

# DECENTRALISED SANITATION SOLUTIONS IN TAJIKISTAN

Decentralised wastewater treatment systems (DEWATS) in peri-urban and urban areas in Tajikistan



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## ACRONYMS

<b>DEWATS</b>	Decentralised wastewater treatment system
<b>O&amp;M</b>	Operations and maintenance
<b>SDG</b>	Sustainable Development Goal
<b>TajWSS</b>	Tajikistan Water Supply and Sanitation
<b>WASH</b>	Water, sanitation and hygiene

# EXECUTIVE SUMMARY

An important milestone for the sanitation sector was the adoption by the UN of Sustainable Development Goal (SDG) targets 6.2 (safely managed sanitation and hygiene services) and 6.3 (reducing the portion of untreated wastewater), which focus on managing the entire sanitation service chain. Tajikistan has been at the forefront of promoting these at global level. Meanwhile, the fourth initiative of the President of Tajikistan on the *International Decade for Action on Water for Sustainable Development, 2018–2028*<sup>1</sup> is being implemented at national level.

Over the past decade, sanitation has been given low priority within the focus areas of water sector reform. For example, not all aspects of regulations have been duly revised to adopt new technologies. In addition, many regulations for wastewater treatment remain outdated and pose legal constraints for testing new approaches in the country.

The Tajikistan Water Supply and Sanitation (TajWSS) (Phase III) project piloted a decentralised wastewater treatment system (DEWATS) in the peri-urban Rudaki district in Tajikistan with two hospitals with the aim of scaling up to national level. This learning paper showcases the project findings, assessments and lessons learned in application of the DEWATS.

*A completed DEWATS with planted gravel filter. Photo credit: TajWSS*



The project had assessed that the existing sewerage infrastructure in Rudaki was inadequate to treat all the wastewater generated. The untreated water, unfortunately, ends up in rivers and canals, and worse of all, infiltrates the soil contaminating underground aquifers. During the Covid-19 pandemic, Oxfam partnered with BORDA e.V. to design an alternative sanitation solution for two hospitals in Rudaki district that face growing demand; the objective was to minimise costs and land usage, but maximise public health and environmental benefits. DEWATS was introduced for the first time in Tajikistan to not only treat the waste, but also recycle the wastewater for reuse with the potential for irrigation. The installed system demonstrates the urgent need to revise the new law on Drinking Water and Wastewater and the Construction Norms and Standards of the Republic of Tajikistan to accommodate alternative technologies in water and sanitation.

Based on the assessment it is recommended that DEWATS is immediately scaled up, as an effective option for wastewater management in the country. Stakeholders see it as an alternative option to be implemented where centralised sewer networks cannot be used, or for institutions that aim to be self-sustainable from a water perspective. While this assessment highlights the potential for scaling up DEWATS in Tajikistan, there are also risk factors:

- Under-investment by the government and donor agencies in sanitation infrastructure
- Unclear roles and responsibilities between state bodies and limited capacities
- Strict and rigid regulations for design and construction as well as effluent disposal
- Lack of standards for treated wastewater disposal or reuse from decentralised sanitation systems
- Limited capacities of organisations including government to design, implement, monitor and manage alternative technology options (DEWATS)
- Lack of sanitation sector strategy addressing the entire sanitation value chain
- Inadequate sanitation-related data

These hurdles must be overcome to ensure that DEWATS can be effectively scaled up across Tajikistan. They should be addressed systematically by organisations and projects providing water and sanitation services. This is with the intent that DEWATS can help to improve sanitation in the country in a sustainable way, while the sector develops an enabling environment for improving sanitation.

# INTRODUCTION

## SANITATION IN TAJIKISTAN

There is high disparity in Tajikistan in access to drinking water and sanitation facilities between urban and rural populations, while national averages hide the fact that many water, sanitation and hygiene (WASH) systems have broken down or deteriorated. Rural areas are particularly badly affected and progress in achieving sustainable water supply and sanitation services has been frustratingly slow for rural populations.

Sanitation is a challenge in Tajikistan and remains a neglected issue. Only 18.2 percent of the population in small towns have access to sewerage systems, while only 0.2 percent of the rural population do. In 2017, nearly 5.7 million people in Tajikistan (97% of whom live in rural areas) did not have sewerage, and many people relied on pit latrines. Even where sewerage is available, grey water is usually discharged into open drains. Sewerage and treatment facilities have not been rehabilitated for the past 20 years, and this has resulted in minimal wastewater treatment. In small towns and rural areas, wastewater produced by households and industries is discharged into the soil and environment without treatment. Throughout Tajikistan, there is a notable lack of wastewater/faecal sludge treatment facilities.

Most of Tajikistan depends on 'on-site sanitation' systems like pits or septic tanks, which are not connected to sewers. Despite progress in increasing access to improved sanitation, investments in the subsequent steps, such as the safe collection, disposal and treatment of faecal sludge from on-site sanitation systems, remain a significant challenge.

About 70% of all infectious diseases in Tajikistan are intestinal and most of them related to water and hygiene. Moreover, the mortality rate attributed to exposure to unsafe WASH services is 2.7 per 100,000 people<sup>2</sup> – the highest in Central Asia. This requires systems to be put in place – both hardware and software – to implement and sustain sanitation and sewerage services, and change hygiene behaviours.

