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Reducing the cost of water using smart technologies

H. Holtslag [Netherlands] & W. Mgina

Background

To increase rural water supply in Africa, hand piston pumps were widely disseminated in the 1980s. After technical improvements, the focus shifted from technology to the so called VLOM approach (Village Level Operation and Maintenance management) but still 20 - 50% of the hand pumps in sub-Saharan countries are not working at any given time. A major reason seems the lack of capacity of the users to manage the maintenance, and although hand piston pumps are relatively simple it seems that in many cases they are still "hi tech" for the target group. "Lo-Tech" pumps or so called Appropriate Technologies (AT) also often fail because they are not efficient or not accepted because of their "stone age" image. Another reason is the lack of the involvement of the local private enterprises in production, sales and maintenance. When the projects finish, the activities often stop because local production, quality control, sales and marketing (supply chain) are not developed.

Making improvements

In many situations the sustainability of water supply could be improved and the cost could be drastically reduced by shifting from conventional hand pumps that are often imported, to simpler and locally produced options. An example is the rope pump which was known as a "string and bamboo" option. With new design inputs it now is a very effective pump for boreholes or hand dug wells as deep as 60 meters. Worldwide some 3 million people now use rope pumps of which some 1.4 million are in Africa and it is probably the fastest growing hand pump worldwide. It is fit for family use but also supplies water to communities of 250 people. Because of its high pump capacity it is very effective for MUS (Multiple Use Services) from both shallow wells and deep wells. For the same depth, the rope pump is 5 to 10 times cheaper than piston pumps. Under experiences with rope pumps in 3 countries.

Smart technologies

The rope pump is not "Hi tech" but also not "Low tech" so it can be considered as a Smart technology (smart tecs) and is just one example of innovations that took place in the last 10 – 20 years. Other Smart tecs are there in the field of wells, storage irrigation, treatment, sanitation and hygiene. Smart tecs can be defined as innovative, simple and affordable water- and sanitation solutions that in general can be produced and managed with locally available skills and materials. Smart tecs have proven to be sustainable and reduce cost by 50% or more compared to conventional options. Some Smart tecs for Multiple Use Services are:

Box 1. Rope pump experiences

Nicaragua. Some 70.000 rope-pumps have been installed since 1990. The shift from imported piston pumps of 600$ to locally produced rope pumps of 70$ has doubled rural water supply in ten years, much faster than countries that apply piston pumps. Users do the maintenance and over 95% of the pumps remain in operation (IRC, 1995).

Zimbabwe. This Rope pump model was introduced by the organisation Pump aid in 1990. Now some 3000 pumps serve 950.000 people and more pumps will be installed before 2015 and reach 3 million more people. With this approach Zimbabwe may reach the water MDG!

Ghana. First experiences with rope pumps have been discouraging. In a World Bank funded project 80% did not function after one year because of lack of user involvement and errors in design, production and installation. The "wrong" introduction of the rope pump hampered the acceptance of this option by the government for a long time and it took organisations as Water aid a long time to repair the "image damage" with better pumps and more user involvement.

- Upgraded wells: Simple lining systems to deepen the well in dry periods, well cover combined with EMAS pump or a Rope pump Windlass model
- Manual drilling (Step auger, Rota sludge, Baptist drilling). The drilling options are based on the Indian sludge method and can drill in semi hard ground layers of resp. 50 and 80 meters deep. In Tanzania a combination of a manually drilled borehole and locally produced rope pump costs 600$ compared to 3000$ for a machine drilled borehole and a piston pump. The Baptist drilling is cheaper than the Rota sludge. In Bolivia, over 2300 family wells have been drilled and combined with a simple PVC pump, for a cost of 3$/m. A water point for 100$!
- Wire cement tanks: These tanks use wire instead of construction steel for reinforcement and locally available support material as bricks, bamboo or wood. Compared to Ferro cement tanks the cost of wire cement tanks are 30-50% lower and tanks up to 60 cubic meter have been made with this technique.
- Easy drip. A low pressure drip irrigation system consisting of local poly pipe and imported lay flat hose. It can directly be coupled to a treadle pump or rope pump without the need for a water storage tank and irrigate in one time some 400 m2 meters of tomatoes from a 10 meter deep well. Time needed, 0.5 to 1 hour per day. Cost of material for 400 square meters is 35 – 50 US$
- Tube recharge: A simple option to recharge the aquifer with rainwater that otherwise would flow away. It consists of a hand augered hole of 5 to 10 meter deep filled up with gravel and closed at the top with a sand filter. Experiences in Zambia indicate that hand dug wells that before went dry at the end of the dry season, now had water all year round. After training, these systems can be made by families themselves at a cost of 2- 5 US$ for materials
- Siphon filter. A small and effective water filter that produces 30-60 litres of safe drinking water per day and costs 8-12$. (see "Marketing safe water systems" www.poverty.ch)

Cost -benefits of (new) water options for donors

In general it is very cost effective to invest in improvements in water ane sanitation: 5$ to 28$ returns for every dollar spent (WHO/ SIWI 2004). Treatment of water at the household level can even lead to a benefit of up to US$60 for every US$1 invested (SIWI/WHO, 2004; WHO, 2007). An example is Nicaragua. Dutch aid invested 1 million US$ in improvements and first dissemination of the rope pump. The resulting increase of family incomes has led to an increase of the yearly BNP of Nicaragua by 10 million US$!

