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Acceptability of rope pump technology as a water supply option in rural and peri-urban areas of Malawi

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Access to safe water in rural and peri-urban areas of Malawi remains a challenge despite government's efforts to improve it. For many years the government of Malawi has emphasized the promotion of rural water supply using gravity-fed systems and hand pumps such as the Afridev, Malda and Climax pumps on tube wells. However, there are several other low-cost technologies such as Rope pumps which have the potential to be used on tube wells. An increase in the number of organizations promoting Rope pumps as an option for rural water supply, and whether or not all stakeholders have fully accepted this technology, are the main reasons why this survey was carried out. This paper also addresses claims which are often raised by the government concerning the adoption of Rope pumps and how the Rope pump is a good option for self-supply effective and for small communities where conventional pumps are too expensive.

Introduction

Access to improved water and sanitation for rural areas in Malawi is currently at 85% and 81% respectively (WHO & UNICEF, 2017). Only 9% of rural population have access to piped water networks which means the rest rely on other sources of water such as groundwater. The government of Malawi is however working to provide new water facilities in an effort to improve this coverage of equitable access to safe and potable water (Rijsdijk & Mkwambisi, 2016). One way to achieve this is by promoting an integrated approach to rural water and sanitation services through diversification of technologies in water and sanitation. Cost-effective and sustainable technologies such as gravity-fed systems and hand pumps managed with VLOM (Village Level Operation and Maintenance) have been used by the government for a long time to increase Rural water supply (GoM, 2005). Currently there are three government standardized pumps for rural water supply in Malawi namely: Afridev, Malda and Climax pumps (GoM, 2016). In general these pumps are designed to be used by 150 to 250 people.

However, there has been an increase in the adoption of other hand pumps which have not been standardized by the government of Malawi. These pumps, which include Mark V, Canzee and Rope pumps, have been installed and used in thousands of locations in of rural Malawi especially in areas where there is no or low coverage of the standardized pumps and areas where shallow wells are a main source of water.

This study focussed on the acceptance of one of the common hand pumps, the Rope pump, among users as well as government and NGO staff with an aim to identify bottlenecks for further introduction as well as possible improvements needed.

A Rope pump (formerly called the rope and washer pump) is a type of a hand pump made from locally available materials like galvanized and PVC pipes, It uses a rope and washers to lift up water in a rising pipe. By means of a wheel the water is moved upwards inside the rising pipe (WASHtech, 2013). The Rope pump is able to pump 10-40 litres of water per minute depending on depth of the well (URD, 2009). There are different Rope pump models installed by different organizations in Malawi. The notable models of the Rope pumps include the Elephant Pump model and SHIPO model. The survey focussed on experiences with the SHIPO model promoted by CCAP SMART Centre and other organizations in Malawi.

Methodology

The study targeted six districts in Malawi namely: Karonga, Kasungu, Mzimba, Mzimba, Nkhatabay and Rumphu. The districts selected were mainly those where companies, trained through CCAP SMART Centre, installed at least 10 Rope pumps per district between the years 2012 and 2017. A total of 127 pumps which had been installed more than six months before the time of the survey were purposively selected. Data was gathered through a structured questionnaire using the mobile app mWater surveyor. Five questionnaires at each site were administered to Rope pump users. Also Government officials and implementing organizations were each engaged in Key Informant Interviews. Analysis of the data was done using Microsoft Excel.

