and implementing efforts to prevent violations of rational use of natural resources and waste management requirements

The Ministry of Housing and Communal Services (MHCS) of the Republic of Uzbekistan is the key agency authorized for the WASH sector management. MHCS's structure, including territorial departments (See Figure 3).

The main organization delivering WASH services is *Uzsuvtaminot* JSC. Its main objectives include enhancing service delivery by consolidating human resources and technical capacities, leveraging economies of scale, and promoting financial sustainability, creating companies capable of generating sufficient revenue to finance the necessary capital investment, increase operational efficiency, and expand service coverage.

In general, the establishment of a national-level ministry responsible for supervising the WASH sector is seen as a positive development and an opportunity to build capacity and knowledge in the sector, create a modern regulatory framework and provide a framework for long-term planning and investment, as well as sustainable O&M. However, many stakeholders involved in WASH sector management have endured fragmented and dysfunctional regulatory and institutional frameworks, limited sector planning capabilities, weak coordination and oversight, and unclear and ineffective regulatory compliance mechanisms imposed by state agencies.

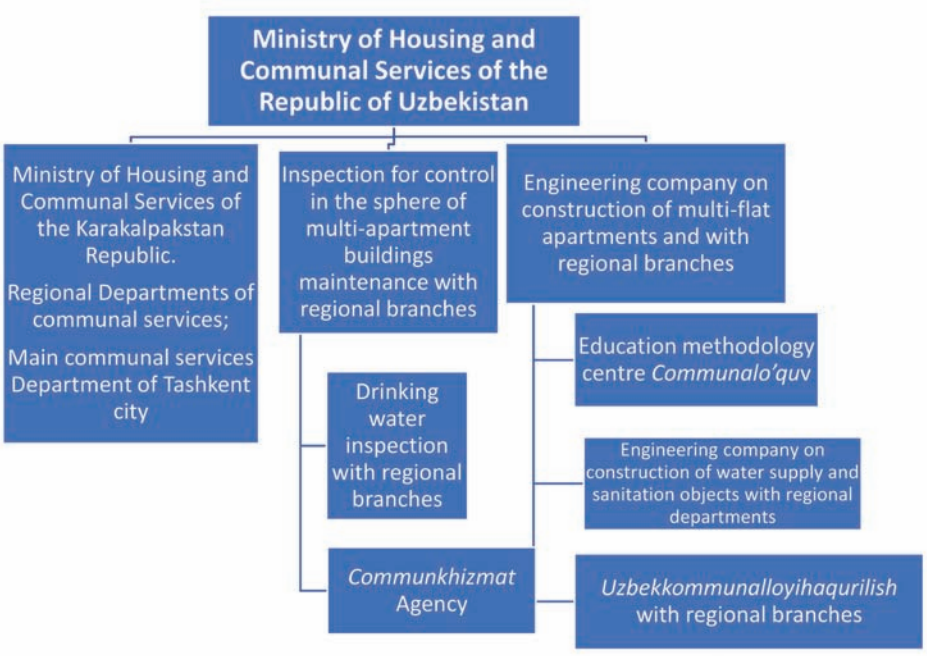

Figure 3. Organizational structure of MHCS of Uzbekistan

Chapter 2.

WASH: financing and economic aspects

Uzbekistan is aiming to increase the water supply rate to 98 per cent in urban and 85 per cent in rural areas, as well as the sewage provision rate to 31 per cent by 2030. To achieve this, USD4.5 billion is required [11]. In recent years, Uzbekistan has made substantial investment in upgrading its WASH services. From 1995 to 2014, the total public borrowing for target improvements amounted to USD344.1 million; larger than any other Central Asian country.

Having policies and plans approved or under development or review does not necessarily guarantee the robustness and sustainability of domestic WASH services. Insufficiency of financial and human resources constitutes a major barrier to full implementation of WASH-related plans.

The reform considers the application of the following approaches:

- Develop full cost recovery service schemes, including upgrading costs
- Introduce a procedure for state compensation for drinking water expenditure for communities residing in remote and mountainous locations
- As a pilot, transfer water supply and sewage systems to entrepreneurs under PPP schemes

Water tariffs

Traditionally, water tariffs have been and remain subject to periodic revision, they are adjusted, usually on a semi-annual basis, according to changes in operating costs to allow asset amortization and acceptable profit. Although tariffs have increased recently, they still remain too low to cover O&M costs or to accumulate funds for subsequent investment. The ADB has estimated that inadequate revenues result in low staff wages, reduce the ability of service providers to hire and keep skilled staff, as well as perpetuate a deficient O&M cycle [12, 13]. The main tariffs of the WASH sector are presented in Table 14.

Household water related expenses were estimated at 3 per cent of the total average family expenditure, 4 per cent for poor, and 3 per cent for non-poor households, that is, below the conventional 4 per cent World Bank threshold. Usually, household tariffs are charged on a fixed and variable basis depending on whether a household has a meter or not. It is also noticeable, that the collection efficiency increased from a low 50 per cent to 70 per cent level in 2011 to over 90 per cent currently. Yet, although the tariffs were recently raised, they remain low and are not sufficient to cover operations, maintenance, and capital expenditure within the WASH sector.

Furthermore, the current pricing approach, when customers without meters are charged based on high assumed consumption, removes the incentive

for service providers to install meters, as customers almost always consume far less, owing to low water availability, than they are billed for. In communities with adequate water treatment, the lack of customer meters encourages overconsumption and waste [12, 13b, 14].

Subsidies and other government preferences

The Ministry of Finance and MHCS were tasked with deploying a procedure in accordance with which, as of 1 January 2020, tariffs would be calculated based on full cost recovery and upgrading costs. However, this approach can significantly affect poor communities. In the meantime, to support vulnerable populations, it is envisaged that a procedure for the state compensating a share of drinking water costs incurred by communities in remote and mountainous territories.

Application of innovative financial mechanisms and private sector involvement

During a pilot project, certain water supply and sewage systems will be transferred to private entrepreneurs under PPP schemes. However, to make the sector attractive for private companies it is necessary to ensure its profitability. For now, WASH service providers often have debts and cannot afford to cover the operational costs associated with rendering high-quality services. Electricity debts, low tariffs, and vast serviced areas with many customers, as well as high O&M costs, pipes and pumps suffering from accumulated wear and tear and a shorter operating life owing to frequent and sudden power cuts all contribute to the status quo.

Table 14. Water tariffs for WASH services in Uzbekistan for 2020 [14]

	Fixed tariffs (per capita/ month)	Variable tariffs for households		Commercial tariffs		
		Water supply	Wastewater services	Water supply (current)	Wastewater services	Social institutions, (schools, hospitals) WS+S
Rural	2,100 UZS/m^3 (USD0.21)	350 UZS/m^3 (USD0.04)	240 UZS/m^3 (USD0.02)	1,000 UZS/m^3 (USD0.10)	550 UZS/m^3 (USD0.06)	440 UZS/m^3 (USD0.04)
Urban	10,826-12,697 UZS (USD≈1.04-1.22)	565 UZS/m^3 (USD0.054)	350 UZS/m^3 (USD0.034)	839.5 UZS/m^3 (USD0.08)	529 UZS/m^3 (USD0.05)	644 UZS/m^3 (USD0.062)

Chapter 3.

WASH: community-based water schemes

A number of management systems operate in parallel in Uzbekistan today. Large urban centres have centralized wastewater collection systems with primary treatment facilities such as screenings and facultative lagoons. Although gradual adjustments are taking place, Uzbekistan's WASH public administration is still highly centralized. Against this background, certain actions are undergoing development jointly with international development actors including, the ADB, WB, SDC, and Crosslink International, to support community-based water schemes. The fact that local residents can participate in decision-making stimulates the overall acceptance of a project. The last few decades have witnessed the emergence of several community-level water schemes across the country, although their share remains marginal.

Rural settlements currently have no centralized sewers and rely mostly on decentralized onsite household wastewater disposal installations. Around 95 per cent of rural families dispose of domestic wastewater using onsite facilities, pit latrines, septic tanks, or other similar soil absorption methods.

In 2013-2018, Uzbekistan had implemented a large-scale water program aimed at advancing the local water supply management framework. The project helped municipalities to build their own drinking water supplies. As a result, old or broken water installations underwent reconstruction and villages previously without access to drinking water were connected to operating water supply networks. At present, local communities are also responsible for O&M of their water installations, such as protecting them from freezing. Village committee meetings make joint decisions on water supply and monthly tariff rates to cover running costs, such as, electricity for pumps, maintenance, and salaries. Still, community-based WASH services are much less developed across the country except for a limited number of projects managed by UNICEF in schools and HCFs and other organizations [16, 17, 18, 19].

Thanks to these projects, in the last decade over 40 localities, more than 160,000 residents, received a drinking water supply. Nonetheless, the share of community-based water schemes is quite small. Assessing and detecting good WASH practices suitable to local conditions should be given high priority alongside advancing conventional schemes.

Chapter 4.

WASH: knowledge, technology, and experience sharing

Insufficient funding and human resources are often among the major constraints in WASH surveillance and oversight. Speedy reforms, capacity-building based on various techniques and approaches is critical to improve and foster WASH evolution in Uzbekistan.

An effective institutionalized framework for sharing WASH knowledge, technology, and experience is lacking. The country has WASH training programmes and institutions to build in-country human capacity, yet these programmes are either partially or completely insufficient. The existing SUI *Communalo'quv* Education Methodology Center, for example, mostly focuses on upgrading the knowledge and competencies of water supply and sanitation technicians, operators, and mid-tier professionals.

There is a need to design potent and suitable knowledge, technology, and experience-sharing mechanisms in the WASH sector. An average training budget is far below the global best practices for water utilities. Only two training centres are licensed to provide O&M training for water supply and wastewater companies. The National Training Center under MHCS performs training of trainers for district-level staff. The training budget of service providers does not meet their needs. Knowledge-sharing either among operators inside Uzbekistan or through twinning projects with international water companies is not sufficiently developed. The training materials available for the wastewater sector are likewise limited [13].

