

# Improved Operation and Maintenance and Revenue Collection from Metered Water Supply Systems: Lessons from Rural Afghanistan

## SUMMARY

The Government of Afghanistan is investigating service delivery options to achieve access to safe and affordable drinking water (SDG Goal 6.1). One option to provide rural communities with sustainable and quality water is metered household water connections. The Afghan government began supporting such an approach in 2006 which it began to scale-up in 2016. This study documents and assesses experiences in the operation and maintenance as well as revenue collection systems of this intervention.

Research was carried out in 16 rural villages in Bamyan, Ghazni and Herat provinces where water supply systems with household connections have been functioning in recent years. Communities were overwhelmingly positive about the benefits of these systems. Those interviewed appreciated the operation and maintenance (O&M) mechanisms established in communities (most often through Community Development Councils (CDCs)) with support from local government. Moreover, respondents underscored a willingness to contribute to pay for establishing such water systems.

Community's willingness to pay for the development of such systems is high; it was found that households contributed significantly to the construction of the systems. Women's participation in the operation and maintenance was however limited to the household level, and they did not effectively engage in the management of the water supply systems outside of the household. Yet, the study found that women's contributions to the household connection and the water meter were crucial and that future scaling-up of metered networks should encourage higher levels of women's participation in the leadership, administrative and operational management of the systems.

## Introduction

Sustainable Development Goal (SDG) 6.1 aims for ensuring universal access to 'safely managed drinking water that is located on premises, available when needed and free from

contamination (JMP,2017). UNICEF Afghanistan's Water, Sanitation and Hygiene (WASH) programme is committed to supporting the Government of Afghanistan in implementing SDG 6.1. through the construction of piped water supply systems with household connections.

## KEY POINTS

- Overall, respondents reported that the metered water supply systems improved the situation in the village. Community members in all 16 villages expressed confidence in the readings of their water meters.
- Household connections and metered water supply systems have contributed to water saving and a sense of household and community ownership.
- In general, a CDC or Shura is the platform for collective decision-making on water systems.
- While women maintained water meters and connections at the household level, they had minimal access to managing water systems outside their households.
- Delegating operations and maintenance of water supply systems to qualified mechanics plays a crucial role in keeping the systems functional.
- Skilled mechanics, materials and equipment to maintain and repair water systems were generally available locally or nearby.

Equipping these systems with water meters can also promote the realisation of SDG 6.4 which aims to ‘increase water-use efficiency’ and ‘supply freshwater to address water scarcity’.

In rural Afghanistan over the past 15 years, the Ministry of Rural Rehabilitation and Development (MRRD), the National Solidarity Program and several NGOs have constructed different types of water supply systems including borewells with hand pumps; borewells with diesel generators and solar panels and piped systems with public taps. While government and private-metered connections are common in urban areas (managed either by the Afghanistan Urban Water Supply and Sewerage Corporation (AUWSSC) or private water companies), piped and metered house connections are an exception in rural areas. Public taps and hand pump systems can be inefficient and are often poorly maintained.

Water can be contaminated during transportation or when kept in storage. Water supply connections reduce these contamination risks. Providing water to communities through piped and metered connections has the potential to improve these aspects significantly.

Access to piped water on premises at the rural level is only 4.2 percent (ALCS 2016-17), but any further analysis about metered water supply systems is not well documented. In 2016, the President’s office called for metering of all piped water systems with household connection to record improvement in revenue collection and promote increased operation and maintenance, as well as to enhance community participation and ownership of such systems. UNICEF Afghanistan has supported the MRRD’s efforts to scale implementation of metered water supply networks in rural areas.

This field note aims to serve as a guide for the WASH sector in Afghanistan and the region. It describes how communities are managing the daily operation and maintenance as well as administrative and financial aspects of operating and managing piped, metered, water supply systems in 16 rural communities in Bamyan, Ghazni and Herat provinces. It is hoped to promote the expansion of metered water supply systems and this service delivery model to other rural communities.

## Description of Intervention

In 2018, a pilot study to assess the operation and maintenance and pricing of metered water supply systems across three provinces in 16 villages in rural Afghanistan was conducted. The study was led by MRRD in three villages in Bamyan and six villages in Ghazni, while UNICEF WASH led the study in seven villages in Herat.

