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Metered handpumps: privately operated handpumps as a way to improve sustainability and service delivery

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In Uganda, Water User Committees dominate management of water supplies in rural areas. However, their failure to efficiently collect user fees to cater for operation and maintenance has led to the stagnation of water coverage. In contrast piped water schemes common in urban areas are metered and managed by private operators. Overall, statistics reveal higher functionality rates for metered systems. To encourage private sector engagement in the operation of the point water sources, Water for People and Appropriate Technology Centre have on-going research under which a meter for handpumps is being tested. This product has been introduced to entrepreneurs with the expectation that they will prove to be better managers of water points than the current committees. The results have been mixed with the current water-meter not adequate for high-yielding boreholes. However, there is unmistaken increase in revenue owing to the water meter.

Introduction

The India Mark II pump is considered to be one of the most successful handpumps in the world. Together with the Afridev and Bush pumps, it is reported that hundreds of thousands if not millions of these pumps have been installed worldwide. Production of the India Mark II pump which started in India extended to various countries including Togo, Uganda, Italy, Germany and Nigeria. (Baumann & Furey, 2013).The Uganda version of the India Mark II is called the U2 pump and it is one of only 2 standardized borehole pumps in Uganda (Kimera and Achiro, 2010). Deep boreholes serve 38% of the Ugandan population. It was reported in 2010 that of the 24,660 boreholes in the country, 4,957 (20.1%) were non- functional (Uganda Water Supply Atlas, 2010).

The water coverage in rural areas has stagnated between 63 and 64% for the last 6 years despite the installation of hundreds of new handpumps every year. A major cause of the un-improved water coverage is the poor level of functionality of Water User Committees (WUCs) which currently stands at 71% in rural areas (Uganda Water and Environment Sector Performance Reports [SPR], 2009 – 2013). These WUC comprise 7 to 10 members. Also, the Capital Expenditure of the U2 pump is highly subsidized by the government. These pumps usually serve communities of about 300 people. The operation and maintenance costs of these pumps are supposed to be met largely by the beneficiary communities through WUCs which should collect fees to cater for operation and maintenance. The failure of the WUCs has led to the low functionality levels of the handpumps (Nimanya, et al, 2011).

On the other hand coverage in urban water areas dominated by piped supply systems has steadily increased from 61% in 2007/2008 to 69% in 2012/2013 (SPR, 2009 – 2013). This success may be attributed in part to the engagement of private operators to operate and maintain the systems since 2001 and the use of water meters which enables the billing of customers to recover costs. The Ministry of Water and Environment is in support of the private sector engagement for service delivery as it has realized the efficiency gains from their involvement (SPR, 2012).

Water for People and the Appropriate Technology Centre are working on using a water meter for U2 pumps. This model entails using Private Operators to manage and maintain the handpumps in clusters of five. A small fee would be charged for the water collected by the users per jerrycan and the water meter would assist the business owner to track the payments collected and reimbursed by the various caretakers.

In Kyuso district in Kenya, a number of communities were clustered to provide economies of scale and pool risks in the operation and financial delivery of maintenance services. A single maintenance service provider was then introduced with accountability for service delivery to all these communities. All the handpumps in this cluster were installed with a mobile enabled transmitter to provide reliable and timely information on hand pump functionality to improve institutional, operational and financial performance to the selected service provider. Results show that pump outage times dropped by an order of magnitude from a mean of 27 days to under three for 95% of all the handpumps in this cluster. The results also showed that a hand pump on this model needing a minor repair was over four times more likely to have been repaired within two days than under the existing system. 98% of handpumps under this model in Kyuso are now working (Water Programme, Working Paper 1, March 2014).

This model of metering handpumps is being piloted in Kamwenge and Kyegegwa districts in Western Uganda. This paper outlines the methodology and the results as well as lessons learned so far from this process.

Methodology

A review of the available literature did not reveal that prior work had been done on metering of handpumps in Uganda. However, the study revealed that in some communities, especially the small trading centres, people were paying for water per jerrycan from handpumps. There are no guidelines presently with regard to privately operated handpumps. Caretakers of such handpumps usually tie up the handle onto horizontal poles to restrict its movement during times when they are not there. In another case, the caretaker removes the chain in the head assembly at the end of the day. However, experience shows that removal of the chain is more effective as defaulters vandalise the poles at night and collect water freely. Generally they charge per jerry can collected and the usual cost is 50-100 UG shillings. Caretakers in Kamwenge district were paid about 30,000/- per month. There isn't any real record of the water collected on a daily basis. The operator can have suspicions that the hand-pump caretaker is pocketing some of the money collected from the water sales (Zikusooka, 2012).