The corresponding drawbacks include low staff motivation and performance, absence of a systemic training needs assessment and development program and deficient capacity.

WASH: National recommendations

As a country with the largest population in Central Asia and a rapidly developing economy, Uzbekistan is the most vulnerable in terms of the availability of water resources. The WASH sector and national MHCS face huge and still unaddressed complex strategic tasks to improve drinking water supplies, sewage, and wastewater treatment at both technical and institutional levels. Continual efforts to improve supplies of drinking water and sanitation to the population, as well as to strengthen the material and technical base of water management organizations are under way. The study findings give rise to the following recommendations:

1. Legal and institutional basis for WASH sector development

- WASH sector management needs an improvement in regulatory and institutional frameworks, sector planning capabilities, coordination and oversight, and effective regulatory compliance mechanisms

- It is necessary to generate a new WASH strategic plan or amend existing ones to include the following vital tasks for the MHCS:

- Draft a general strategic plan for the development of water supply in cities and rural settlements in Uzbekistan up to 2035
- Draft a general strategic plan for developing domestic urban and rural water supply and sanitation systems up to 2035

2. Financial aspects of WASH sector development

- Forge mechanisms for a broad, competition-based mobilization of funds on behalf of stakeholders and the private sector to ensure the sustainability of WASH systems for advancing WASH services and ensuring their sustainability
- Strengthen financial modeling and cost-benefit analysis for implemented or newly developed WASH schemes and conduct the necessary mid-term planning
- Prioritize the development of a well-founded staffing plan to improve staff motivation and efficiency by means of salary adjustments and recruitment of additional qualified engineering staff
- Develop national projects and programmes aimed at improving fee collection and raising tariffs for deployment nationwide, pro-poor, and full cost recovery mechanisms

3. Capacity-building for WASH services management

- Identify good WASH practices suitable for specific local conditions, and simultaneously develop traditional schemes
- Further develop national and local water awareness programmes for all dimensions including, hygiene, technology, economic, and environmental
- Justify and expand the implementation of WASH schemes and systems typical for certain localities based on their environmental and economic conditions

4. Knowledge and information sharing

- Modernize the institutionalized framework for sharing WASH knowledge, technology, and experience. To improve the efficiency of the WASH training programmes and institutions building in-country human capacities
- Enhance material, financial, and human resources to support research and innovations on water supply, sanitation, hygiene, and wastewater treatment
- Build up technical and laboratory resources of educational establishments, and improve training programmes in the WASH sector
- Develop mechanisms to generate and maintain awareness among staff and organizations via timely and effective sustainable knowledge, technology, and experience-sharing practices to ensure high-quality capacity-building
- Design and introduce special programmes for exchanging international experiences on applying new technologies

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Part 3. Case Studies

Application of innovations

China case study: application of a novel type of infiltration gallery for a centralized water supply in farming areas of Minhe County of Qinghai Province

The project was carried out jointly by the Bureau of Water Resources of Minhe County, China IWHR and Qinghai Institute of Water Resources (QIWR)

Location: Minhe County of Haidong in the east of Qinghai Province, China.

Main challenges: Minhe County is a farming area with a relatively dense population, drinking water is mostly supplied via a centralized network. The original system had no disinfection facilities, and since the traditional infiltration galleries had fairly limited purification capacity the turbidity of the effluent usually exceeded safety limits. Pollution of water sources with animal faeces was common with the number of microorganisms in the water routinely over the permissible level. Piping and reservoirs were all in poor condition.

Main goal: The main goals of this project were to implement a new type of infiltration gallery to supply water to the three villages of Jiefang, Zangan, and Guangming and a total of 3,819 residents with a total water supply of 381.9 cubic metres per day.

Main approach: The target technology was developed by IWRHR and the Qinghai Institute of Water Resources. The construction was done by the county-level Bureau of Water Resources, and the villagers were encouraged to participate.

The proposed novel infiltration gallery design utilizes a new capillary percolation band (2mm thickness) to replace the PVC pipes, as well as concrete and steel tubes often used in conventional infiltration installations. The design of the infiltration gallery is simple, efficient, and easy to maintain. The grooves with their 0.2mm to 0.3mm widths are set right under the capillary holes, and the holes and the grooves form a series of 'Ω' apertures [1] (see Figure 4).

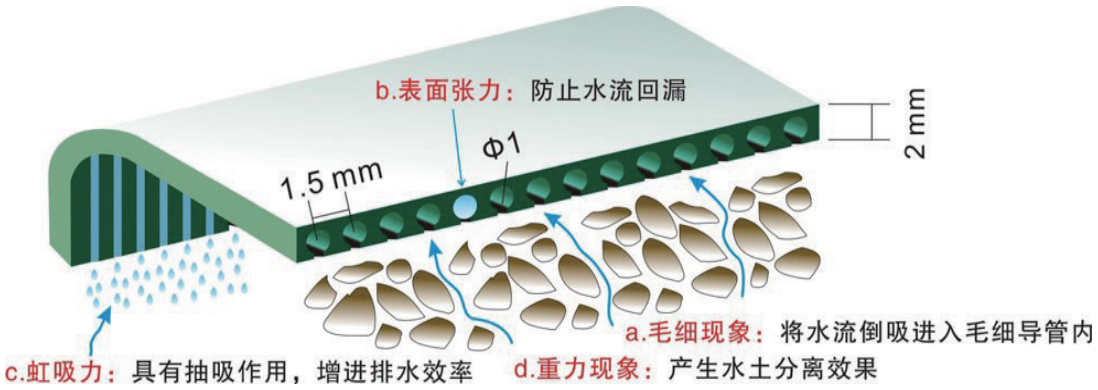

Figure 4. Capillary rain belt infiltration

(a. capillary: water intake into the capillary belt; b. surface tension keeps water in the grooves; c. siphon: improved drainage effect with a suction function; d. gravity separation of soil and water)

Capillary percolation effectively addresses clogging. The holes face the rubber band to absorb water and since the diameter of the groove entrance is smaller than that of the capillary tubes, suspended matter naturally gravitates down and does not enter the grooves. Meanwhile, surface tension prevents water from escaping the grooves. When the band reaches its full capacity, the water inside exits the band through gravity. The water dripping from the groove exit triggers the siphon effect, this helps to increase absorption efficiency [2]. The two types of drain belt infiltration based on this design are shown in Figure 5.

System maintenance requires only one or two people to clean the grit chamber, dosing, repairing the piping, and to monitor water quality for residual chlorine content. After it has been in operation for three years, silting issues may arise, and it may require three or four people to remove sediment and perform a complete system clean.

The project is based on a participatory approach, and users can partake in all stages of construction and maintenance of the water system. A user management organization can be established to assume responsibility for taking care of this water supply project [3].

A wide awareness raising campaign, included consultations with the population on the applied technology, the distribution of drinking water safety knowledge manuals in target villages, as well as issuing public awareness materials to cover the whole project area. In addition, a feedback mechanism was created to receive comments from the beneficiaries on the performance of the technology and the work of the management company. The online public platform (12314 Feedback Platform) under MWR of China was launched for citizens to provide their opinions back to the management organization [4].

Financial aspects: This project was included in the Rural Water Supply Enhancement Plan of Minhe County and was funded with central and local finances. The construction of the water intake and disinfection facilities, as well the piping between water sources and reservoirs was financed by the Research and Application Special Fund of Qinghai Province under the 13th five-year plan RDWS enhancement budget, and provincial and county finance totaling USD280,500, approximately USD0.87 per capita. Finances were mainly used for people living in poverty and accounted for 89 per cent of the entire investment, while the provincial and county contribution covered the remainder.

The system's annual O&M cost is USD9,450, which includes salaries of USD5,400 per year, dosage (USD1,800 per year), and piping maintenance (USD2,250 per year). The water fee roughly covers the costs. In the case of a major repair, costs are covered from the provincial RDWS O&M budget. Since 2016, the annual O&M budget appropriated from the provincial government of Qinghai to Minhe County has amounted to USD60,000. According to the Regulations on the Operation of RDWS Projects in Minhe County, the water fee is determined by a user committee and a user congress and can cover O&M costs.

Main results: The project has benefited 634 households by ensuring the safety of drinking water in target villages and enhancing overall social stability and economic growth.

Sustainability: After completing the construction, the ownership and main responsibilities were transferred to the local village committees and the government of Guangzhou Town. In Minhe County, the WUA was established for daily management and maintenance. The WUA's management committee is comprised of three users elected by other water

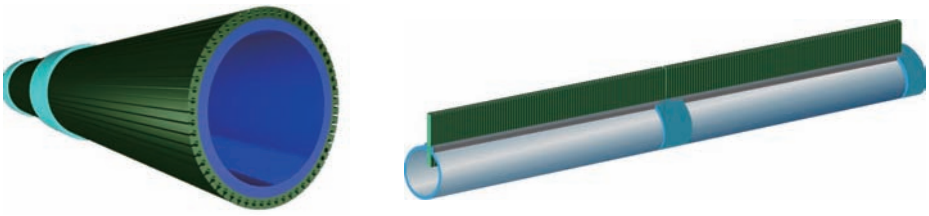

Figure 5. Two types of capillary drain belt infiltration

users. These elected representatives have prestige within the community, as well as possessing some management experience. Whereas the WUA's management committee decides on the general matters of the water supply project, the WUA governs more significant issues. The Bureau of Water Resources sends agents to help the villagers and promotes the project's outcome assessed by research centres.

The project has become the first to use a capillary percolation band for water intake at infiltration galleries, setting a new standard. The introduced technology has solved the water supply shortage efficiently during the dry season and enhanced the purification capacity of the infiltration galleries during floods. In addition, the water supply guarantee rate and water quality have both improved greatly. The practice ensures safe drinking water for local rural residents. Residents pay more attention to personal hygiene and wash their hands more often, improving public health overall. Indeed, people now seldom catch waterborne diseases, leading to a significant reduction in medical costs.