All villages were selected in consultation with MRRD and had functional metered water supply systems for at least one year. On average, the systems studied were roughly six years old.

Individual systems provided water supply to 128 to 850 families.

Assessments were facilitated by the Provincial Rural Rehabilitation Department (PRRD). CDCs were informed at least two days before visits to ensure the presence of key community members. The study was conducted using focus group discussions tool with beneficiaries, operators/mechanics, CDC members and village elders. Open-ended and closed-ended questions were used to gather community responses. Several water supply systems were checked randomly, including house connections and water meters.

81 percent of the water supply systems were funded by the Government and UNICEF in collaboration with the National Solidary Program and the Rural Water Supply, Sanitation and Irrigation Program and were implemented by the Community Development Council (CDC). The other systems were fully funded by beneficiary communities and were managed by private sector companies through a service delivery contract set up directly with the traditional village level committees (Shura).

## Outcomes

This pilot revealed a number of significant issues related to water supply systems in rural Afghanistan. This section will detail the outcomes identified by fieldwork undertaken in Bamyan, Ghazni and Herat provinces. These findings can be categorised as follows: general findings, community decision-making, water consumption, pricing and costs, monitoring systems, as well as mechanics and system repairs.

### General findings

Overall, this survey demonstrated that piped-water supply systems can benefit communities in rural Afghanistan. 81 percent of surveyed communities reported having 24-hour water access, with 94 percent of these villages commenting that their water access was sufficient for their daily use. In the 16 villages studied,

100 percent of households with piped water supply connections were metered. Community members reported that water meter performance was satisfactory in all villages. In 63 percent of villages people accessed water exclusively from piped water supply systems as opposed to other sources. Interviewed households generally agreed that water prices were low compared to the high level of service they received. Respondents identified that systems resulted in an improvement in sanitary conditions.

In general management plans established that mechanics served as the lead for overseeing water supply systems. Women, who usually bear the responsibility of collecting water in Afghanistan, contributed to maintaining water meters and house connections. Respondents indicated that systems allowed for better privacy for women, though there was no sign, however, of any women's participation in the operation and management of these systems outside of the compound or on other supply related issues.

### Organisation of the management of the systems

All 16 surveyed villages established a management plan for their water supply projects. 11 systems were managed by the village CDC or community Shura, four by private sector companies (three in Ghazni and one in Bamyan), and one was managed by a joint Shura-private sector initiative. In general, a local mechanic acted as the lead person in charge of maintaining and monitoring water meters. In 56 percent of the surveyed villages, women were present on the village CDC/Shura. In the other 44 percent of villages, however, no women were present. Notably in Bamyan province, women and men jointly made decisions on water supply systems. In the other two provinces, however, very little women's participation was reported and there was little evidence of their involvement in the administrative aspects of the water supply management.

Households not complying with agreed rules regarding repair and replacement of water meters, were required to pay a very simple fine/penalty. For example, if a household did not repair its water meter by an agreed-upon deadline, the household's water connection would be disconnected, or extra money charged. 50 percent of those interviewed said that if a household did not pay or contribute to repair their individual connection or meter, the household would be disconnected from the system. These rules were not, however, applied systematically and not documented.

At the same time, most of the surveyed communities collectively agreed to provide the poorest sections of their villages with water for free or at a reduced price. Households benefiting from free or cheaper water were identified by the CDC or Shura. Also, households who were not able to pay water bills on time were allowed to pay later when they were able to do so.

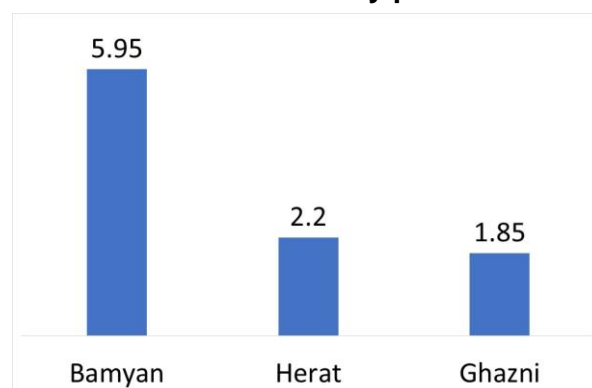
Two villages reported that prominent community members disproportionately affected decision-making processes. In these villages, influential community members were reported as missing the timely payment of their water bills, and in one village in Herat, a group of influential community members used water for agricultural purposes which was not allowed.