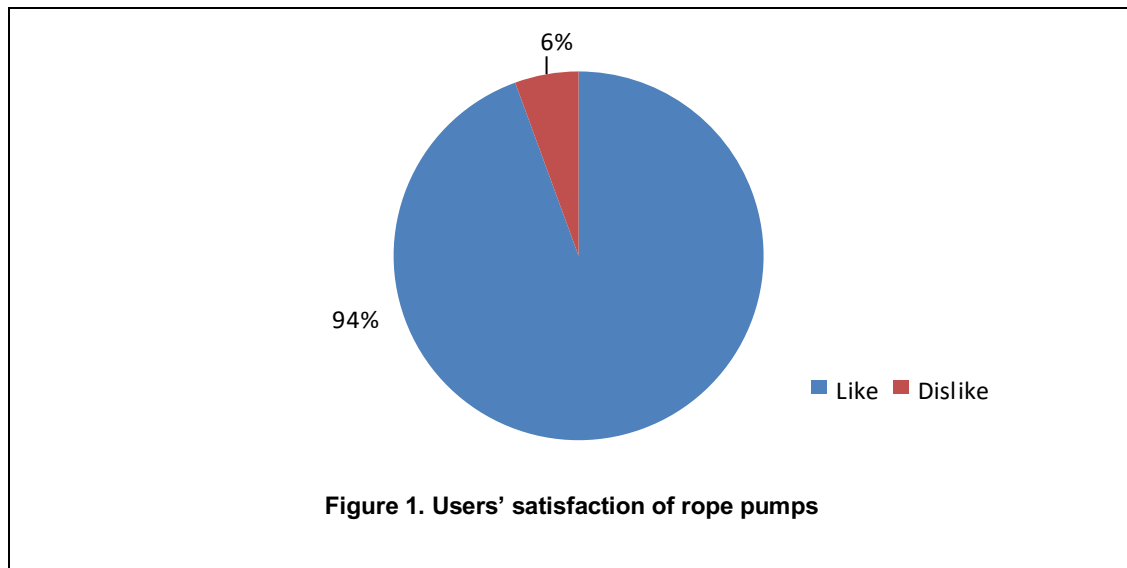
Findings

Acceptance by communities

Acceptance of the technology by the communities was measured based on how satisfied people were with how the technology works, their willingness to use the technology and willingness to pay for repairing the technology after breakdown.

Satisfaction

It was observed that out of 323 respondents who were interviewed during the survey 305 respondents liked the Rope pump technology and were satisfied with how the technology works representing 94.4% and 18 respondents did not like the Rope pump representing 5.6%.



The table below gives a summary of reasons why respondents liked the Rope pump technology. It was observed from the results that majority of the respondents had the view that Rope pumps on a Tube well or a covered hand dug well could provide a safe source of drinking water compared to using unprotected sources such as open wells, rivers and lakes.

Willingness to adopt the technology

Communities' willingness to adopt and use a particular technology can be triggered by several factors. The survey found out the following factors play a role in the acceptance of a technology: (1) preference of the technology, (2) cost of operation, (3) availability of other water options and (4) convenience of the technology.

Preference of the technology

Although majority of the respondents (about 94%) liked how the Rope pump works, preference was given to other types of pumps mainly the Afridev hand pump. This was the case because Rope pumps had a problem of frequent breaking of the rope. The difference was observed in terms of the size of the community using the pump. In very large communities, for example with more than 150 users for a single Rope pump, there were

often breakages of the ropes and respondents preferred the Afridev. However, in smaller communities where the pump was used by fewer people, breaking of the rope was less, the Rope pump was preferred as one of the best technologies according to users.

Availability of other options

Communities that had other sources of water for domestic use such as gravity-fed systems, Afridev pumps or other pumps sometimes ignored the use and management of Rope pumps. The majority of the communities who fully adopted the Rope pumps are those which entirely relied on Rope pumps for almost every use of water such as drinking, washing clothes, cleaning utensils and domestic animals.

Convenience

The ability of the Rope pump to produce water at all times was another factor that triggered the use of the Rope pumps. Results of interviews with Rope pump users from urban areas of Malawi, for example in Mzuzu, indicated that 91% were satisfied with the technology. Despite having a piped water system as the main source of domestic water it is not a continuous supply so the adoption and acceptance of Rope pumps was high in the City of Mzuzu because it supplies a more reliable supply of water in terms of quantity as compared to piped water.

Reasons	Number of respondents	% respondents (out of 323 multiple responses)
Cheap	149	46
Easy to maintain	42	13
Produces clean water	270	84
Used for irrigation	13	4
Easy to operate	221	68
Save money	62	19

Willingness to pay for O&M

Community's willingness to pay for operation and maintenance of the Rope pump was another indication whether the technology was accepted or not. Members who feel ownership of the facility will be more likely to feel obliged to pay for all the costs incurred in the course of using the facility. Community members, through their water point committee, put in place different systems of financing O&M of the Rope pumps some of which include: monthly user fees, piece works specifically to raise money for the repairs and other contributions whenever there is a problem. It is important to put in place systems of financing the O&M of the facility, but what is more important is making sure that those systems are functioning at any given time.