*Sanitation facility types in rural and urban Tajikistan*

Facility type	Year	RURAL Coverage (%)	Population	URBAN Coverage (%)	Population
IMPROVED LATRINE	2015	94.0	5,819,626	42.9	969,902
	2020	94.9	6,562,515	40.5	1,062,011
SEPTIC TANK	2015	3.0	186,438	0.9	20,211
	2020	4.1	286,931	0.6	16,839
SEWER	2015	0.9	57,189	54.8	1,238,606
	2020	0.5	34,321	57.7	1,514,694

Source: World Health Organization/UNICEF Joint Monitoring Programme (2021)<sup>3</sup>

# THE NEED FOR SANITATION SOLUTIONS IN PERI-URBAN TAJIKISTAN

Since 2017, new laws, policies and institutions have created a more effective working environment in the WASH sector in Tajikistan. Nevertheless, significant challenges remain, particularly concerning the sustainability of water supply and sanitation services. The main problems are the high share of rural and peri-urban population groups without adequate access to safe sanitation. Particularly, wastewater and faecal sludge that are not safely managed are contaminating land and water resources. In addition, inadequate hygiene practices and poor sanitary conditions of toilets and latrines are significantly reducing the benefits achieved during recent years of improving access to safe drinking water. Overall, the negative economic impact of poor water and sanitation services in Tajikistan is estimated at \$275 million per year (almost 4% of GDP), the highest proportion among Central Asian countries.<sup>4</sup>

To cover the high demand in rural and peri-urban areas (such as small towns) within an acceptable budget and timeframe, alternatives to conventional/centralised wastewater treatment systems are required. This is because conventional solutions (extensive sewer systems with large centralised treatment plants) take too long to be implemented and very often exceed the available budget. Decentralised or semi-centralised systems are an affordable alternative that are highly flexible and can easily be adapted to local needs and framework conditions. Particularly in peri-urban and rural areas, non-conventional/decentralised sanitation systems have proved to be sustainable and cost-efficient options in many developing countries.<sup>5</sup>

According to a sanitation feasibility study conducted by Oxfam and BORDA (a German NGO with 40 years of global experience in decentralised sanitation),<sup>6</sup> the need to improve sanitation and wastewater treatment in Tajikistan is very high. The project initiated a promotion of decentralised sanitation solutions and piloted DEWATS in Rudaki district to reduce environmental risk resulting from inadequate sanitation. Oxfam started this initiative in 2018 through its long-term and well-established TajWSS project, funded by the Swiss Government through the Swiss Agency for Development and Cooperation, and engaged BORDA.



The project has also translated the Compendium of Sanitation Systems and Technologies into Russian in partnership with Eawag and trained more than 50 stakeholders, especially construction companies, on developing sanitation systems and technologies.

[www.eawag.ch/en/department/sandec/publications/compendium/](http://www.eawag.ch/en/department/sandec/publications/compendium/)



# THEORY

## WHAT IS DECENTRALISED SANITATION?

### SYSTEM APPROACH TO MAINSTREAM SANITATION

SDG 6 on clean water and sanitation commits nations to the urgent need for alternative sanitation solutions that better fit with local needs and existing capacities. It intends to stimulate the water and sanitation sector into rethinking the entire sanitation service chain including its governance.

This necessitates future wastewater treatment solutions to be more efficient, mobile and reusable. Although large, conventional wastewater treatment systems and/or sewer systems will remain indispensable for large cities and metropolises, they may not be the only solution for all countries or areas, especially those that lag significantly behind in achieving SDG 6 indicators. The decentralised and compact wastewater treatment options have proven highly flexible and easily adaptable to local conditions. Decentralised sanitation solutions can help minimise water pollution and allow water reuse to the optimal extent possible (irrigation, groundwater recharge and direct reuse). Without recognising and making use of this complementarity, neither the SDGs nor the human right to sanitation will be achieved.

### PRINCIPLES OF DEWATS TREATMENT

DEWATS is a technical approach to decentralised wastewater treatment in developing communities. It consists of a variety of approaches for collecting, treating and disposing of/reusing wastewater close to where it is generated – be it for individual dwellings, clusters of homes, entire communities, institutional buildings, schools or hospitals.

It is based on the principles of decentralisation, simplicity and reuse of the treatment products. Simplicity is achieved through on-site treatment without chemicals or electro-chemical equipment/energy input, and by low maintenance requirements. Necessary maintenance activities can be carried out by service providers or by supervised and trained maintenance personnel on-site.

There are three main treatment steps and modules, which are combined and customised according to local conditions:<sup>7</sup>