New connections were added without consulting engineers of the provincial government but were done through a consultative process among the households of the village. In some villages, expansion happened at scale. In one village where 250 water connections were initially implemented, connections have doubled to 500 connections. In another village, the initial system served 100 water connections, which has now tripled to 300 connections. It is important to mention that the scaling-up of systems had been accounted for, and therefore these systems are still working properly to address the water needs of all concerned households.

## Water quality and consumption volume

In surveyed communities, and more broadly in rural Afghanistan, it is common for related, extended families to live together within a compound and share services like piped-water connections. Surveyed communities on average had seven individuals per family. The average number of families per water meter for each province is illustrated below in Figure 1.

**Figure 1: Average number of families per water connection/meter by province**



Source: Assessment reports of the study

Average daily water consumption per family varied greatly between villages, from 84 liters/day to 625 liters/day. 13 villages reported having water access 24 hours a day, while the other three villages reported having water access for most of the day (up to 14 hours). 15 of 16 villages reported that the water was sufficient for their daily use.

Households mentioned that they felt that piped-water supply systems were far superior to the sources of water they used before. 94 percent of villages reported that the systems provided good quality water, though this was not verified with bacteriological tests. Respondents mentioned a decrease in water-borne diseases (this was not assessed by field teams). Improved access to water led to visibly improved hygiene levels, including cleaner toilets.

## Water to public institutions

88 percent of surveyed communities provided free water to public spaces such as mosques and schools. Mosques were the public spaces predominantly connected to water systems for free; schools placed second. In one village in Herat, a water supply system provided free water to nine public spaces (eight mosques and one school). One village in Ghazni reported that the system provided water for free to 18 unmetered, public spaces. In some instances, this added significant monthly costs, including an estimated AFN 17,820 per month (USD 228) in one village.

## Operation and maintenance costs and service affordability

Water tariffs were set using different modalities based on consumption (cubic meter of water) and people paid based on quantity consumed. Where the Government funded the project, MRRD/PRRD assisted in determining water price for the first year of operation. Some villages simply agreed on a price and later changed it because the agreed initial price was unrealistic. In 50 percent of villages, the water price was not changed, while it was reported that the price was changed in the other 50 percent of villages to be more realistic. In those cases, the tariffs were reduced by between 10 and 50 percent. The reason prices were reduced included: inexperience in setting an appropriate pricing structure at the start of the operation, reduced costs (a consequence of the conversion of systems to hybrid systems), and to keep tariffs affordable for all households.

Competition between mechanics (in cases where management of the system was entirely outsourced to mechanics) also contributed to the price determination. The mechanic with the lowest cost for water was generally selected as the winner with whom the management of the water system was contracted.

For systems outsourced to private utilities, the price was agreed between village inhabitants and the company. The bidder with the lowest cost for water was generally selected as the contractor to

manage the water system. Billing plans varied amongst villages: 11 villages used monthly billing cycles, three used bi-monthly cycles, and two used trimester billing cycles. In one village, people paid a flat fee of AFN 30 (USD 0.39) per water meter every two months, regardless of household water consumption. In two villages, on top of paying for their water consumption, households paid AFN 100 (USD 1.3) per month during the winter season.

This study found that households were careful to conserve water and generally did not use the water supply system for the watering of plants or for agricultural purposes. In 94 percent of villages, inhabitants limited the use of water from the system for domestic consumption. In one village, to reduce the usage of water for agricultural and other non-domestic purposes, an arrangement was made whereby households agreed to pay AFN 10 (USD 0.13) for up to 5 cubic metres of water and AFN 20 (USD 0.26) per cubic meter beyond that amount. Prices generally varied based on energy sources as detailed in Table 1.