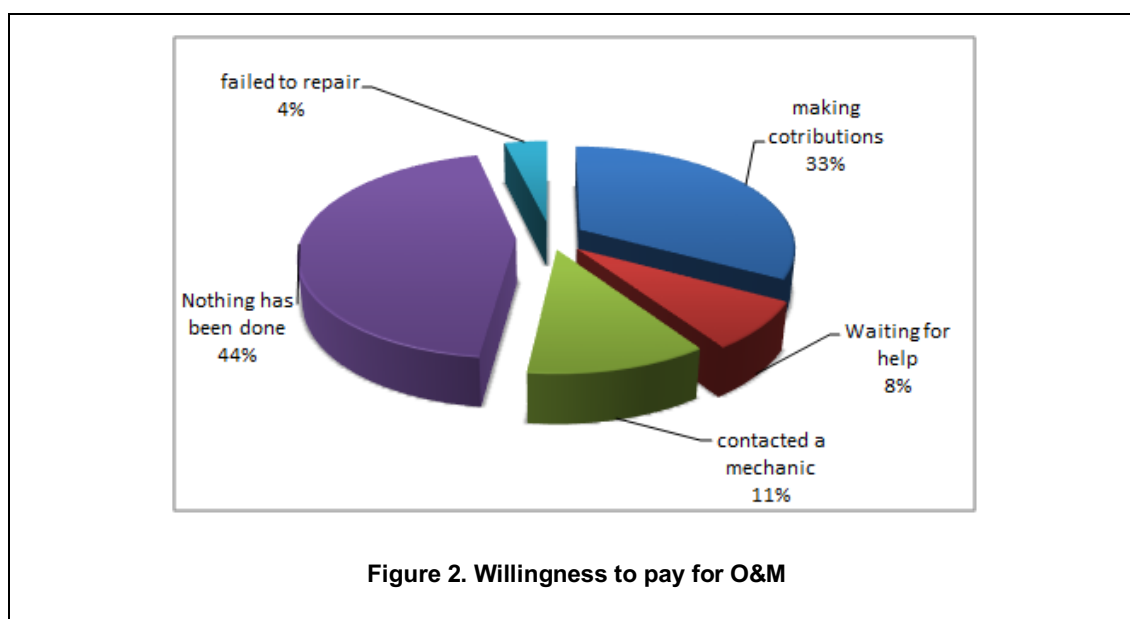
On average, the research found that a sum of MK 150 (\$0.20) was agreed to be paid per household per month. However, the following were observed: the majority of the community members do not pay the monthly amount to facilitate operation of the Rope pump, and that committees are not effective in making sure that financial systems are functioning. When asked why they do not contribute, members said there was lack of trust in the committee members, the amount charged for O&M was high which members, particularly the poor, cannot afford.

Box 1 – Socio-economic benefits of rope pumps to rural and peri-urban communities

- **Low initial investment costs** – The Rope pump in terms of costs for a pump and installation is far cheaper than conventional imported pumps. This agrees with findings in Ghana that Rope pumps cost 75-80% less than conventional pumps (WASHtech, 2013). In Malawi a combined cost for installing a Rope pump on an existing well ranges from MK50,000 – MK120,000 (US\$70 – US\$165) while the cost for an Afridev ranges from MK350,000 – MK 550,000 (US\$480 -US\$760). The low costs for Rope pumps makes it possible for rural communities and single households to afford paying for the costs of the technology.
- **Convenient water source** – Convenience was defined in the sense that users were able to get water whenever they want provided the pump is working and the well has water. Once installed and well maintained, users do not have to worry about flow interruptions and disconnections. Water is accessible each time a person wants it. This is not the case in other systems such as piped water system where flows are not guaranteed. Convenience was also defined in terms of their locality. Rope pumps were located closer to households. 38 respondents out of 305 said they no longer fetch and carry water over long distances. The respondents felt they save time by using the Rope pump which is installed closer to their households. They also indicated that this extra time was used in productive activities such as farming, selling the products and also house chores.
- **Easy to operate and maintain** – VLOM pumps such as Afridev have proven to be harder to maintain at village level than had been designed (Colin, 1999). Research has shown that despite design improvements, communities find it difficult to repair the VLOM managed pumps. However, experiences from this research found out how easy communities were able to repair the Rope pump. The pump does not need complex technical knowledge and training to operate and operate. Simple basic training given to community members was enough to ensure sustainability. Replacement parts such as the rope and pistons were easy and cheap to replace since the pumps are simple and produced locally. More than 42% of respondents including women and young people were able to maintain the Rope pump on their own without external assistance.
- **Alternative source of safe water** – The perception of respondents on the quality of water pumped by Rope pumps indicated that 270 respondents out of 323 respondents regarded Rope pumps as a source of clean water for domestic use. In these cases the Rope pumps had aprons well-built and covering the well thereby reducing the risk of contamination of the wells. It was found out that Rope pumps provide access to clean and safe water compared to other source such as open wells, rivers and other surface water source which communities initially relied on. About 89% of the respondents were satisfied regarding the turbidity, odour and taste of the water.



Photograph 1. Women removing the rising pipe to fix a broken rope.
Communities are able to maintain the rope pump on their own.



Views from the government and organizations

Pump's design

The way the pump is designed raised a number of concerns from the government officers and some NGOs which affect the rate of adoption for the technology. The first concern on the design of the Rope pump was the openness of the technology to contamination. The rope which is the main pumping element of the technology is exposed to the environment and can as such be prone to contamination. Flies and animals can get in contact with the rope thereby transmitting disease causing pathogens. People can also touch the rope leaving dirt and transfer pathogens if their hands contain strains of faecal pathogens. The rising pipes can be a point for potential harmful objects. People could throw items into the PVC pipe like dirt, plastic and other hazardous objects through the PVC pipes. However, no evidence was found to substantiate this claim by government officials. There was a concern by the stakeholders that the pump needs to be improved in terms of its design to address these perceived water quality concerns.