#### PRIMARY TREATMENT

*(Sedimentation)*

Settler and/or biogas digester



#### SECONDARY TREATMENT

*(Biological processes)*

Anaerobic baffled reactor, anaerobic filter, horizontal/vertical gravel filter



#### ADVANCED SECONDARY TREATMENT OPTIONS

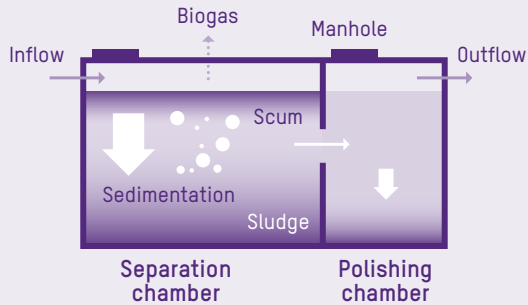
## DEWATS treatment modules



### Primary treatment

# 1

#### SETTLER

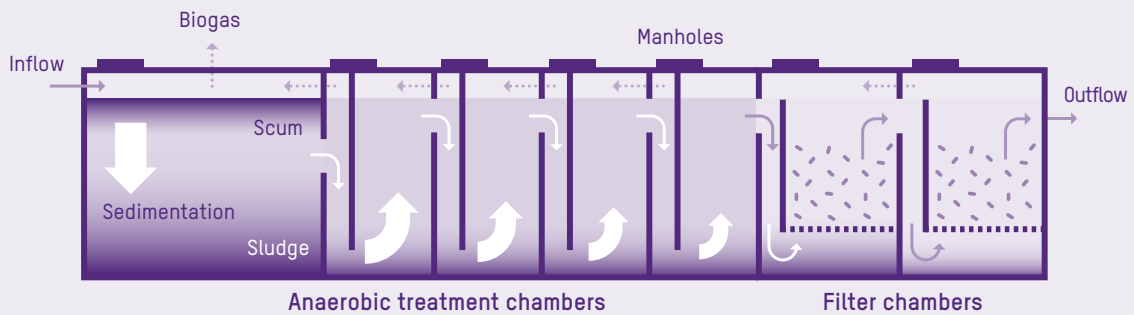


### Secondary treatment

# 2

#### ANAEROBIC BAFFLE REACTOR

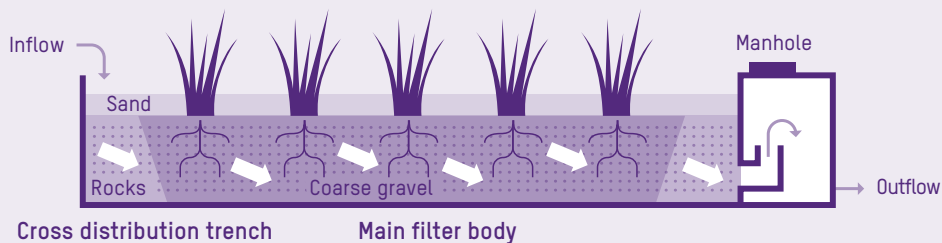
#### ANAEROBIC FILTER



### Advanced secondary treatment options

# 3

#### PLANTED GRAVEL FILTER



Source: BORDA (2019)<sup>8</sup>



DEWATS facilities are designed to be climate resilient. DEWATS is a low carbon technology which saves 34.3–37.3% in operation emissions compared with an equivalent non-methane capturing conventional wastewater treatment system. This is due to its low electricity requirements for operation.<sup>9</sup> It uses gravity, rather than pumps, and locally available construction material to build and operate the wastewater treatment solution. When pumps are essential to overcome elevation issues, solar pumps can be used.

### Characteristic features of DEWATS

- ✓ They can treat wastewater from domestic or industrial sources.
- ✓ They can be an integral part of comprehensive wastewater strategies and should be seen as complementing other centralised and decentralised wastewater treatment options.
- ✓ Units can be constructed from locally available materials and implemented by the local workforce.
- ✓ They usually function without electricity but pumping is sometimes required for water lift.
- ✓ They can provide a renewable energy and wastewater reuse source: biogas supplies energy for cooking, lighting or power generation; treated water can be reused for irrigation and gardening.
- ✓ They require few operations and maintenance (O&M) skills. Most operational tasks can be carried out by the users and some maintenance services might be provided by locally trained service providers. Hence they are reliable and cost efficient for O&M.



# PRACTICE

## DEWATS DESIGN IN TAJIKISTAN

### FEASIBILITY AND NEEDS ASSESSMENT IN HOSPITALS

The project conducted a feasibility study in 2018 at two hospitals in Somoniyon town in Rudaki district to examine the technical and operational suitability of DEWATS and evaluate its ability to be replicated as a scalable model.

The water supply in the district centre of Rudaki is provided by centralised water supply systems. Peri-urban areas use water from open sources (river and lakes) without any purification. Households and institutions (such as schools and healthcare centres) in remote villages mostly use hand pumps. Some mountain areas use available spring water by making connections with gravity flow water to households, schools and healthcare centres.



*The urgency of the situation made DEWATS an ideal solution.*

As there are many ongoing projects – mostly funded by international donors – to improve water supply in urban and rural areas of Tajikistan, with improved water supply, the problem of wastewater management will also increase. At present, there is no available data on the quantity of wastewater generated. Data on the water quality of rivers and groundwater is not available; however, it can be assumed that these (which are also sources of drinking water) are contaminated with sewage (black and grey water).

Households and public institutions in urban and rural areas may have access to toilets. Yet old and defunct wastewater management infrastructure, lack of grey water management and safe disposal of sludge from containment structures – along with poor hygiene practices – result in poor living conditions, an unclean environment and high incidence of waterborne diseases. These in turn create health hazards for schools, medical facilities, public toilets, households and the environment.

To solve this sanitation problem, a context-specific, decentralised approach might be successful. As part of the piloting, two hospitals were identified as the site to apply the DEWATS approach. The key factors used to select the hospitals were:

- Hospitals are connected to the very old, district-level sewer system, which does not meet the needs of an increasing population.
- The sewage was discharged to a local treatment plant, which was working partially and had considerable leakage.
- Some wastewater from the hospitals was poured into canals without any primary treatment, causing serious health risks for the population using water from the canals.
- The toilets in hospitals were outdated and some of them did not meet requirements.