Next steps: As an applied water supply model, infiltration galleries are cheap in terms of construction cost while being able to provide outstanding water quality thanks to the aquifer filtration effect on river water. The new design of utilizes capillary bands to accomplish highly efficient water intake, greatly reducing the pressure on filters, and addressing the silting problem caused by floods. The technology can efficiently prevent water shortages in winter, which makes it suitable for rivers in cold regions. Its water supply guarantee rate is high and the O&M of projects based on this technology is undemanding. This case study is a good example of the use of a new material in the industry; it is highly likely that the technology will receive much wider application in the near future.

Specifying ownership, access, and management rights is a crucial element of small-scale single-village water supply projects. The user committee model based on the participatory approach is a good way of demonstrating the idea of awarding the rights to end users. This practice proves that participatory approaches can help to build a sustainable management system, as users are encouraged to participate in the management and maintenance of their own water supply system. It is strongly recommended that users participate in all the stages of project implementation.

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Application of innovations

China case study: New energy in the water supply system of Gangcha County [1]

Under the program of China IWHR
and Qinghai Institute of Water Resources (QIWR)

Location: Gangcha County of Huaibei Tibetan Autonomous Prefecture, China.

Main challenges: Adjacent to Qinghai Lake, Gangcha County is a pastural area with a relatively dispersed population where drinking water is mostly supplied via decentralized systems.

The target territory faced major issues with accessing water from wells. Gangcha County had no power supply, so it was necessary to find a designated power source for water pumps. Internal combustion engines could perform the task, but this approach appeared too costly and cause environmental damage. The total water demands of three demonstration projects was estimated at 24.56 cubic metres per day, 21.98 cubic metres per day, and 20.22 cubic metres per day, respectively. The fuel demand for water intakes was approximately 0.2litres per cubic metre. Assuming the price of a litre of fuel of USD1.13, the daily water intake cost would be approximately USD0.22 per cubic meter.

Main goal: Provide access to drinking water for the villagers of three remote settlements by using advanced alternative water sources.

Main approach: The scheme utilizes three different water supply technologies using new renewable energy: (a) a solar powered, motor pumped well, (b) shafts using solar powered water pumps, and (c) motor pumped wells using solar and wind power.

(a) Solar powered, motor pumped well, well water source → main solar powered water intake → reservoir → secondary solar powered water intake → user.

The main water pumps are operating continuously with sunlight input. Most of the time, the system functions in 'high lift, low flow rate' mode, that is, the water drawn from the water source is stored in reservoirs. If necessary, the solar power system switches from the main pump to the secondary water pumps. The secondary water pumps draw water from the reservoirs and pumps it to water tankers or troughs. In this instance, the whole system shifts to 'low lift, high flow rate' mode, and when it is complete, the mode resets. The total capacity of the reservoirs in the system normally equals the daily water usage of the users.

For the scheme to operate efficiently, the water sources need to be wells more than 30 meters deep and the reservoirs need to be able to resist low temperatures. The project covers 10 households (23 residents), as well as supplying water for over 800 sheep and over 300 yaks. The water source is a motor pumped well of 49m depth and 0.11m diameter (see Figures 6 and 7).

(b) Solar powered water pump shaft—water source (shaft) → solar powered water intake → users
The solar power system provides electricity for the water pump to draw water from the source, working continuously with sufficient sunlight. The whole system is set in 'low lift, high flow rate' mode. The water pumped from the shaft is pumped directly to the users.

For this scheme, the water sources need to be shafts less than 30 meters deep and for water sources with insufficient water it is necessary to add reservoirs to the system. The project covers three households of 11 residents. In addition, the scheme supplies water for over 900 sheep and over 210 yaks. In this case, the water source is a shaft of 6m depth and 0.8m diameter (see Figures 8 and 9).

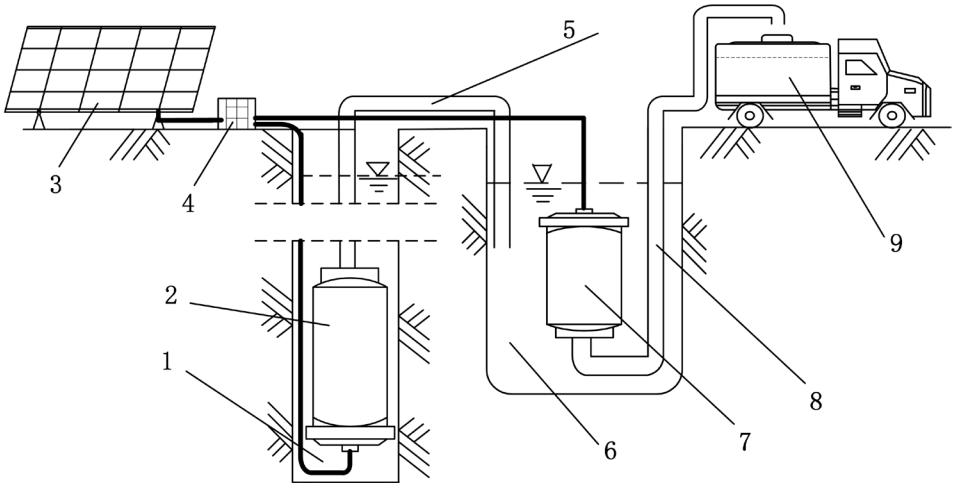

Figure 6. Configuration of the solar powered, motor pumped well system:

1 (water source), 2 (main water pump), 3 (solar power system), 4 (control system), 5 (upstream piping), 6 (reservoir), 7 (secondary water pump), 8 (downstream piping), and 9 (water tankers)

Figure 7. Demonstration project in Huanlunxiuma Village

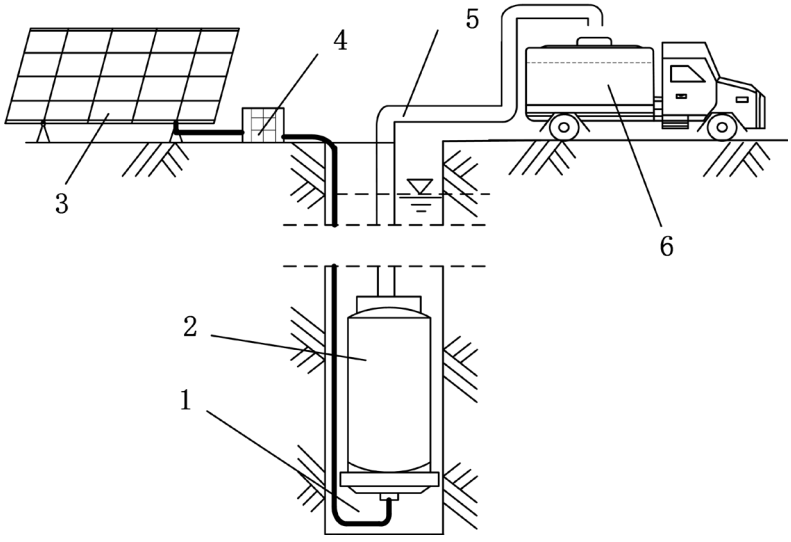

Figure 8. Configuration of shafts using solar powered water pumps:

1 (water source), 2 (water pump), 3 (solar power system), 4 (control system), 5 (piping), and 6 (water tankers).

Figure 9. Demonstration project in Jiaoshikexiuma Village

(c) Motor pumped wells using solar and wind power—water source (deep well) → main water intake → reservoirs → secondary water intake → users

This approach is applicable to deep, 80m to 150m, motor pumped wells in locations with a relatively high water supply demand. Whereas the main water intake system operates in 'high lift, low flow rate' mode to pump water to the reservoirs, the secondary water intake system works in 'low lift, high flow rate' mode to pump water from the reservoirs to the water tankers and troughs. The system is mainly solar powered. From 5pm to 9am when few people are using water, the system switches to wind power. The wind power system provides electricity to the main water intake system to pump water to the reservoirs. In case the users need water, the secondary water intake system operates as it does during the daytime. The project covers two households of 8 residents and supplies water for over 300 sheep and over 370 yaks (see Figures 10 and 11).

All the water sources referred to in this section comply with the 'Standards for Drinking Water Quality (GB5749).'

Financial aspects: The Research and Application Special Fund (RASP) of Qinghai Province and central finance supported the projects. Based on Table 15, the cheapest practice is the Solar powered, Water Pump Shaft. However, it cannot operate without sufficient sunlight. The most expensive model is the Motor pumped Wells Using Solar and Wind Power; this option allows water to be pumped at a stable rate thanks to the ability to switch between solar and wind power.