Design capacity and period

The Rope pump is limited to the number of people that can effectively be supplied. The Rope tends to break more frequently with an increase in the number of people using it and should be limited to not more than 150 per pump, which can never be the case in most rural setup in Malawi. Where wells are expensive the government opts providing a technology which can serve a larger community such as an Afridev pump which is fit for communities of 250 people.

A perception is also that the materials which are used to make the Rope pump e.g. nylon rope, used car tires are also considered not durable. The rope is prone to frequent breaking and cannot last for a couple of years unlike other technologies which are preferred by the government. The pumps require a lot of maintenance compared to other technologies. This is however more of a perception than based on facts as the Rope pump is able to stay more than 10 years serving 50 – 150 people, as examples from Ghana, Nicaragua and Tanzania have shown (Holtslag, 2018). A condition for sustainability of Rope pumps is that there is a good quality of production and installation and that the community is willing to pay for the maintenance and repairs.

Other factors

There are several factors which are not necessarily shortfalls of the Rope pump itself but have undeniable effects on functionality of the Rope pumps. Such factors include: the type of well and the depth to the aquifer and drilling techniques.

This method of drilling for wells also has an impact on the perceptions that people have on Rope pumps. The majority of the Rope pumps in Malawi are installed either on a manually-drilled tube wells or a hand-dug well. Manual methods (auger Mzuzu drilling or the SHIPO percussion sludging method) usually raise two major concerns. The first concern is when cow dung is being used in the drilling mud to facilitate the drilling

of the borehole. Cow dung contains pathogens which can pose risk of contamination if a well is not properly developed or treated with disinfectants. However, the use of other materials such as polymers and clays to replace cow dung has helped to clear this concern on manual drilling.

The second concern is that manual augering or manual percussion drilling are not suitable in hard formations therefore do not always go very deep so are prone to drying up during dry season when the water table drops. This can make manually-drilled wells unreliable sources of water as some dry-up during the dry season leaving communities in dire need of drinking water. Shallow wells can also easily be polluted. However, it is not correct to associate manual drilling with shallow wells. With manual drilling, one is able to go more than 35 meters, which is not shallow. A distinction should be made therefore between hand-dug wells and manually-drilled tube wells which are deeper in most cases (up to 45 meters as proven in other countries). Manual drilling can also often be carried out through water so the tube wells can be constructed deeper in to the aquifer than large diameter hand-dug wells that usually do not go more than 1.0 meter into the aquifer as they may not be possible to dewater when very deep below the water table.

Major strengths of the technology

Flexibility

Most of the organizations promoting Rope pumps pointed out that the technology can be installed on hand-dug wells and hand-drilled tube wells. A Rope pump is therefore a good option for improving existing open wells. It was also mentioned that the Rope pump can be used for multiple uses to suit the client's preference. They are not only used for domestic water supply, but also for irrigation or livestock and other purposes. This makes it possible for an organization to implement different projects in communities using the Rope pump. Two programs for example, a WASH program and a food security program, can be implemented simultaneously using the Rope pump.

Simplicity

One of the major strengths of low cost-technologies such as Rope pumps is the possibility to produce it with materials that can all be sourced locally and its simplicity to operate and maintain. The local and decentralized production also guaranteed the availability of spare parts and skills in case repairs are needed. This is advantageous not only to organizations but also to beneficiaries because easy and affordable O&M ensures sustainability of any given facility. Implementing organizations are assured that the water facility serves communities for a very long time.

Low investment and operation costs

Investing in rural water supply using low-cost technologies such as Rope pumps is less costly than investing in convectional pumps. Installation costs of Rope pumps are two to three times lower than installation costs of convectional pumps such as the Afridev pumps. So with the same investment organisations can reach and impact more communities with Rope pumps than with imported pumps.

Conclusion

The results of the study suggest that if Rope pumps are produced and installed with good quality, they can be a very cost-effective and sustainable water supply solution, especially for small rural communities where conventional technologies have not reached and are not cost-effective. The low cost of Rope pumps makes it fit for a self-supply approach which will ensure that individual families and communities own their water facilities thereby reducing pressure on existing water facilities. Government's views on Rope pumps indicates that there is a preference of one technology over others and government's acceptability may not necessarily relate to product shortfalls. This is demonstrated by a discrepancy in terms of satisfaction between users (communities and implementing organizations) and government which calls for a need for the government to start using other technologies which are not preferred. There is a strong need for all stakeholders in the Water sector in Malawi to learn from good and bad practices of this technology and to collaborate so that all issues concerning Rope pumps can holistically be addressed and see if and where this promising technology can help with the goal of water for all always.

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