The overall situation indicated a high urgency for improving and rehabilitating the sewerage system. DEWATS was a perfect solution to connect the main sewerage network and treatment system into mobile, decentralised treatment systems.

## DEWATS DESIGN AND CHALLENGES

DEWATS is designed to be affordable and low maintenance, use local materials and meet environmental laws and regulations. The treatment modules are watertight structures that are either a civil construction or prefabricated using suitable material. They use a combination of anaerobic and aerobic modules that are selected based on the local context of wastewater quality, treatment objectives, land availability and environmental regulations. DEWATS facilities include sewer pipes, a sedimentation module called the settler, an anaerobic baffle reactor followed by an anaerobic filter for degrading organic load into wastewater, and a planted gravel filter.

### Proposed DEWATS modules

- Grease trap
- Settler
- Anaerobic baffle reactor
- Anaerobic filters
- Planted gravel filter
- Disinfection (chlorination system)
- Collection tank

*Right: Settler, anaerobic baffle reactor and anaerobic filters.  
Below: Planted gravel filter.*





## Primary treatment

### Settler

The settler is a small-scale, decentralised treatment module that is the most common worldwide. It is compact, robust and extremely efficient when compared with the cost of constructing it. It is basically a sedimentation tank in which settled sludge is stabilised by anaerobic digestion and light materials such as grease and plastic float on top and create a scum layer. Dissolved and suspended matter leaves the tank untreated.



## Secondary treatment

### Anaerobic baffle reactor

The anaerobic baffle reactor works in a similar way to an up flow anaerobic sludge blanket. In such a reactor, the anaerobic degradation of suspended and dissolved solids takes place. They are simple, reliable, highly efficient and can be built underground. Also, the hydraulic and organic shock loads have little effect on treatment efficiency.

### Anaerobic filter

The anaerobic filter, also known as a fixed bed or fixed film reactor, treats non-settleable and dissolved solids by bringing them in close contact with a surplus of active bacterial mass. Together with 'hungry' bacteria, this quickly digests the dispersed or dissolved organic matter. Most of the bacteria are immobile, and tend to fix themselves to solid particles or reactor walls. Filter material, such as gravel, rocks, cinder or specially formed plastic pieces provide additional surface area for bacteria to settle. Thus, the fresh wastewater is forced to come into contact with active bacteria intensively: the larger the surface for bacterial growth, the quicker the digestion. Anaerobic filters are simple, reliable, highly efficient and can be built underground.



## Advanced secondary treatment

### Planted gravel filter

A horizontal planted gravel filter is a large gravel and sand-filled basin that is planted with wetland vegetation. As wastewater flows horizontally through the basin, the filter material filters out particles and microorganisms degrade the organics.

The filter media acts as a filter for removing solids, a fixed surface on which bacteria can attach, and a base for the vegetation. Although facultative and anaerobic bacteria degrade most organics, the vegetation transfers a small amount of oxygen to the root zone so that aerobic bacteria can colonise the area and degrade organics as well. The plant roots play an important role in maintaining the permeability of the filter.

However, it was very challenging for the project team to find an experienced private design institute to provide an optimal DEWATS design and get state approval for the construction process. After several discussions with the Tajik Technical University and Committee for Architecture and Construction, it was decided that BORDA would take a lead in designing DEWATS and coach the local design institute to design so as to build their capacity in using a technology design that is piloting for the first time in Tajikistan. Therefore, the process took about 7 months instead of the initially planned 3 months.

# IMPLEMENTATION PHASES

## TECHNICAL KNOW-HOW

The central hospital in Rudaki district is located in Somoniyon town. This public hospital has 471 beds with around 7,000 inpatients and 35,000 outpatients per year, while a smaller private hospital nearby has 35 beds, with around 1,000 inpatients and 7,000 outpatients per year. The public hospital has 585 employees including health workers, nurses, cleaners and technical workers, while the private hospital has 12 employees.

The project planning for DEWATS started in May 2019 and was completed in July 2021.

The **first project phase** was scheduled for 12 months. For demonstration and awareness-raising purposes a DEWATS was constructed at the two hospitals in Somoniyon town.

Old sewer lines for wastewater collection from different buildings of the two hospitals were replaced and safely connected to their toilets, showers, laundries, kitchens, laboratories and staff rooms. The wastewater is treated in a system comprising a settling unit for solids separation and an equalisation tank which guarantees an even flow to the subsequent biological treatment unit. Biological treatment takes place in a combination of an anaerobic baffled reactor and an anaerobic filter. For post treatment, a planted gravel filter is applied. The effluent from the system is then discharged to a drainage ditch, which leaves the hospital complex.

The installed system was used to demonstrate alternative and hybrid sanitation practice and to enable authorities and sector players to operate it. However, it is also required to clarify consequences for technical norms and standards as well as wastewater regulations. The new law 'Drinking Water and Wastewater' does not envisage the technical aspects of application of alternative sanitation approaches, while the Construction Norms and Standards of the Republic of Tajikistan need to be revised to accommodate alternative technologies in water and sanitation. This is urgently required since most wastewater policies and technical regulations are from Soviet times and have not been amended for decades.