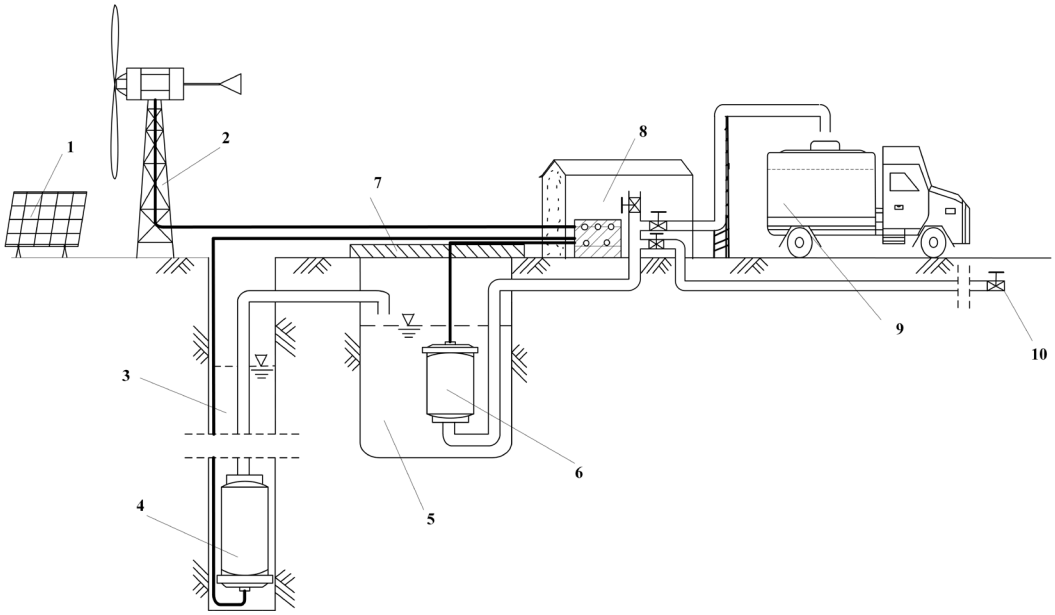

Figure 10. Configuration of motor pumped wells using solar and wind power:

1 (power system), 2 (control system), 3 (cabling of main water intake system), 4 (water source), 5 (main water intake system), 6 (cabling of secondary water intake system), 7 (reservoir), 8 (heat preservation facilities), and 9 (secondary water intake system).

Figure 11. The Demonstrationproject in Gangchagongma Village

Table 15. Total cost of water supply equipment and water source projects for the three new energy water supply schemes

Village	Model	Number of households benefiting	Cost of water supply system (financed by RASP of Qinghai Province)		Cost of water source project (well) (financed by central finance)	
			Total	Per family	Total	Per family
Huanlunxiuma	Solar powered motor pumped well	10	USD4,995	USD499	USD5,295	USD529
Jiaoshikexiuma	Solar powered water pump shaft	3	USD1,305	USD435	USD1,050	USD350
Gangchagongma	Solar and wind powered motor pumped well	2	USD12,045	USD6,022	USD7,995	USD3,997

Main results: The application of this technology has greatly improved the water supply guarantee rate in the target areas and the overall health of the residents. The project has also addressed the shortage of drinking water for cattle, sheep, and goats, which is a significant contribution to the development of local animal husbandry. The life quality of local residents has also improved considerably. Each project covers three to ten households and is managed by its users.

The described technologies are environmentally friendly. Saving up to 13.35litres of fuel per day, or 4,873.5 litres per year, equaling an annual reduction in carbon dioxide emissions of 10.7 tons. Operating the projects for 25 years could save 122 cubic meters of fuel and prevent the release of 267.5 tons of carbon dioxide into the atmosphere.

Sustainability: The life span of solar power systems is usually 25 years, against 8 years for internal combustion engines. Thanks to the control system, the water supply systems can operate automatically, requiring no manual control or management. Over its lifespan, the system requires only a one-time maintenance of the power equipment and the water pumps need to be replaced twice.

The main advantage of the Solar powered; Motor pumped Well model in Huanlunxiuma Village is that this technology can be used for deep wells that were rarely used before. However, the main drawbacks are that it is impossible to operate in insufficient sunlight such as in cloudy weather or at night and the high investment requirement.

The relatively low initial investment is the main advantage of the Shafts Using Solar powered Water Pumps model in Jiaoshikexiuma Village. However, the main disadvantage of such systems is the possibility of their failure in insufficient sunlight.

Likewise, the management and maintenance of these two schemes can be relatively challenging. For the Motor pumped Wells Using Solar and Wind Power model in Gangchagongma Village, the main advantage is that it can function well without sufficient sunlight or wind. It is also easy to use, and the water supply guarantee rate is high. However, the main weaknesses of this technology are a relatively high construction cost and high management and maintenance requirements.

Next steps: The three water supply systems using renewable energy sources introduced in Gangcha County all have their own pros and cons, yet at least one of them could be suitable for a specific application scenario. Systems using only one kind of renewable energy (RE) tend to lose stability in case of a power outage, easily caused by weather changes. This instability can lead to insufficient water supply and low water supply guarantee rates. Although the hybrid systems face instability issues, in practice the systems using both solar and wind power demonstrate a better performance than those using only solar or only wind, while systems using only wind power perform least well. Economic analysis shows that the RE-based systems require a large initial investment, although the payback period is long, and long-term investment is much less demanding. Such systems can unburden rural residents from hard labour and greatly improve water use convenience, as well as reducing water fees. The application of RE removes the need to use fuels like petroleum for water supply purposes, thereby benefiting the environment. On average, each of the described demonstration projects can save labour to equal to five people. The corresponding effect will grow exponentially with the broader application of the technologies and it is strongly recommended to deploy such. systems in other pastural areas.

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Innovation in financing mechanism

China case study: application of PPP in rural water supply projects

Location: Rucheng County, Hunan Province, China.

Main challenges: Rucheng is a county of Hunan Province at the junction of the three provinces of Hunan, Guangdong, and Jiangxi and covers a total area of 2,401 square kilometres. Rucheng County includes 14 townships with a total population of 4.08 million people, including 0.34 million in rural localities. It is listed as a critical county under the national poverty alleviation campaign. In the period 2005 to 2014, Rucheng County used USD22.17 million under the 11th and 12th five-year plans for the construction of rural drinking water projects. In total, 1,084 projects were executed, including 338 with a supply capacity of over 20 cubic metres per hour. Thanks to that, the overall RDWS situation in Rucheng County has significantly improved [1]. However, owing to the county's complex geographic situation, dispersed rural populations and limited funds, the RDWS projects constructed before 2015 are mostly smaller in scale and lack sufficient water treatment facilities. For example, using mountain brooks as a water source and therefore facing seasonal disruption [2]. Meanwhile, small-scale RDWS projects are directly managed by local communities, making the effectiveness of their long-term operations a complex task. To address the challenges of high construction costs and matching management and maintenance requirements, ensuring financing is a priority.

Prior to 2014, construction within the framework of RDWS projects was mainly funded from central and local budgets, followed by self-raised funds of residents, with only a minor percentage of non-government capital. For a long time, the construction of rural infrastructure has faced a funding shortage. According to the natural monopoly theory [3] and principal-agent theory [4], RDWS projects qualify both as public goods and natural monopolies. On the one hand, the external economy, high exclusiveness, and low competitiveness of RDWS projects can cause a shortage in personal supply and difficulty in market distribution. On the other hand, the water supply industry is in a market of government-regulated natural monopoly. Compared with market distribution, such state-managed monopoly systems lack efficiency, as well as facing issues of principal-agent relationship between the government and water supply enterprises [5]. To resolve this problem, it is necessary to establish a system whereby the government and water supply enterprises could collaborate towards a shared cause. The former could introduce policies encouraging private enterprises to participate in RDWS projects and cooperate with the government, so that both the government and enterprises could better leverage their strengths, resulting in a highly efficient resource distribution.

Main goal: Establishing an effective financing mechanism in the rural settlements of Rucheng County, Hunan Province, through the introduction of PPP schemes as an effective method for financing the construction, operation, and management of RDWS projects.

Main approach: In 2014, the State Council of China issued 'Instructions on Encouraging Non-Governmental Capital to Participate in the Financing of Projects in Crucial Innovative Domains,' encouraging non-government capital to participate in the construction, management, and maintenance of profitable water conservancy, especially water supply projects based on methods such as franchise agreements and stake holding [6].

From 2015 to 2017, Rucheng County made a consistent and continued effort to apply the PPP model to urban and rural water supply and drainage projects, including a USD0.17 billion province-level PPP demonstration project. The project incorporated all the centralized water supply projects and wastewater treatment projects of Rucheng County, and as a PPP project it was accessible to non-government capital. After the

completion of construction, private enterprises could generate profit under franchise and make sure that their investments had a fair return by charging a usage fee and acquiring government subsidies. The duration of the cooperation, equity percentage and investment return rate were all properly clarified by the government. The Rucheng Second Tap Water Plant was built in the Rucheng Industrial Park to cover all residents of nearby rural communities. Plant branches were also built to supply drinking water to rural residents living relatively far away from the county centre. Urban–rural water supply system integration was realized countywide [7,8].

In February 2016, the government of Rucheng County, Beijing Enterprises Water Group Ltd (BEWG), and Hunan Second Engineering Ltd signed the *Memorandum of Sole Procurement Source Confirmation of Rucheng Urban–Rural Water Supply and Drainage Integration PPP Project*. In April of the same year, the *Contract of Rucheng Urban–Rural Water Supply and Drainage Integration PPP Project* and *Joint Investment Contract,* stating that the government should have a permanent stake holding percent of 20 per cent, were both signed. Later, in November, Rucheng-BEWG Water Development Ltd was registered and construction began on the Rucheng Second Tap Water Plant and its branches [9]. Whereas the construction of water plants and main pipelines was financed under the PPP project, the construction of the pipe systems inside villages was financed directly by county-level government. In January 2017, Rucheng-BEWG Water Development Ltd also officially took over the operation of the wastewater treatment plants of Rucheng County. In late 2018, the construction of the Rucheng Second Tap Water Plant, its branches, and pipe systems was completed.

The Rucheng county-level Chinese Communist Party (CCP) committee and Rucheng county-level government paid great attention to the management of PPP projects. The Rucheng PPP Project Management Lead Group was established. Consultants included, the secretary of county-level CCP committee, the chairperson of county-level People's Congress Standing Committee, and the chairperson of county-level CPPCC (Chinese People's Political Consultative Conference). Under the leadership of the county magistrate, and directors of all related departments as members. The PPP Project Management Office affiliated with the Lead Group was also established to deal with PPP-related affairs.