Prior work carried out by Sugden (2012) indicated that the multi jet water meter would be quite appropriate for this kind of intervention. Multi-jet meters use multiple ports surrounding an internal chamber to create multiple jets of water against an impeller and are very accurate in small sizes. They are commonly used for residential and smaller commercial uses in ⅝" to 2" sizes (Wikipedia, 2014). Some water meters are sensitive to the momentum of the water impacting on the impeller or the turbine thus a partial blockage of the inlet strainer may affect the accuracy of the meter. Arregui et al (n.d.) proved that this parameter only affects domestic single jet meters, while displacement and multi jet meters are insensitive to it.

Calibration of water meter

A ¾" inlet multi-jet water meter was procured and then calibrated using a graduated 20 litre bucket. The meter was connected to a tap and volume of water collected in the bucket was measured against the reading of the meter as depicted in photograph 1. The meter reading was found to be accurate over 10 measurements. As part of the design process, an analysis of the requirements to fit the water meter on a U2 handpumps was done. With the help of the District Water Officer of Mukono, a borehole was identified in the district for the first trial.

Photograph 1. Calibration of water meter using a 20-litre graduated bucket; water meter connected to a tap

Source: Field photo

Before installation of the water meter, 3 people pumped water into a standard 20 litre jerry can and an average individual time for each of them to fill the container was determined. This was to establish whether the introduction of the water meter would in any way affect the delivery rate. The meter was connected to the horizontal part of the spout which had to be cut and threaded by a trained hand-pump mechanic at a cost of 30,000USh ($12). A reducing socket was then used to connect the meter to the pump as shown in photograph 2. A similar process of calibration of the water meter this time with it fixed to a hand pump was repeated. The pumping of the hand-pump did not affect the accuracy of the readings.

Fixing of the meter on the hand pump

Further research has shown that the water meter can be fixed directly to the water tank if the initial spout is completely cut off and a socket that readily receives the meter is welded in place. For mass production of handpumps that use meters, sockets that readily receive water meters shall be welded onto the water tanks as shown in photograph 3. This initial modification was done in collaboration with WATCOM services limited at a cost of 20,000UGX ($8) per pump.

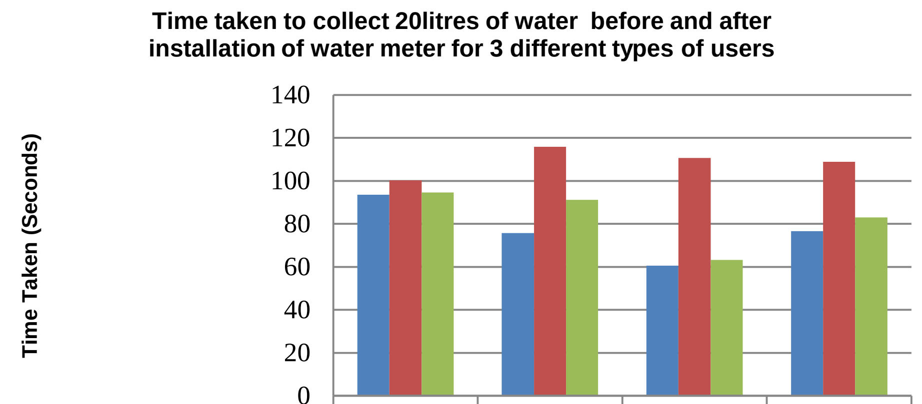
Photograph 2. Metered hand pump; Circled area shows the modification to the spout, the original spout is cut and a reducing socket is used to connect the ¾" multi jet water meter to the spigot

Photograph 3. 1" multi jet water meter directly screwed onto a U2 water tank (connection emphasized by circled area). The inset shows what the connection was like before this modification.