In parallel with construction work, the project team held capacity-building workshops for key stakeholders on planning, construction and O&M. Furthermore, hygiene behaviour change training for hospital staff and related authorities was also conducted.

The **second project phase** was about upscaling and promoting decentralised sanitation among stakeholders in Tajikistan, which is planned for 2021 to 2025. The demonstration of DEWATS in Rudaki district as part of the TajWSS project would encourage further scaling and promotion. Oxfam and BORDA have, therefore, raised additional funds with the Lions Club under Campaign 100<sup>10</sup> and secured initial funding of Swiss francs (CHF) 3.2m until 2024 to build four additional DEWATS in hospitals in urban and peri-urban areas of Tajikistan. BORDA is now implementing this project with the Lions Club funding in partnership with Oxfam's spin-off organisation Equidev (Equitable Development).

Hospital capacities in Somoniyon			
	CENTRAL DISTRICT HOSPITAL	PRIVATE HOSPITAL 'DILBAR'	TOTAL
Staff	585	12	597
Capacity (beds)	471	35	506
Inpatients per year	7,050	1,065	8,115
Outpatients per year	35,000	7,000	42,000

It is worth exploring if DEWATS would be an effective solution for the wastewater management problem of urban and peri-urban areas, especially at community level and for institutional buildings. The objectives of scaling include:

- Achieving the crucial number of DEWATS demonstrations in Tajikistan for justification of alternative sanitation solutions
- Developing training modules and designing manuals for technical universities, vocational training centres and private construction companies
- Developing design manuals jointly with technical universities, vocational training centres and private construction companies
- Developing business plans on sanitation products for DEWATS in cooperation with the private sector
- Imparting the approach to donors, authorities and the private sector as well as international and national organisations working in the sector

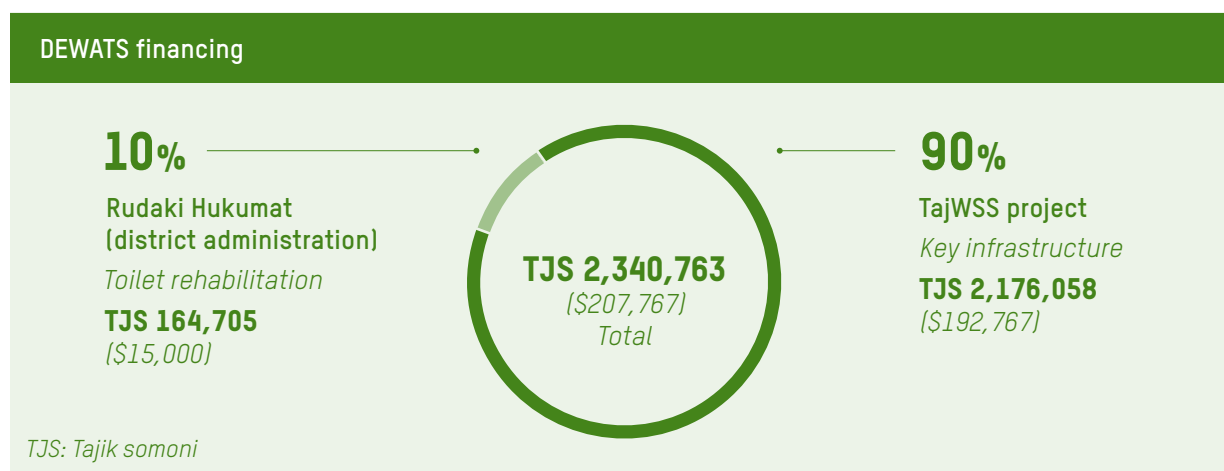
## FINANCE

The cost of the DEWATS, based on the initial quantity estimation, was around **\$153,000 in 2019**. However, due to currency inflation and the Covid-19 pandemic, the price of construction materials rose significantly within a year. The final cost was **\$207,767 in 2021**. This cost also included the cost of constructing the new sewer systems, renovating the toilets and sewer inside the Department of Infectious Diseases, installing the chlorination system and constructing a simple irrigation network.

Of this, **10% was a contribution from the Rudaki district government** that rehabilitated all toilets in the Department of Infectious Diseases. **The remaining 90% was the TajWSS project investment** for the construction of all DEWATS components and rehabilitation of pipes linking the two hospitals to the system.

Besides that, the project has spent \$55,000 on designing training modules, publishing training materials, delivering training and procuring tools for the O&M of DEWATS such as a shovel, hose pipe, bucket, wheelbarrow, rake, steel wire brush, sludge level indicator, rubber boots, gloves and safety workwear.

The construction work was implemented by Pulod-1 Construction Company, whose staff were trained by BORDA and the system building was carried out under the supervision of project engineers.



# SCALING UP POTENTIAL

## APPLICABILITY OF DEWATS AT WIDER SCALE

The project used the Technology Applicability Framework to assess the applicability and scalability of DEWATS technology in Tajikistan. This tool analyses the financial, social, institutional, legal, environmental, technical and capacity conditions from the perspective of three stakeholder groups (users/buyers, producers/providers and regulators/investors/facilitators). Its results show the suitability of a technology for the given contextual conditions and the key requirements (risks and opportunities) for its successful introduction or scaling up. The results allow for a better understanding of the performance of a technology, in terms of different sustainability dimensions and the requirements for its introduction.