**Table 1: Average price of water by system type**

System type	Price (per cubic metre)	Surveyed villages using this system
Hybrid (Solar + Diesel Generator)	28.7 AFN/ 0.368 USD	3
Diesel Generator	28 AFN/ 0.359 USD	3
Solar-powered	12.4 AFN/ 0.159 USD	5
Gravity-fed	7.5 AFN/ 0.096 USD	2
Hybrid (Solar + City Grid)	6.7 AFN/ 0.0859 USD	3
<b>Average</b>	<b>17 AFN/ 0.218 USD</b>	<b>Total: 16</b>



On average, the cost of a connection with all related accessories was AFN 2,740 (USD 35), while a new system cost between AFN 2,000 and 2,500 (USD 25 to 32). In general, households made payments to the CDC and the CDC was in-charge of all aspects of the system including repairs. In 81 percent of surveyed villages, mechanics were supported by the CDC or village Shura to collect water bills from households. Two of these villages established a small committee to help the mechanic collect money from households. The three systems managed by private companies hired a mechanic to carry out the revenue collection. In 38 percent of surveyed villages, respondents and mechanics stated that the households paid water bills on time.

Despite an affordable price, some households were unable to pay on time. Different villages took different approaches to clear financial dues with households and mechanics. A CDC in one village met with the mechanic every six months and cleared all outstanding payments, identifying who still owed money as per the tracking system. Late payment was reported to be tolerated by the CDCs and mechanics due to the reality that at the village level many often do not have cash readily available for such payments. In 25 percent of surveyed villages, the CDC or Shura identified small groups of people who were unable to pay and provided them with water for free or at a reduced price.

### Women's participation in operations and maintenance

It was largely recognised that women were involved in the operation and maintenance of the water connections inside their compounds, taking care of the water meters and the taps installed. Women's contributions to keeping the water meters as well as house connections functional and clean were significant. There was no sign, however, of any women's participation in operation and maintenance outside of their compounds.

The participation of women in other water supply-related issues was also not very visible. In nine villages, a few women were part of the village CDC/Shura, and some women held deputy and secretary-level positions. In the other seven villages, no women were present at the CDC/Shura-level. In one village, there was a parallel CDC/Shura composed of women, separate from the men, and this village was found to have a stronger management process of the water supply system compared to the other villages, as a result of this collective decision-making. External operation and maintenance issues were not discussed in this women's CDC.

### Monitoring systems and financial bookkeeping

All villages expressed confidence in their meters' water readings at the end of each billing cycle. Households themselves, especially women, monitored the performance of water meters. During each cycle, mechanics check if any meter is performing significantly different from the previous period and double-checks with households if consumption differed during the period. Households contacted their mechanic/operator if they suspected readings were incorrect.

Water meters experienced minor defects with four systems recording no breakdowns; four systems recording one breakdown each; three systems recording two breakdowns each; two systems recording three breakdowns each; and three systems recording twelve breakdowns each during the past year. Most breakdowns were minor and related to water meters (inaccuracy in water measuring, leakage around the water meter, etc.). Other common problems included leaking pipes and taps (reported in eight villages), pump issues (reported in four villages), electricity and generator issues. Blockages also occurred in pipes during the cold season due to freezing and some defects in fittings were also reported by a few villages.

69 percent of surveyed villages were able to present financial logbooks and household billing booklets with all relevant information recorded (see Figure 2). The mechanic or CDC and the household kept copies of these billing booklets. Record-keeping helped to monitor household consumption overtime. In the four villages where the company was in-charge of operations, there was a more-structured financial system with segregated expenses based on salaries, repairs and other aspects.

Figure 2: Household tariff/bill booklet

Source: Assessment reports of the study

Some villages maintained detailed financial records; Figure 3 shows an example from Herat.

Figure 3: Meters registration and financial bookkeeping

Source: Assessment reports of the study

### Mechanics, frequency of breakdowns and surveillance of water supply system

Maintenance and repairs of household connections/water meters were accepted as individual household's responsibilities. The frequency of breakdowns/defects in community water supply systems across surveyed villages saw huge disparities from zero to 12 times per year. Average time to address the most common problems averaged around six working hours for the 14 systems visited. More complex problems like pump replacements were reported to take up to one day.

Salary-based mechanics were generally hired to maintain community piped-water supply systems. Mechanics conducted regular checks of the entire water supply system including the water connection/meter and informed households about damage or nonfunctional connections/meters. Mechanics were selected based on their technical experience and were trained on the job with the implementing partner. 15 of 16 villages reported having mechanics carrying out regular system check-ups, accompanied by members from the CDC or Shura in some cases. Such check-ups were not well-documented, however, and no systematic checklist for system surveillance existed. Mechanics checked systems by doing a complete walkthrough of all the parts of the system when reading the meter at the water fee collection time.