Source: Field photo

Performance of the meter

The installation of a ¾ inch multi jet water meter on the hand-pump did not affect the performance of the hand-pump. However, the delivery rate was affected with each of the 3 users requiring 42% more time on average to fill a 20litre jerrycan. It was also observed that on pumping vigorously, water overflowed above the water tank of the hand pump and therefore users were required to pump in a more restrained manner. The above shortcomings were addressed by procuring a meter with a larger gauge (1" diameter – class B, Baylan Multi jet – dry type water meter with a length of 260mm manufactured by Baylan Olcu Aletleri San.Ve Tic Limited in Turkey). This was sourced from the local market at a cost of 150,000USh ($60). This too was calibrated and only found to be satisfactory upon removal of the inlet and outlet screens within the meter which resulted in an improved 8% average decrease in time needed to collect 20 litres of water. The results of the timings in seconds are shown in the legend of Figure 1. This percentage increase in time almost goes un-noticed for young children (between 8 and 12 years of age) and the women (between 30 and 40 years of age) who are major users of these water points represented by User 1 on the graph.



	User 1	User 2	User 3	Average
With no meter installed	93.53	75.63	60.48	76.55
With 3/4" meter installed	100.23	115.91	110.63	108.92
With 1" meter installed	94.52	91.15	63.24	82.97

Figure 1. Graph showing time taken to collect 20litres of water before and after installation of water meter for 3 different types of users

Source: Field data

Outcomes of the hand pump market testing

The installation of 1 inch meter was done at 3 sites, 2 in Kyegegwa district and one in Kamwenge district. The setting in these areas could be described as urban or peri-urban. The users continued to pay 100/- per jerry can at the sites where the meter was installed to the caretaker who would then reimburse all the collected money to the private operator. All these sites have full time caretakers

At one of the water points, collections doubled from 8,000UGX to 16,000UGX per day. This site has over 400 users which is above the capacity of the pump and as such, it always has a long queue. The installation of the meter slightly increases the time required to fill a given volume of container thus slightly increasing the queue but the users accept this as they have come to appreciate the importance of the meter on the hand pump. This site also had the meter clogging up after a month of use thus reducing flow rate and increasing overflow above the top of the water tank. This is thought to be due to a problem of iron corrosion of the old pipes, part of the down-the-hole components of the pump, but water quality analysis is yet to be done to conclusively determine what is causing the clogging. At another site, the operator revealed that there was an increase in payments and revenues although due to the prior poor record keeping, this could not be exactly quantified. This source has about 150 users as others opt for the slightly more expensive (200 -300UGX per 20 litre jerrycan) piped water in the neighbourhood of this water point.

However, at the third site, the caretaker pushed for, and succeeded in having, the water meter removed. The caretaker at the third point did this precisely because he wasn't interested in having the true story of the revenue collected from the borehole revealed. Another challenge at this source was the high flow rate which caused some water to bypass the meter and overflow through the tank. Due to the fact that the meter was removed, it wasn't possible to work round this problem. It remains the objective of this research project however to identify and install a meter at a borehole with a similar high yield.

Photograph 4. Metered hand pump in use in Kyegegwa district

Source: Field photo

Conclusions and recommendations

This initial phase of the work showed that the 1" water meter will work well for U2 pumps, with limitations if the flow rate from a borehole is very high. However this could be addressed by again installing a larger water meter.

Further sensitization of the caretakers and all stakeholders involved is necessary so that they are comfortable with the new approach.

There was a clear indication that using the water meter can greatly enhance the collection of user fees and although in the short project period it is not yet possible to say for certain, but it is expected that this strengthened collection can greatly improve down times of handpumps and therefore functionality and water coverage.

With funding from The District Local Government of Kamwenge and The Adventure Project, we are moving to roll this out on 40 handpumps to better understand its applicability in different situations. These 40 boreholes shall be operated in clusters of 3-5 by selected and trained entrepreneurs in Kamwenge District. With results from these 40 boreholes, enough evidence shall have been created to decide whether to take this to scale at national level and beyond.

In the short term, the water meter shall be assessed using Technology Applicability Framework Applicability Framework (TAF) developed by WASHTech. This process that will bring together, the Government, private sector, District local governments and NGOs, shall assess the technology along 6 sustainability dimensions and inform the project on the scalability of the water meter, as well as point out key issues that need to be addressed for success.

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