Based on participatory workshops and interviews, the results are analysed and visualised based on a graphic scorecard profile with comprehensive interpretation of each indicator (see next page).




The assessment of the six sustainability dimensions shows that the social and technology dimensions are favourable for scaling up. The environmental, institutional and legal aspects and the skills and know-how dimensions could potentially have negative impacts if they are not addressed. Hence the assessment reveals that DEWATS has the potential for scaling up with certain sustainability dimensions that could become critical factors if not addressed.

Monitoring, capacity development, enabling procedures and regulations around design and construction approvals, effluent standards, siting, sizing and safe disposal or reuse regulations need to be developed so that the potential for scaling up improves. The institutional and legal dimensions do have potential, due to recent reforms, but need to be developed soon. Other critical aspects would support scaling up if staff recruitment, capacity development and provision for revenue generation is supported through reuse or tariffs for wastewater management services.




In the assessment framework, the economic dimension, especially from the user's perspective, is considered inadequate. The capital investment required by users or buyers of DEWATS for wastewater generated from institutional buildings – like schools, universities, hospitals, health centres, offices, hotels, restaurants and residential buildings or complexes – might not be available, although the individual institutions are willing to implement DEWATS.

Scaling up of DEWATS requires an enabling environment in the country – adequate funding, supporting legal frameworks and governance structures, capacities of all involved stakeholders and contextualisation of technical approach to the situation in Rudaki and then across the country.

**KEY PERSPECTIVES**

 User/buyer  Producer/provider  Regulator/investor/facilitator		
SOCIAL		
<p><b>Demand for the technology</b></p> <p>Due to its easy operation, low O&amp;M cost, and suitability to cultural and religious habits, the demand for DEWATS in peri-urban areas is high.</p>	<p><b>Need for promotion and market research</b></p> <p>Though the producers have low capacity to promote DEWATS, the government could play a role in marketing this technology. The producers are confident in promoting it if supported by the government or donors.</p>	<p><b>Need for behavioural change and social marketing</b></p> <p>A sanitation system with cost-effective O&amp;M would stimulate demand. The hospital has been trained to raise awareness about this technology and facilitates the regulatory work with relevant ministries.</p>
ECONOMIC		
<p><b>Affordability</b></p> <p>Users are hesitant about capital investment, though more willing to pay for O&amp;M.</p>	<p><b>Profitability</b></p> <p>Due to its low-cost O&amp;M, it has high potential to be profitable through service provision, especially at community level.</p>	<p><b>Supportive financial mechanisms</b></p> <p>The government’s budget allocation is very minimal and inadequate for providing sanitation access to all. However, there is potential to lobby the government for capital expenditures and operating expenses investment due to reform processes as part of the International Decade for Action on Water for Sustainable Development (2018–2028).</p>
ENVIRONMENTAL		
<p><b>Potential for benefits or negative impacts for user</b></p> <p>Theoretically there is no adverse impact on the environment. However if the required O&amp;M is not carried out, there is potential for pollution.</p>	<p><b>Potential for local production of product or spares</b></p> <p>Treated wastewater has to be safely reused or disposed of, to not create any adverse effects on the environment or public health. Regular monitoring and treated effluent quality will prevent negative impacts.</p>	<p><b>Potential for negative impacts or benefits for natural resources on a larger scale</b></p> <p>Reuse of treated wastewater or sludge should be planned effectively so that it does not accumulate in the locality but is reused. The impact of climate change, in terms of extreme weather conditions, should also be considered during design and operations. Performance monitoring needs to be carried out regularly.</p>

**Scorecard**

-  High value, neutral or positive, supportive characteristics
-  Potential impact, could become critical, needs follow-up
-  Low value, negative, critical, hindering characteristics



(Continued)

## KEY PERSPECTIVES

 User/buyer	 Producer/provider	 Regulator/investor/facilitator
<b>INSTITUTIONAL AND LEGAL</b>		
<p><b>Legal structures for management of technology and accountability</b></p> <p>Currently there is no legal framework for the operation of DEWATS. But if adequate government support is not provided in terms of reforms, the management of such a system might be an issue.</p>	<p><b>Legal regulation and requirements for registration of producers</b></p> <p>The regulatory requirements for design and construction materials lack flexibility in terms of alternative technologies being adopted in the country. The effluent standards are stricter than international standards and this might prove to be a challenge for reuse.</p>	<p><b>Alignment with national strategies and validation procedures</b></p> <p>Capacities in terms of personnel, knowledge and resource availability are very limited if more DEWATS are implemented. The State Unitary Enterprise (<i>Khojagii Manziliyu Kommunalii</i>) in general has focused on water supply and its experience with sanitation services is limited. Its rural subsidiary, the <i>Tojikobdehot</i>, does not have experience with managing sanitation services, though there is potential to carry out such services if trained properly.</p>
<b>SKILLS AND KNOW-HOW</b>		
<p><b>Skill set of user or operator to manage technology including O&amp;M</b></p> <p>Due to the simple O&amp;M requirement, there is no need for high skills and knowledge to manage the day-to-day O&amp;M of DEWATS technology.</p>	<p><b>Level of technical and business skills needed</b></p> <p>Oxfam’s spin-off organisation Equidev and international organisation BORDA will be available physically in the country for advisory and technical support. And there is also the potential to work with the Tajik Technical University to build local technical knowledge for future reference.</p>	<p><b>Sector capacity for validation, introduction of technologies and follow up</b></p> <p>The sector capacity is considered to be limited when it comes to introducing new technologies. There is a need for a country-level training centre on WASH operations and management to build the capacity of design companies, service providers and relevant ministries on policy reforms.</p>
<b>TECHNOLOGY</b>		
<p><b>Reliability of technology and user satisfaction</b></p> <p>DEWATS has underground treatment modules and requires minimal maintenance, is easy to operate, has low frequency of desludging and in general good performance. Therefore, for users, this technology is likely to be a well-accepted system.</p>	<p><b>Viable supply chains for product, spares and services</b></p> <p>DEWATS is a new concept for the country and local design and construction firms’ experience of designing and implementing these facilities is limited. However, availability of experienced professionals from BORDA and Equidev will be helpful to coach recently trained professionals.</p>	<p><b>Support mechanisms for upscaling technology</b></p> <p>The government’s commitment under SDG 6, and the evolving reforms and support of donor agencies to the sanitation sector, are all favourable indicators for bringing about long-term investment in the wastewater sector.</p>