The study did not find a harmonised approach to paying mechanics, though there were similarities between systems, especially for those which were established by the Government. Mechanics monthly salaries varied significantly. In the 15 villages that paid a mechanic to run water systems, the mechanics' monthly average earnings were AFN 6,500 (USD 85). Mechanics reported receiving their wages on time. Local mechanics installed water meters in 50 percent of villages, while outside mechanics installed water meters in 31.5 percent other villages. In the remaining 18.5 percent of villages, systems were metered by outside private companies.

81 percent of villages reported that equipment and spare parts for repairs could be found nearby, while 19 percent reported that they needed to travel quite far to secure such equipment and spare parts. All mechanics confirmed that experts were available nearby for complicated system repairs. Only two of 16 mechanics stated that they might need outsider support to address complicated issues.

75 percent of surveyed communities maintained reserve funds to pay for unexpected systems repairs or replacement. Repairs were estimated to cost as little as AFN 400 (USD 6), while larger pump repairs were reported to cost between AFN 15,000 to 30,000 (USD 200 to 400).

## Lessons Learned

The following are lessons learned from this study:

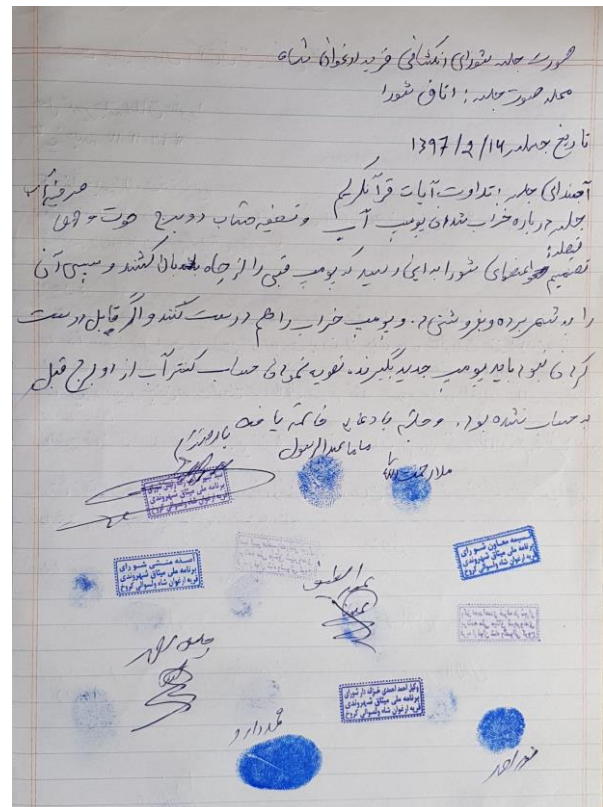
Some good practices are as follows:

- Half of surveyed villages reported that the **Government continued to support** the water supply systems after completion and handover. For example, six villages received solar panels from the Government to reduce water prices.
- Water systems have been designed to last for 20 to 25 years, anticipating network growth. 63 percent of communities reported **expanding household connections** to their piped-water systems, though this expansion did not affect system performance.
- Where CDCs or private companies managed systems including **financial management**, there were more structured financial systems present. In some villages, surplus revenue supported operations, maintenance, and repairs. While there are limited banks available in rural Afghanistan, in one instance, a village kept this surplus revenue in a bank account.
- The study revealed that **community members** felt that they had considerable input through CDC decision-making processes. Notably in

Bamyan province, **women and men** jointly made decisions on water supply systems.

- **A well-established water committee** and functional CDC appeared to positively impact outcomes.

**Figure 4: CDC meeting minutes on water pump (collective decision)**



Source: Assessment reports of the study

- In many surveyed villages, **mechanisms were established to address conflicts**. While most conflicts were minor, in 50 percent of surveyed communities, the CDC or Shura managed disputes related to the water supply system. In 25 percent of villages the monitoring and surveillance water committee in charge of the water supply also addressed potential disputes. In general, CDC members and Imams were part of such platforms. In the three villages where private companies were in-charge of managing water supply systems, they also addressed water-related conflicts, often with the support of the CDC/Shura. One village was found to have



a dedicated committee to manage conflict/dispute settlements, supported by the CDC. Most conflicts were minor such as the timeliness of repairing water meters.