Financial aspects: According to the trial version *Guideline on Contracts of PPP Projects* a special purpose vehicle (SPV) can be established by non-governmental capital, whether a single enterprise or a union of multiple enterprises, or jointly by the government and non-governmental capital. They are responsible for the design, financing, construction, management, maintenance, and ownership transfer of a PPP project [8]. In 2012, the government of Rucheng County set up the Rucheng Water Investment Group Ltd and invested USD7.65 million in it. In 2015, Rucheng County included all the centralized water supply projects and wastewater treatment projects in one bundle. Beijing Enterprises Water Group (BEWG) Ltd joined the construction and an SPV was set up by the government and the union of BEWG and Hunan Second Engineering Ltd with a total investment budget of USD1.66 billion [9].

The project specified a reasonable cooperation duration, cooperation mode, stake holding percentage, and investment return, so that the government subsidies could be properly utilized and thereby medium and long-term financial risks could be averted. The cooperation duration of this PPP project is 29 years, and the build-operate-transfer (BOT) mode was implemented. The shareholding ratio of the local government is 20 per cent, in which upfront expenses, such as expenses for land acquisition and demolition, land application and approval are regarded as government supporting funds; the rest are all derived from social capital investors. The reasonable return of non-government capital investment was guaranteed by user fee payment and government subsidies. The internal investment return rate after tax was set at 6.8 per cent, and the price alteration mechanism would be triggered if the internal investment return rate reached 12 per cent [9].

Main results: As a result of the project, 0.22 million rural residents of Rucheng County gained access to safe drinking water. The application of PPP under the project significantly contributed to building local infrastructure, alleviating the debt pressure on local government, and curbing medium and long-term financial risks. Its success encouraged the local

market to make more investments, while serving as a great demonstration of a novel method to achieve sustainable WASH; that of collaboration of governmental and non-government capital instead of the traditional method with sole government participation.

The total water supply capability of the newly built Rucheng Second Tap Water Plant is 80,000 cubic meters per day. The water source is a nearby reservoir. It serves a total of 285,000 people, 130,000 urban and 155,000 rural, living nearby. The branches cover 36,000 consumers. Thanks to this PPP project, the rural residents of Rucheng County can now enjoy a piped water supply system that is available to every household, with water meters installed for accurate accounting for usage. The water price was determined by the government after a public hearing, and a detailed water pricing plan was drafted by the effective operators and finally checked by the county-level NDRC.

Sustainability: The PPP model applied in the target county demonstrates that this operation mode is feasible and qualifies as an effective financing method for the construction, operation, and management of RDWS projects. The PPP mode made good use of government strengths in strategy planning, market supervising, and rendering public services, while also benefiting from non-government capital advantages as to management efficiency and technology innovation. It also helped specify the line between the government and the market, so that the former could better perform its public service role. This project actualized water supply and drainage integration, its large scale effectively reduced management costs under the target water supply and wastewater treatment projects, while at the same time facilitating the shaping of the professional operating team and greatly improving the overall quality of public service.

The project adopted the rules of risk distribution optimization, risk-return match, and controllable risk. Factors such as the government's risk management capacity, investment return mechanism and the market's risk management ability were all considered to reasonably distribute risks between the state and non-state capital.

As a rule, PPP projects are rather long, and the determination of which non-government capital to choose from is carried out at an early stage. This means that during most of the operation time, non-state operators face little competition and so the government has to be extremely cautious when choosing partners. The PPP modes applied under RDWS projects are BOT, transfer-operate-transfer (TOT), build-own-operate (BOO). The choice of a non-government capital partner should depend on the mode chosen. The method of choosing it, usually via open bidding, competitive negotiation, relies on the profit mechanism of a particular project and on the degree to which margins and limits are specified [10].

RDWS projects can be deemed semi-profit in the sense that the usage fees paid by consumers are insufficient to cover full cost. This lack of return requires that the government subsidizes operators and/or provides them with resources to compensate the spread. More precisely, the government can grant enterprises franchises and subsidies or make direct investment and hold a stake using modes like BOT [11].

Figure 12. Rucheng Second Tap Water Plant built under this PPP project

Next steps: For an RDWS project, it is necessary to assess which specific PPP mode could be applied. The key tasks of project identification include analyzing the appeal of the project, comparing the efficiency of traditional and PPP modes, and carrying out a value for money (VFM) assessment. To complete the analysis, three main aspects must be considered [12]: (a) the scale of investment should not be too small, and the investment should be stable in the long term (b) paying due attention to VFM quantitative assessment and making sure it does not become a formality, influencing final decisions (c) evaluating project needs from different stakeholder perspectives.

RDWS PPP projects should likewise apply the 'risk sharing principle' during the design phase by establishing a clear and reasonable risk identification and distribution system. The key points are: (a) risks should be assumed by the party that is best at dealing with them or most capable of managing them; (b) non-government capital should take charge of the investment, construction, and operation of the project and assume the corresponding risks. The government should assume the risks associated with policies, legislation, and so on. Under PPP contracts, it is also recommended to strive to quantify anti-risk plans.

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Change in maintenance system

Mongolia case study: school WASH in rural Mongolia

The efforts were implemented with financial and other support of ACF, UNICEF, ADB and Australian Aid

Location: School WASH projects were implemented in 17 *aimags* of Mongolia, including Arkhangai, Uvurkhangai, Khuvsgul, Bulgan, Selenge, Tuv, Khentii, Sukhbaatar, Orkhon, Dornogovi, Dundgovi, Zavkhan, Bayankhongor, Govi-Altai, Khovd, Uvs, and Bayan-Ulgii [1].

Main challenges: The 2007 survey of school dormitory conditions by the Ministry of Education, Culture, Science, and Sports (MECSS) revealed the following [2]:

- 74 per cent of 502 dormitories used water carried by hand from outside water kiosks and wells
- 46 per cent of water supplied to schools did not meet hygienic standards
- 78 per cent of schools had only outdoor latrines, most of which were unsafe and unhygienic

Decentralized WASH facilities were deployed in rural areas, yet wastewater treatment installations were virtually non-existent in rural localities, including in schools.

The responsibility of local water and sewerage organizations represents another issue with local water and sewerage organizations responsible for all activities associated with heating, water supply and apartment owner communities.

Water quality is extremely important for school-based WASH services; it is one of the main indicators to measure the reliability of rural WASH services. Unsafe water and hygiene practices are the main causes of diarrhoea and hepatitis in children in rural Mongolia. Moreover, the Mongolian winter climate is harsh and cold, so technology suitable to a cold climate is necessary. Climate resilient technologies were considered while developing the school WASH program in Mongolia.

Main goal: Address the issues in schools and kindergartens without piped connection to centralized systems and improve WASH in schools in Ulaanbaatar City and rural areas of Mongolia.

Main approach: The school WASH program was launched in 2014 with the proposed approach stipulated in *Joint Decrees No. A253, 252 and 173 'Norms and Requirements for WASH in Kindergartens, Schools and Dormitories'* of 29 June 2015 and detailed in the *'Improving Water, Sanitation, and Hygiene in Schools' Guide [2]*.

The approach consists of the following main steps:

Step 1. Aimag and Ulaanbaatar City education departments consider needs, assess priorities, execute lists of schools with WASH improvement needs and propose the list of priority schools to local administrations and MECSS departments. Local governments, MECSS, and the Ministry of Finance review and prioritize requests for funding. The main financing sources include local development funds of local governments and central government budgets.

Step 2. Once a request is approved for funding, the local government and MECSS launch the bidding for engineering and project design that include measures to prevent freezing, drawings, and cost estimation. A qualified contractor is awarded

through competitive bidding and, as per Mongolia's laws and regulations, performs the construction work.

Step 3. PPP models to provide operation, maintenance, and repair were implemented. In this case, PPP forms included service contracts, management contracts, leasing, partnerships, and BOT concessions. Mobicom Company is a sponsor and promoter this project and of school WASH projects in rural areas of Mongolia. Public service utility organizations are required to conduct regular checks of water and wastewater quality.

The proposed approach requires the involvement of different stakeholder groups. *Aimag* public water supply and utility service organizations are responsible for different aspects of the O&M of WASH services in schools and are engaged in planning, improving, and managing WASH services in school, as well as the regular testing of water and wastewater quality, and are therefore rendering professional services to ensure WASH operation. *Aimag* educational departments are responsible for the hygiene education budget and funding, for allocating school budgets, conducting consultations on possible funding and other support sources, as well as the monitoring and evaluation of WASH facilities. School management committees are tasked with the regular cleaning of sanitation blocks, pump operation, as well as the routine maintenance and inspection of mechanical equipment. In addition, they are responsible for supervising and reporting to education departments, as well as the day-to-day management of the WASH facilities.

Close attention was paid to capacity development and sharing knowledge on the school WASH program. For that, the ADB developed a special guide, *Improving WASH in Schools. A guide for practitioners and policymakers in Mongolia*.

Financial aspects: The WASH school and WASH household practices were implemented in rural areas with financial support from the ACF, UNICEF, KOICA, ADB, the state budget, and the private sector to improve water supplies, sanitation, and hygiene in rural Mongolia. Mobicom LLC supported and financed school WASH practices in 17 *aimags* within the framework of its social responsibility efforts. More recently, WASH construction in schools and kindergartens has been financed by the state budget [3].

Sustainable WASH services rely on funding to cover routine maintenance and ad hoc expenditure on the repair and desludging of septic tanks, as well as hygiene education. It is therefore necessary to include adequate funding related to school WASH in state and local budgets, with local and Ulaanbaatar City education departments responsible for their designated allocation.

Main results: A total of 65,200 children, in 105 schools and kindergartens, in 101 *soums* of 17 *aimags* have benefited from receiving access to improved WASH facilities and as a result of the implementation of school WASH projects in rural territories of Mongolia from 2014 to 2020. School WASH programmes and water, sanitation, hygiene, and wastewater treatment projects have changed the living quality and cultural civilization of Mongolians completely and positively, in particular in rural settings [4, 5].