## KEY CONSIDERATIONS IN PROJECT IMPLEMENTATION

So far, a DEWATS has been piloted in Rudaki district at two hospitals. However, it could also be implemented in schools, office buildings, residential buildings, housing complexes, standalone houses, communities, other institutional buildings, small and medium-sized enterprises and other public buildings. The assessment for scaling up DEWATS in Rudaki district, where the water and sanitation status is poor, shows that it could help reduce the adverse effects of this on the environment and public health. The study shows that the sanitation situation has scope for improvement from the perspectives of behaviour, practice, infrastructure and maintenance.

Introducing DEWATS can ensure the safe collection of wastewater (both grey and black) and its adequate treatment. Treated wastewater has the potential for reuse in agriculture or can be disposed of safely in the ground or surface water bodies. This will help to improve the current environmental sanitation, where most wastewater is disposed of untreated, and can in turn lead to improvements in public health. Stakeholders interviewed in the feasibility study of DEWATS technology in Tajikistan in 2021 highlighted that a clean environment will be an added advantage amid the Covid-19 pandemic. Stakeholders, especially the international donor agencies and regulators working in the sector, believe that DEWATS is a suitable technology approach for improving the sanitation situation and a step towards achieving the SDGs.<sup>11</sup>

In general, the physical and climate conditions in the area allow for the application of DEWATS. The conditions are similar to other places where DEWATS has worked successfully around the world, including nearby countries such as Afghanistan, Jordan and Iraq. The groundwater table is usually below two metres, except for the areas close to rivers, making it generally suitable for application of DEWATS. In areas with high water tables, adequate measures during the construction stage can be adopted to make the construction of DEWATS and its functioning feasible. Due to the changing climate, however, there have been periods when there is excessive rain during the spring season. This might result in rising groundwater table levels. The design of DEWATS makes it work even in such conditions as long as adequate construction measures are taken to ensure that the wastewater does not contaminate the surroundings, adversely affecting the environment.

As DEWATS is a water-based treatment system, water supply needs to be ensured for it to work. DEWATS is a passive, gravity-based design and does not require electricity for the wastewater to flow through the system. As the treated wastewater flows out at the lowest point, it is possible that, in some locations, electricity and pumps might be required for pumping out treated wastewater for irrigation or disposal.

It is crucial to design the DEWATS implementation plan taking into account legal and bureaucratic constraints in Tajikistan. The following table envisages the implementation plan from diagnostics to final phase of handover.

DEWATS Implementation Plan

Phases	Activities	Time allocation
<b>1</b> <b>DIAGNOSTIC PHASE</b> 	<ul style="list-style-type: none"> <li>Understanding of the current situation (technical feasibility study)</li> <li>Identification of sites and operators</li> <li>Legal and institutional assessment for gap findings</li> </ul>	1–2 months
<b>2</b> <b>STRATEGY PHASE</b> 	<ul style="list-style-type: none"> <li>Stakeholder analysis</li> <li>Identification of non-technical and technical options</li> <li>Development of implementation plan</li> </ul>	1–2 months
<b>3</b> <b>PLANNING PHASE</b> 	<ul style="list-style-type: none"> <li>Tendering for selection of construction company*</li> <li>Capacity building of the construction company</li> <li>Detailed engineering design, fine-tuning and modifications</li> </ul>	3–4 months
<b>4</b> <b>ACTION PHASE</b> 	<ul style="list-style-type: none"> <li>Site clearance and excavation</li> <li>Installation of DEWATS components and piping</li> <li>Technical testing and leakage check</li> <li>Development of DEWATS management guidelines and tools</li> </ul>	7–9 months
<b>5</b> <b>HANDOVER PHASE</b> 	<ul style="list-style-type: none"> <li>Development of legal documentation for handover</li> <li>DEWATS O&amp;M training for operators and regulators</li> <li>Commissioning and final inspection for handover</li> </ul>	3 months
<b>6</b> <b>MONITORING</b> 	<ul style="list-style-type: none"> <li>Development of timetable and monitoring indicators</li> <li>Regular reporting and effluent water sampling</li> <li>O&amp;M cost calculation and performance evaluation</li> </ul>	Recurring

15-20 months

Note: This is an indicative timeline: in practice the duration of individual stages can vary.