Cost - benefit of (new) water options for users

Surveys in Nicaragua indicate that rural families with a well generate twice as much income than families without a well and a 70$ rope pump on a water well generates 220$ extra income per year (Zee, undated). The low cost and simplicity make rope pumps also affordable at family level (NWP, Undated). Treadle pumps or rope pumps reduce can make very low cost irrigation possible for small farmers could increase (double) food production and reduce poverty if combined with agricultural inputs and access to market (Polak, pers. Comm.). The introduction of wells and pumps has to go hand in hand with actions on water conservation.

Photograph 1. Hand Digging a small diameter well of 20 m deep, using a "well ventilator"

Photograph 2. Manual drilling a 30 m borehole using Baptist drilling (Soil: compact clay, time taken: 3 days)

Photograph 3. An example of MUS: A rope pump used for 10 families and irrigation of 200 m^2 vegetables

Photograph 4. Easy drip irrigation, directly coupled to a Rope pump (Material cost 35-50US$ per 0.1 acre)

Photograph 5. Tube recharge system: This family has water in their hand dug well at the end of the dry season.

Photograph 2. Smart tec center Tanzania for demonstrations: training in production and maintenance

Box 2. Examples of smart technologies for MUS

The Money-maker in Kenya : a pedal pump called "Money-maker" is used for small-scale irrigation. This treadle pump costs $70-120 and can generate $200-500 per year extra net income per family. More than 40,000 pumps are presently in use (Heierli , undated)

The Rope pump in Zambia: After training by Connect international, the local organisation DAPP now trains other NGOs and local workshops in production and installation. Since 2006, some 500 pumps have been produced and of which some 50% are used for both domestic use and small scale irrigation of vegetables. Cost of a pump and well improvement are US$150 – 250 and families pay back credits for this investment in 6 to 12 months by selling vegetables to the local market. Similar activities are now starting in Tanzania, Mozambique and Malawi

Dissemination of Smart technologies

One could observe that if these technologies are so promising why aren't there many more in use in rural Africa? There are many reasons but two major ones seem to be:

- **Lack of awareness.** An estimated 90% of rural families in Africa have never heard or seen the new options. Although some options have been demonstrated on water events and are available on the internet, it takes much more marketing and promotion to make policy makers, NGOs and end users aware. This needs funding that until now is difficult to get .Also there are many wrong assumptions made regarding the rope pump. Some people remember the rope pump from 30 years ago when it was introduced in Africa as a low lift pump only fit for family wells. Others think that the rope pump does not count as an improved water source since it is partly open and the well can be contaminated. Experiences indicate that both assumptions are not correct.
- **Simple is not easy.** A major problem with options like rope pumps and hand drilling is that they are "too simple". If people see it, they think they can make it. Although they are indeed easy to make, some basic design rules are needed in order to avoid damage. For instance the wrong clearance in a bushing can cause the handle to break within two months and if it is right, a bushing lasts for 15 years. As with maintenance of other technologies , users need to be involved, families or pump caretakers need to be trained etc.

Lessons learned

Some aspects that successes have in common are:

- Aid was is essential for introduction, training, quality control, awareness creation, marketing.
- Involvement of local private sector and profit for are essential for profit based sustainability.
- It is essential to create supply chains where all actors make a profit
- "Reparability" of a technology is more important than the "reliability".
- To reach water related MDGs, low cost and locally produced hand pumps can be more effective than hi quality imported pumps. (for wells, boreholes up to 60 m deep)
- Over 95% of the rope pumps function at any given time (if well introduced)
- Simple is not easy. The development and dissemination of simple technologies require professional knowledge transfer both on technical and social aspects.
- A large scale dissemination of small scale options can make a huge impact on the MDGs.

Recommendations

- More development aid for water and sanitation for two reasons. Firstly, water and sanitation are essential to reach 6 out of 8 MDG's. Secondly, Improvements in WASH have a "guaranteed" benefit of 5 -60 US$ for every dollar invested.
- Give people choices! If rural communities get a new water supply, give them the choice between a piston pump or a rope pump! (Let them pay a % of the real price)
- Invest money where it is most effective. Money can only be spend once and maybe shifting investments for urban to rural can be effective for reasons as 84% of the MDG poverty and water target group lives in rural areas (UNICEF /WHO 2008) and furthermore access to water in rural areas may reduce migration to cities

- Use existing subsidies for water to stimulate family wells. With the new low cost options, a hand drilled borehole and rope pump may be affordable for middle and lower income families (eventually with credit)
- Replace (part of the) broken piston pumps by locally produced rope pumps.
- "Create awareness" with a Coca Cola approach: all stake holders should at least be aware of new options, than they can choose themselves.
- Create "Smart Tec centres". In every region or even better in every community there should be demonstrations of new proven Smart tecs with real examples of different wells, drilling options, hand pumps, storage tanks, irrigation, filters, latrines/ hygiene ideas as Tipp taps etc.

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Note

The first author is since 1987 active in some 16 countries in the development and supply chain of rope pumps and other Smart tecs. He is initiator and main author of Smart Water Solutions published by the Netherlands Water Partnership. Other smart series are on sanitation and water harvesting (see www.IRC.nl and information on rope pumps at www.ropepumps.org as well information on smart tecs at www.AKVO.org and www.connectinternational.nl). The second author is technical Director of SHIPO which has a Smart centre in Njombe, Tanzania.

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Contact details

Henk Holtslag
De Zeis 60, 7335KB Apeldoorn, Netherlands
Tel: +31-55-5414156
Email: Holtslag.dapper@planet.nl

Walter Mgina
PO Box 227, Njombe, Tanzania
Tel: 026-2782989
Email: Shipo@cats-net.com
www: www.Connectinternational.nl