The implementation of school WASH efforts in rural localities impacts a broad variety of sectors, including education, health, sanitation, hygiene, construction, water, public services, social development, labour and social protection, energy, and local development. WASH facilities likewise have created jobs for at least one to three rural residents depending on *soum* size, population, and the number of children in *soum*-level schools and kindergartens.

The national Water Commission has approved the tariffs for wastewater transportation and include profit and revenue streams generated from centralized and decentralized options for rural schools and households. Establishing the tariff makes it possible to earn income, enhancing the attractiveness of the model for private companies.

Sustainability: The sustainability of the proposed practice is ensured based on the following main parameters.

Firstly, the school management committee and specific school principal are responsible for the day-to-day management and oversight of the WASH facilities. They are also tasked with checking the

Figure 13. Photos from pilot territories of school WASH projects in Mongolia

quality of construction materials and the main construction dimensions and components to ensure proper construction as per drawings and specifications.

Secondly, effective coordination and enhanced networking are crucial for the successful implementation of school WASH programmes. In 2021, within the scope of the joint project 'Introduction of community-based, climate-resilient water supply, sanitation and hygiene services' the national Ministry of Health, KOICA, and UNICEF plan to execute an initiative to improve drinking water supply and sanitation facilities in 62 soum level schools, kindergartens, dormitories, health centres, and public establishments in Bayankhongor, Govi-Altai, and Zavkhan aimags [6].

Thirdly, private sector involvements and PPP or concession schemes have greatly contributed to WASH development in rural territories by delivering better WASH services to the population.

The *aimags* connected to centralized networks and systems have no difficulties ensuring water quality. All wastewater treatment options require protection against freezing.

Next steps: The following steps are necessary to further promote the proposed practice:

- Strengthen local public service organizations to address the issues associated with decentralized WASH construction in rural areas
- Improve basic WASH services in urban and rural schools and kindergartens at national level, and reach 90 per cent coverage in the long-term
- Reflect current expenditure for the WASH sector in state and local budgets
- Design measures to ensure frost resistance of WASH facilities
- Ensure and strengthen effective stakeholder coordination and networking crucial for the successful implementation of school WASH programmes

Mongolia's school WASH scheme includes funding and planning components for improved WASH. The validated operational details and climate resilient technologies can be replicated in other CAREC countries within the scope of domestic school WASH programmes. However, it is necessary to analyze country specifics to ensure the solid performance of the model, since country needs and context need to be reflected in national policies, plans, programmes, and projects.

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Change in maintenance system

Mongolia case study: WASH in rural Mongolia

Target projects were implemented with the financial support of ADB

Location: The nationwide WASH related infrastructure and service development projects were implemented in Umnugovi, Dornogovi, Arkhangai, and Uvurkhangai *aimags.* Umnugovi and Dornogovi *aimags* are located in southern Mongolia and include the Central Region. Arkhangai and Uvurkhangai *aimags* are located in central Mongolia and include the Khangai Region [1].

Main challenges: According to a UN analysis in 2018, out of 334 *soums* only 20 had centralized water supply systems and 34 *soums* did not have drinking water sources meeting Mongolia's drinking water standards. In some *soum* administrative centres, water supply systems relying on district-level heating systems, that were installed before Mongolia started the transition from a centrally planned to a market economy, had failed because the district-level heating systems were no longer operational [2].

Nevertheless, Mongolia is embarking on economic growth efforts, such as, mining in Dornogovi and Umnugovi *aimags*, and the trade corridor with China is expanding.

The separated locations of rural *soums* and the long distances between them make it impossible to provide centralized systems. Therefore, the decentralized WASH model has been gaining momentum in rural localities with almost no wastewater treatment installations. In addition, local public service organizations require capacity-building to address the problems related to rural area decentralized WASH construction whilst Mongolia's harsh winters make the provision of WASH services in rural areas a more complex.

Main goal: The project's main goal was to support the provision of infrastructure and service improvements in urban areas in Southeast Gobi of Mongolia.

Main approach: The project's main approach was to enhance the economic development and standard of living in *aimag* administrative centres and in the mining and border towns in Southeast Gobi. The expected outcomes include improved urban development and governance and expanded access to sustainable infrastructure and public utility services in urban communities. The key outputs include urban roads, water supply networks, wastewater treatment, district heating, and a solid waste collection and disposal systems, as well as urban service delivery reforms.

The government played the main role in strategic decision-making on investment and the ratification of loan agreements. The national Ministry of Finance was the key negotiator for the loan and project agreements, ensuring timely provision of project funding. *Aimag* governments were responsible for project implementation, including administration, technical matters, monitoring and evaluation, safeguard compliance, and emergency response with the assistance of consultants. The Ministry of Construction and Urban Development was responsible for coordinating efforts by the implementing agency, financial management and administration.

Local communities were involved in selecting WASH facility and cost-sharing schemes for improved household toilets in Uvurkhangai and Arkhangai *aimags*, as well as organizing community groups, construction and supervision.

The design of target projects took account of Mongolia's cold climate and included the protection of water delivery systems against freezing, including burying lines below the soil frost zone or heating the lines [3].

Operational safety is also important and complicated maintenance and repairs require measures and engagement on the part of both *aimag* and national-level agencies. Public service utility

organizations need to check water and wastewater quality regularly. Onsite tasks at WASH facilities include the regular cleaning of sanitation blocks, pump operation, routine maintenance of equipment and deficiency checks.

24-hour operational automatic (smart) water supply wells or kiosks were constructed. QR code, QPay, and MonPay systems were used to pay for water, hot water, and wastewater fees. In addition, this smart technology provides water consumption monitoring.

Financial aspects: On 19 April 2010, the ADB approved a grant of USD15 million from its Asian Development Fund for the Southeast Gobi Urban and Border Town Development Project to support the provision of infrastructure and service improvement in urban areas. Under the project, the piped water connection fee to the central water and sewerage system was calculated at 800,000 MNT (approximately USD340) in the form of a one-time payment per household for improving the water supply and sanitation services for residents of Dalanzadgad *Soum* [4, 5].

This WASH rural household model is capable of covering costs with each target household willing to pay the fee of 33,000 MNT to 66,000 MNT (about USD11.6 to USD23.2) for wastewater treatment services in one to two installments per year. The tariff of 33,000 MNT (USD11.6) was approved by the Water Commission and includes a profit margin. Cost sharing was proposed to provide access to WASH services in rural areas under the ADB projects. The cost for each improved facility was 2 million MNT to 3 million MNT (about USD702 to USD1,052), with 10 per cent to 20 per cent of the cost paid by households, 20 per cent to 30 per cent from the local budget, and 50 per cent from ADB funds.

Both the WASH centralized, and decentralized service options can generate revenue through a tariff payment. As the level of centralized systems is low, only 30 per cent of the revenue can stream from the WASH centralized service and 70 per cent from the WASH decentralized service option.

Main results: The project was implemented successfully and yielded the following main results [1]:

- Almost 95 per cent of ger area dwellers in the project soums received access to drinking water within 300 meters of their dwellings
- A total of 39.4km of water supply piping were installed
- 9 water kiosks were constructed and are currently in operation
- One 1,000 cubic meter and three 100 cubic meter water reservoirs were constructed
- A total of 35.9km of sewerage piping was installed and is currently in operation
- Two wastewater treatment plants were constructed
- Three sewerage pumping stations were constructed and are currently in operation
- 2.8 per cent of the population received access to WASH services

Sustainability: Water supply, sanitation, hygiene, and wastewater treatment projects have positively altered the life quality and cultural civilization of Mongolians, particularly in rural areas. Moreover, the implemented practices accounted for the technological development suitable to the Mongolian climate and environmental protection.

The applied approach also involved different stakeholder groups, such as, MCUDs, *aimag* governments, local public water supply and utility service organizations, in decision-making. This, in turn, achieved more sustainable results and engaged local communities in the systems' O&M.

Figure 14. The new water supply and sanitation infrastructure for residents of Dalanzadgad Soum

Water quality is monitored by *aimag*-level auditing organizations. Their main functions include ensuring water quality in rural areas and conducting water quality analysis every three months. *Aimags* connected to centralized lines and systems have no difficulties ensuring water quality.
This practice brought certain financial benefits. The loan agreement for the rural drinking water and wastewater treatment systems was successfully implemented. The Water Commission approved the tariff for wastewater transportation for each household, which includes a profit margin. In certain *soums*, the operation of WASH facilities created jobs for at least one to three rural residents.

However, private companies are still not taking part in decision-making. Local public urban service organizations can participate in decision-making for rural areas. The procurement of all goods, works, and services is done based on international and national competitive bidding, leaving room for private sector involvement.

The described practice demonstrates the innovative solutions that can be used for drinking water and wastewater treatment in rural Mongolia.

Next steps: It is important to develop an overall plan covering *aimag*, *soum*, and *bagh* levels backed with sufficient investment and financing to achieve the main WASH objectives of Mongolia.

A broad awareness raising campaign targeting local communities is necessary in order to disseminate information, brochures, and leaflets on WASH facilities and instructions on building improved WASH facilities and toilets in *soums*. It is also necessary to disseminate the outcomes and best WASH rural practices in other *aimags*, *soums*, and *baghs*.

Overall, WASH services are not developed at *soum* level, but the decentralized option, clean, dry and eco toilets and facilities, is applicable. Open defecation is mainly practiced by nomadic herders. It is necessary to reconsider this approach and develop specific options for nomadic herders in rural Mongolia.

From a financial perspective, it is difficult for rural households to pay fees. Therefore, various financial stimuli need to be introduced to support vulnerable populations and to increase the capacity to pay among rural populations.

It is likewise necessary to build the capacities of local water and sewerage organizations on stakeholder and user services. The future development of WASH services in the country requires the involvement of qualified private companies and the local communities.