\* Contracts with local construction companies are drawn up on an individual basis, with varied terms based on the complexity of the infrastructure and the capacity of the company. In the case of the pilot, BORDA was employed to fulfil the technical supervision of such contracts.

# KEY LEARNINGS

## LESSONS LEARNED

The DEWATS experience shows that, among other important aspects, three major lessons have been crucial to follow up and consider when implementing such technology in Tajikistan. These are:

### 1 FEASIBILITY STUDY ON APPLICATION OF DEWATS

- The technology should be technically feasible and cost efficient to build.
- It should be understood by users, service providers and regulatory bodies.
- It should be affordable to operate and maintain after the handover.
- There should be motivation to adopt and manage the system.

These are the most important entry points before moving into the second stage of implementation. For a year after the completion of the construction, there should be a strict training and monitoring schedule to build the necessary skillset for the O&M of the system with regular monitoring reports based on agreed indicators according to national or international standards.

### 2 DESIGN AND IMPLEMENTATION OF DEWATS

- The project design and implementation should be executed inclusively with all stakeholders and interested parties.
- The operator should be identified before the construction stage and effective delegation of authority should be agreed on.
- The labour-intensive construction process should be closely monitored and supervised by experienced engineers (BORDA can fulfil that role in Tajikistan).
- The O&M instructions should be developed during the construction phase and the operators should be trained periodically about the construction stages, inspection rules and management procedures.
- The service fee should be identified after all the costs are incurred to ensure profitability of the service delivery.
- A periodic monitoring and accountability system should be in place.
- The contractual terms should be laid out and all potential breaches (such as late fee payments and non-compliance in maintenance) clearly explained.

To achieve long-term sustainability in service delivery, more holistic activities should be carried out to raise awareness about WASH and its impact on public and environmental health.

**3****SUSTAINABILITY IN ACCESS TO DECENTRALISED SANITATION SERVICES**

- Significant technical and financial support is required to create an enabling environment for government investment in replication.
- There is a need for leadership, stakeholder commitment and adequate support from the Ministry of Health and Social Protection, Ministry of Energy and Water Resources, State Unitary Enterprise (*Khojagii Manziliyu Kommunalii*) and district governments to recognise DEWATS and acknowledge it as an alternative solution, especially for rural and peri-urban areas or towns.
- The training centre in Tajik Technical University should be established with technical support from BORDA to build the required expert skills and (external) human and financial resources for facilitation.

To achieve universal access to sanitation services by 2030, it is vital to approach WASH interventions holistically, understanding the complex financial, social and environmental aspects from different perspectives. Without such an approach, even so-called ‘appropriate’ sanitation technologies will continue to fail, when the expectations of the users and service providers are not met and determining factors to sustain the technology are lacking. Oxfam’s experience in Tajikistan shows small-scale, decentralised, affordable and repairable technologies are acceptable and welcomed by the government, regulatory bodies and the private sector, as well as users, given their low O&M cost.

This has been evident from year-long operation of DEWATS and feedback from the hospitals. The final take-away has been to develop a simple, manageable and low-cost system so to ensure its sustainability with existing capacity and knowledge.

## CONCLUSIONS

DEWATS is unique in that it enables all the different phases and actions of the sanitation chain to happen under a single umbrella. Successful uptake and scaling of DEWATS is linked to many different factors such as the ability of users to invest and pay for the recurrent costs of O&M, the availability of know-how and skills to operate and maintain the system, and the resources and capacity of local government to support user communities. Therefore, the new sanitation technology can be considered successful when it is taken up by a great number of users (scaling up) and when it provides its services over a long time (sustainability). Although DEWATS requires intensive investment in the construction phase, it requires neither much effort nor resources to maintain in the long run.

For urban and peri-urban areas in Tajikistan, the situation is particularly challenging. Improving access in these areas might be highly sensitive to the socio-economic status of the population, technical capacity of service providers, legal constraints and available finance. Decision makers such as governments, development partners and private investors need efficient and robust tools for assessing the applicability of DEWATS in urban areas too. These tools need to properly address the key aspects of sustainability of services but also cover the introduction process, providing a comprehensive assessment and recommendations.

The objectives of piloting DEWATS in Tajikistan were, therefore 1) to develop a reference point to validate new DEWATS technology on its applicability in a specific context, and 2) to develop a guide which supports decision makers at country, district or city level in the successful introduction of a validated technology in a given institutional framework. This work was done in the framework of the TajWSS project (Phase III), funded by the Swiss Government through the Swiss Agency for Development and Cooperation, and is now being scaled up by BORDA and Equidev in urban and peri-urban areas through other funding, to assess its cost-effectiveness in the long run.

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10. Campaign 100 is an international fundraising effort of the Lions Clubs International Foundation of Switzerland-Liechtenstein. Among other activities, it supports the Clean Water Project to improve the wastewater and hygiene situation in Tajikistan. It aims to improve sanitation and hygiene conditions in hospitals by 2023. Three DEWATS are under construction and the first will be completed in spring 2022. See: Lions Clubs International. (2012). Projekt Clean Water. Retrieved from: [www.lionsclubs.ch/en/multi-district-102/news-1/projekt-clean-water.html](http://www.lionsclubs.ch/en/multi-district-102/news-1/projekt-clean-water.html)
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