- Most villages reported that **materials required** to repair water systems were generally available locally and that mechanics with the necessary capacity were present locally or nearby.
- This study revealed that establishing **annual contracts with mechanics** helped communities develop well-managed systems.
- In a few villages, the **community incentivised mechanics** by offering them a proportion of generated surplus revenue which was believed to lead to better functioning systems.
- While **diesel generators** have been used to power water systems in the past, they often prohibitively raised costs for consumers. This study found that these older diesel-powered water supply systems have begun to being converted to hybrid solar or fully powered solar energy systems, reducing costs.
- **Solar-powered systems** reduced the price of water and frequency of system operating challenges.
- New **digital water meters** (installed in 13 percent of surveyed communities) helped villages measure water consumption more accurately.

Some areas for improvement are as follows:

- The **operating costs** of systems managed by private companies were nearly three times higher than those managed by CDCs/Shuras. The per month/per person operating costs for the 11 systems managed by CDC/Shuras was AFN 44 (USD 0.70) compared to AFN 124 (USD 1.61) for five fully or partially managed by private companies.
- **Pricing and fee collection processes** varied across all systems studied reducing the effectiveness of recovering costs from consumers. Similarly, there was no standardised process for **finances or oversight**.
- Privately managed systems did not address the needs of **impoverished community members** unlike those managed by CDCs/Shuras which maintained closer relations with communities.
- Water systems did not cover 100 percent of households in communities. **Groups of families were not connected** to piped systems for a variety of reasons including being unable to afford the costs of accessing the system or being located far from the system leading to low water pressure.
- **Influential community members** had the ability to dominate collective decision-making processes related to water systems in the community.
- Though women were responsible for safe water management and storage from the water meter to consumption at household level, there were **very few cases where women participated** in the operations and management of systems outside of the compound.
- **Low quality pipes and water leakage** in house connection pipes were identified as problems for some systems.
- Some **mechanics were unfamiliar** with parts of operating and maintaining water meters.
- In some surveyed communities, **water reservoir** volume and capacity were insufficient for community demands.
- For systems reliant on a **city grid connection or needing a backup diesel generator**, electricity fluctuation and high costs posed problems for piped-water systems.

- **Scarcity of water** was a concern for some villages.
- Some raised the concern that **metallic water tanks** were susceptible to stray bullets from ongoing fighting within the region; concrete tanks were proposed as a potential solution.

## Next Steps

Following the successful undertaking of this study, the below next steps were identified:

- This survey indicates that there is real potential and local interest in **expanding piped water systems** in rural Afghanistan. Such expansion should consider the existing capacity of local infrastructure (water pressure may be affected and water may not be delivered to the last points).
- When **handing over infrastructure** to communities, government representatives (at the local or line ministry level) should ensure that recipient communities also receive quality training on the management model and how to ensure long-term sustainability of the system. Government representatives should also monitor completed projects in rural areas to support the longevity of the project and collect further lessons learned on implementation.
- Authorities should be contractually obligated to **test water quality** for chemical and bacteriological contaminations before handing over systems to communities. Relatedly, it is recommended that a simplified water safety plan be implemented to contribute to water safety and systems functionality.
- The MRRD quality control unit should be further strengthened to ensure its ability to **monitor the quality of all materials** at the field-level including pipes. This was an issue raised as a concern by a number of villages. More rigorous monitoring and supervision is required during implementation.
- **Women's participation in the decision-making processes** within water committees must be enhanced. MRRD is planning to evaluate and propose ways to ensure gender-sensitive participation in rural water supply programming.
- **Solar-power and/or gravity-fed systems** should be considered due to the lower operating and maintenance costs.
- Increased efforts to **raise awareness** about the importance of water scarcity, water conservation, water safety, and monitoring systems should be made.
- Experiences from a few villages demonstrated that **different forms of private sector participation** could support sustainable water supply services; these models should be further explored.
- **Water pricing** and fines/penalties should be harmonised. A more systematic approach should be taken to develop a range of potential business models. MRRD as the lead agency could provide support on the issue of appropriate water pricing at the rural level.
- Local level **financial tracking systems** should be systematised and improved.
- The drafted **rural water strategy** should be finalised and adopted.

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