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Change of financial mechanism

Tajikistan case study: HRBA to water governance: from unbundling systemic underperformance towards financial sustainability

Based on the experience of SDC-funded projects: TajWSS, ④ RRWSSP, ⑤ RWSSP FV, ⑥ SDWSMP ⑦

Location: The practice was launched and replicated across 45 villages through 35 WASH schemes serving around 125,000 rural residents, with target communities located in 13 districts across Tajikistan and included *Rudaki* (Direct Rule Districts), Shamsiddin Shokhin, Khovaling, Baljuvon, Muminobad, Farkhor, Hamadoni, and Shaartuz in the Khatlon Region, Isfara, Maschoh, Spitamen, Asht, and Kanibadam in the Sughd Region.

Main challenges: Drinking water supply and sanitation in Tajikistan has been facing the so-called 'vicious cycle' of systemic underperformance, management constraints, low sustainability, and service failure. The common source lies arguably in the current ineffective tariff policies. Tariffs for drinking water, both in urban and rural settings, have traditionally been maintained significantly below the full cost recovery threshold and remain critically low. Tariffs for most systems are at least three or four times less than full cost recovery.

The revised Law on Drinking Water and Sanitation [5] recognizes consumer water fees as one of the sources of financing, however, the legislation largely lacks references to tariff setting principles whether this is full cost recovery, transparency and accountability, social responsiveness, or a pro-poor approach. At national and regional levels, the National Antimonopoly Agency (AMA) under the Government of the Republic of Tajikistan (GoRT) is the sole WASH tariff regulator and service providers are responsible for agreeing tariff schemes with it. Although the recently endorsed guidelines ⑧ for tariff setting provide a comprehensive mechanism for designing full cost recovery schemes, service providers as well as practitioners, report that the mechanism has not received either broad endorsement or implementation [6].

The comprehensive analysis implemented under the TajWSS Project revealed conflicting views among the key stakeholders within the duty-bearer and rights-holder network. (a) national and local authorities, (b) regulator agency (AMA), (c) service providers, and (d) consumer groups [7]. The recurrent mutual objections within the group comprised a series of challenges that prevent tariff improvement towards full cost recovery.

For example, consumers demand improved services and only then would they be ready to pay improved tariffs, suppliers object that service improvement cannot happen without improved payments. Furthermore, supplier organizations demand that regulating agencies approve tariff upgrading to render improved services. In its turn, the regulating agency expects both good governance and consumer rights to be properly implemented and protected while consumers demonstrate their willingness and ability to pay higher tariffs but, on the other hand, feels reluctant to introduce higher

④ Tajikistan Water Supply and Sanitation (TajWSS) funded by SDC and implemented by Oxfam GB in partnership with UNDP Tajikistan.
⑤ Regional Rural Water Supply and Sanitation Project (RRWSSP 2007-2013) funded by SDC and implemented by the International Secretariat to Water (ISW).
⑥ Rural Water Supply and Sanitation Project, Ferghana Valley, Tajikistan (RWSSP FV 2014-2019) funded by SDC and implemented by ISW.
⑦ Safe Drinking Water and Sanitation Management Project (SDWSMP) funded by SDC and implemented by MSDSP in Tajikistan.
⑧ Regulation of the GoRT No. 364 *Guidelines on the order of tariff setting for drinking water supply and sanita-tion services of 23 June 2020; Decree* of Chairman of the Antimonopoly Agency under the GoRT No. 155 *Guide-lines on the order of tariff setting for drinking water supply services for rural systems in the RT* of September 25, 2019.

tariffs owing to political pressure from national and local authorities in connection with any rise in prices for basic services. National and local authorities suggest that higher transparency and accountability measures need to be implemented locally and that the process should be monitored and documented through public discussion.

A major confidence crisis between water suppliers and consumers was described as prevalent for rural communities, consequently the lack of willingness to pay and poor fee collection had impacted upon the capacities of suppliers and upon the overall sustainability of service systems.

Main goal: The main purpose of the exercise was to demonstrate how the application of a HRBA influences achieving full cost recovery tariffs and consequent improvements in fee collection rates. A HRBA was designed and agreed as a tool to address the mutual objections between participating groups in tariff policy design and implementation. The core principles of transparency, accountability, and participation are deemed instrumental in building confidence within supplier-consumer networks, and thereby ease the path towards tariff upgrading and improved fee collection.

Main approach: While the actual implementers of the tariff schemes recognize full cost recovery tariffs as the primary requirement for system sustainability, the immediate shift to such tariffs does not necessarily lead to success unless consumer willingness and ability to pay have actually improved. It is important that a policy agenda promoting all-round support in the short to mid-term meets the needs and demands of all stakeholders. A comprehensive support mechanism should comprise concrete actions through two sets of interlinked policy actions.

The first set of actions is designed to develop an improved tariff policy along with pilot implementation actions, such as, the elaboration of tariff-setting methodologies for drinking water supply and sanitation, capacity-building efforts for consumers and service providers on developing full cost recovery schemes, and the submission to, and approval of, such schemes with designated government regulators. Fully fledged training programmes are necessary to support the entire process for supply organizations by invitation from local authorities and national-level regulatory agencies.

The second set of actions aims to assist the development and application of good governance and consumer rights protection mechanisms, promote adequate consumer behaviour as to their responsibility to pay for water supply and sanitation services, and introduce feedback mechanisms. Transparency and accountability mechanisms are tools that both suppliers and consumers should feel encouraged to benefit from.

The pilot implementation included over 20 service providing entities, such as small-scale community organizations, medium-sized and large operating companies in several major cities and district administrative centres. Most of these are run by communities, public organizations, *dehkan* farms, WUAs, and private companies, others by large urban and district *vodokanals*.

Financial aspects: Supply organizations were supported through the exercise to: (a) determine their full cost recovery tariff schemes, (b) develop a strategy for consecutive moderate tariff improvements, and (c) implement rights-based approaches aiding improved fee collection.

Main results: The approach was initially piloted among 12 WASH schemes supported by Oxfam and the UNDP in selected districts of Khatlon and Direct Rule District (DRD) Regions. Certain elements were bespoke and replicated among more than 25 other schemes via projects supported by ISW, MSDSP, and IFAD in other regions of Tajikistan. The institutional models involved included WUAs, VOs, LLCs, *dehkan* farms and a SUE KMK.

The design of the training program was based on the training module elaborated jointly by the UNDP Water Governance Facility at SIWI (WGF), Cap-Net, WATERNET, and Water Integrity Network (WIN). Three separate modules with ten thematic sessions were delivered to all participating entities. Public Advisory Councils (PACs) were established in two large cities of Dushanbe and Khujand, as well as five district centres run by city and district administrations, respectively. The PACs were first launched in 2013 in Mumibobad District, and then in Dushanbe (2015) and Khujand (2016) with UNDP and GoAL WaSH support. Later the

approach was replicated by Oxfam GB in the four additional rural districts of Rudaki, Kulyab, Vose, and Farkhor with WB's TWISA Project support.

For the initial 12 schemes the exercise concluded with substantial progress made against almost all the project objectives. The project successfully managed to change the perception among regulating bodies and authorities that tariffs may differ from system to system and, therefore, regulators are now able to understand how tariffs are constructed. The new tariffs were then agreed upon and step-by-step increases towards full cost recovery levels were executed. It was considered a breakthrough, as the new tariffs for 12 target systems provided the required precedents for policy change in the sector.

Moreover, the exercise also demonstrated that the application of governance and consumer rights protection measures helped to improve water fee collection rates across most target systems. Service providers became more transparent thanks to sharing more information with consumers, as well as more accountable and responsive owing to regular reporting on their efforts and handling consumer inquiries and complaints systematically. In that sense, the initiative demonstrated that, overall, the balanced approach has resulted in positive progress towards improved economic viability and system sustainability.

Furthermore, the exercise managed to improve confidence among not only suppliers and consumers, but also national and local authorities and regulators. The exercise enabled institutional confidence building through the support of Public Advisory Councils (PACs) inside supply organizations that bridged suppliers and consumers on a practical level, and with national government agencies on a policy level.

Sustainability: Oxfam GB, UNDP, ISW, and MSDSP have since replicated the described practice in a number of other districts across Tajikistan, deeming it worthwhile for improved tariff policy implementation in rural settings. While the implementation approaches differed in substance, the core principles remained the same across all schemes. Some of the latest progress from target organizations is presented in Table 16.

Table 16. Tariff improvement progress and fee collection rates [7]

Implementing agency/project	Tariff improvement progress: *average for all project-supported schemes*		Collection rate: *average for all project-supported schemes*	
	Baseline (year)	*Present (year)*	*Baseline (year)*	*Present (year)*
Oxfam GB/TajWSS (7 schemes in 2 districts. DRD and Khatlon Regions)	29% (2011)	49% (2020)	55% (2015)	80% (2019)
UNDP/LITACA (5 schemes in Khatlon Region)	42% (2011)	55% (2020)	66.4% (2015)	69% (2017)
ISW/RRWSSP (7 schemes launched in Sughd Region in 2009)	100% (2009)	100% (2020)	67% (2013)	75% (2019)
ISW/RWSSP FV (7 schemes launched in Sughd Region in 2017)	100% (2017)	100% (2020)	80% (2014)	80% (2019)
MSDSP/SDWSMP (10 schemes launched in 10 districts of Khatlon Region in 2017)	73% (2017)	73% (2020)	64% (2018)	78% (2019)

Further to the progress noted above, the national authorities and regulatory agency have agreed to allow a moderate consecutive increase, by increments of about 10 per cent to 15 per cent, in tariffs over time towards reaching the target.

All systems demonstrated improved collection rates compared with the baseline year with some level of consistency. Few systems showed some a decline of approximately 6 per cent in certain years, reportedly in part undergoing adaptation to higher and newly endorsed tariff schemes.

The PACs established to extend the application of good governance and consumer engagement mechanisms, have consequently also contributed to improving water fee collection rates, by 11 per cent on average, over 2014 to 2017.

Next steps:

- Conduct national ability-to-pay surveys to establish better justification for consecutive tariff escalation
- Sustain and scale up knowledge-based awareness raising campaigns to support further efforts to achieve transparency and accountability
- Adequately document as a good governance mechanism and include PACs in regulatory documents and national development plans
- Ensure further institutional strengthening and capacity-building for the Consumers Union to facilitate better prospects for scaling up designed approaches in the future and provide an enabling environment for deploying rights-based approaches in the sector

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3. Rural Water Supply and Sanitation Project, Ferghana Valley, Tajikistan (RWSSP FV 2014-2019) funded by SDC and implemented by ISW.

4. Safe Drinking Water and Sanitation Management Project (SDWSMP) funded by SDC and implemented by MSDSP in Tajikistan.

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Change in management system

Uzbekistan case study: water supply and sanitation practices

Supported by SDC projects [1-3]

Location: Villages in Okhunbabayev, Rishton, Pakhtabad, Makhamat, and Ulugnor Districts of Ferghana and Andijan Provinces, Uzbekistan.

Main challenges: A shortage of drinking water supply and sanitation in the village of Uqshi-Dasht for the last 20 years. Residents used 15lcd to 20lcd before receiving yard/house connections.

In addition, a complex care facility, the tuberculosis early treatment clinic and sanatorium, was established in the village in 1967. Initially, it served as a regional hospital specializing in the treatment of active tuberculosis. In 1997, it was converted into an early treatment clinic and regional hospital with a 200-patient capacity, only patients suffering from latent tuberculosis are currently treated there. Yet, the medical center had neither water supply nor sanitation facilities.

Main goal: The project's objectives included infrastructure development, capacity-building for village water committees, hygiene education for women and young people, improving system operational reliability, as well as improving the quantity and quality of rural water supply.

Main approach: The project's approach was based on decentralized management and on the principle of rural communities deciding how to address water supply issues themselves. Principles included organizing village community meetings involving village dwellers, respected village elders, women representatives of schools, water supply organizations and other village stakeholders, to discuss how to set up and manage a water supply system. The model capitalized on community engagement, and the involvement of village men, women, and children, in the project facilitation, by defining their needs and common solutions, and providing technical expertise to set up the village's own water supply system management.

The SDC projects included information campaigns for villagers on hygiene. Precise and targeted explanations concerning acceptable hygiene practices, such as handwashing and thorough cleaning of water containers, helped to reduce several widespread diseases primarily affecting children.

To operate and maintain WASH services, drinking water organizations (DWOs) were established to take charge of managing and maintaining the services, including the billing and tariff collection necessary for proper maintenance.

Financial aspects: A full cost-covering tariff, including electricity for the pump, maintenance services, salaries for staff and technicians and amortization, was calculated to ensure long-term sustainable system management and the expansion of the system over time. The residents of the target villages presently pay a monthly rate to cover running costs, such as electricity for pumps, maintenance, and salaries. The share set aside for amortization can account for as much as 30 per cent of the water tariff.

The tariff for a single cubic meterage is approximately USD0.4, which is comparatively high for a water supply service alone. But it is up to 35 times cheaper than the amount people pay for water delivered by truck vendors. This tariff reaches its breakeven point if 85 per cent of the population pays for its water, leaving room to accommodate poor populations that would not be able to afford the price of water. According to opinion following a transition period, the collection rate can be as high as 90 to 95 per cent and remains at that level as long

as people continue to receive water and are satisfied with the work of their DWOs.

Main results: Decentralized water management systems were launched and fully functioning in three provinces of the Ferghana Valley with sustainable operation being carried out by local organizations. During the process of establishing the scheme, one of the focuses was on supporting the umbrella organization and local public and private institutions. In total, the projects helped target communities build a water distribution system for 15,000 users and for 250 patients in the tuberculosis medical center. The water delivered by the systems is disinfected by chlorination and fully corresponds to WHO standards.

In addition, increasing the availability of drinking water has improved the living standards of local residents and their overall well-being, not only of individual families but also of entire villages, since water is now readily available through house and/or yard connections. Women and girls no longer need to fetch water and can therefore dedicate their time to other activities.

Thanks to the project's intensive hygiene education program, project interventions also contributed to public behaviour changes, mostly in respect to handwashing and household hygiene associated with cooking and indoor water storage. This education program has led to improved key indicators on several major water-borne diseases.

Sustainability: The villagers learned to build and maintain their water supply networks in the long-term. As of today, after three years of operation, they themselves ensure that the pumps are in good working condition and they monitor the disinfection system, pipelines, reservoirs, and wells. They are also responsible for ensuring that the water network is protected from freezing.

Village committee meetings make joint decisions on water supply. The fact that the residents themselves could participate in decision-making improved the project's public acceptance increasing its sustainability.

Overall, the system is sustainable owing to the drinking water tariff of approximately USD0.4 per cubic meter which entirely covers all the required costs.

Certain unsolved issues remain. For example, the ownership of the rural water supply assets is yet unclear: Article 306 of the new regulations issued by MHCS refers only to ownership of urban water systems without any reference to rural water supply investment.

Next steps:

- Analyze and compile a list of rural settlements where the model can be applied, paving the way for its successful replication throughout Uzbekistan
- Create a transparent mechanism for involving the public in decision-making on WASH services management, and include it in further legislation
- Clearly define property ownership of rural water supply assets to support the future development of the WASH sector and attract investment
- Conduct broad awareness raising and an information campaign on consumer rights, as well as the possibilities for engaging in systems management, the key elements for understanding the new approaches.

Figure 15. Pilot villages in Ferghana and Andijan Provinces, Uzbekistan

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Change in management system

Uzbekistan case study: construction of drinking water supply system in Samarkand Kupaki Community (Mahalla) and Ferghana Gulistan Community

With financial support under UNDP projects [1,2]

Location: Kupaki Mahalla, Samarkand Region, and Gulistan Mahalla, Ferghana Region.

Main partners: WUA in Gulistan Village and WUA 'Musojon Ismoilov.'

Main challenges: Over the past 20 years, owing to dilapidated water supply systems in the two target villages local authorities applied a temporary solution by delivering water to residents, local schools, health centers and kindergartens.

Households in the Kupaki Community in the Payaryk District of the Samarkand Region had lived without access to drinking water for many years and were forced to build deep wells of 7m to 8m in depth to get to water of extremely poor quality. This had a negative impact on the health of local residents with 80 per cent of disease incidence caused by low water quality.

Since 1998 the population of Gulistan Village in the Fergana Valley has almost doubled; water demand has also grown, making the need for a permanent and sustainable water supply solution even more acute.

Main goal: The project's objectives included infrastructure development for two target villages and transferring it to the managing companies.

Main approach: The rural populations were involved in decision-making about improving access to drinking water. However, the projects did not include a hard component such as a physical system building or a budget to cover O&M costs.

However, based on a request from the community, the project was allowed to go ahead, and construction works were carried out. In March 2020, the drinking water system was completed. The total cost of the construction of the drinking water system for the Kupaki Mahalla was USD75,000. The operation of the system was handed over to the regional drinking water management organization or '**suv-oqava**'.

Figure 16. New water supply systems in Kupaki and Gulistan Mahallas

To provide high-quality service to water consumers, an emergency dispatch service was established to respond to accidents with water supply lines, as well as a service unit to ensure timely accounting and payment by the consumers.

Financial aspects: The total construction cost of the drinking water system for the Kupaki Mahalla amounted to USD75,000 and USD30,000 for the Gulistan Mahalla. The projects were not involved in the systems' further O&M costs (Table 17).

In case of Kupaki Mahalla, after the construction was completed, the drinking water supply system was handed over to the authorized state company, the management department of the SAMSUVSOZ Company of Samarkand Region Water Supply System for further O&M. The tariff was about USD0.3 to USD0.35 per cubic metre of water from the pipe. State support programmes are available for the population who are unable to pay. In some cases, the wealthier segment of the population covers part of the cost through donations.

In the case of Gulistan Mahalla, the drinking water supply system was transferred to WUA Musojon Ismoilov (NGO) to ensure operational control.

Main results: The Kupaki Village Rural Drinking Water Facility provides access to water for the 2,300 residents, 450 students, 120 kindergarten children and a rural medical center.

The new drinking water system in Gulistan village supplies water to around 700 households of over 4,500 residents in the Kuva District in the northeast of the Fergana Region, 20km from Fergana City, where the regional administrative center is situated.

Sustainability: The SAMSUVSOS Company is responsible for maintaining the water supply network, ensuring that the pumps are in good working order and monitoring the disinfection system, piping and well.

In addition, both the Kupaki and Guliston Mahalla Committees take part in the review and decision-making, especially around tariffs, ensuring proper administration. The corresponding systems are fully sustainable thanks to the water tariff entirely covering the required costs.

All rural consumers in the area were identified and water meters were installed. The communities established tariff payment schedules agreed among all residents.

Next steps:

- Clearly define all rural consumers in the area covered by the systems, complete the installation of water meters and ensure timely payment conditions as per the tariff, involve the public in decision-making and system management
- Conduct an information campaign explaining consumer rights and obligations, as well as the possibility of engaging in systems management
- Develop action plans for specific water supply improvement scenarios depending on population growth and increasing water demand
- Provide opportunities to improve the quality of drinking water supply services for the population and create conditions for attracting extra-budget funds to upgrade the facilities after a certain period of operation
- Ensure the economically justified profitability of WUA 'Musojon Ismoilov'

Table 17. Efficiency of project financing of drinking water supply systems [1]

№	Investigation site	Investment amount, million UZS	Total income, million UZS/ year	Investment project payback period	Return on investment ratio	Net present value (NPV)
1	Construction of drinking water system (Samarkand)	550,000,000	202.5	2.7	0.36	> 0
2	Construction of drinking water system (Ferghana)	247,497,653	102.8	2.4	0.41	> 0

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