The Tube recharge
An extreme low cost option for rainwater storage

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Context
There are an estimated 3 to 5 million hand dug wells in Africa, many of which dry up at the end of the dry season. Reasons for drying up include low yielding aquifers, over extraction and lack of rainwater infiltration due to compact top soils in combination with climate change and shorter but more heavy rains. (Knoop et al. 2012). Options to increase infiltration of rainwater includes small dams, cultivation on contour, or planting trees and plants like Vetiver.
Another and new option is the so called Tube recharge. The principle of this option is based on recharge pits as used in India but it includes a deep recharge hole with a PVC tube to channel water below the surface, and a sand and cloth filter to avoid clogging of the hole. After a short training, local well diggers or families themselves are able to construct it. The cost of materials for a Tube recharge is around 10 US$ and the volumes that can be infiltrated in the ground can be 100 to 500 cubic meters per rainy season. So the combination of a well, a hand pump and a Tube recharge has much potential to increase access to water.

The technology
The Tube recharge system consists of a pit of 1 meter deep and diameter of 1 to 5 meters or more. It is installed some 5 meters from a hand dug or drilled well that dries up in the dry season. The volume oft he pit depends on the rain pattern. In areas with few but heavy rains the pit should be large and in areas with frequent rains it can be smaller. Inside the pit a recharge hole with diameter of some 10 cm is made with a “Soil punch”. This is a punch with a 3 meter heavy pipe and lightweight extensions and holes to 8 meters deep can be made with this tool. (See Photo 1). The depth of the recharge hole is 3-8 meters, and should be such that it passes the top compact layer and enters in more permeable soils. A PVC pipe of 3 meters, with hacksaw made filter slots at both ends, is placed in the hole. Thant he hole is filled with small gravel or course sand. A cloth filter is placed on top of the sand filter and can be taken out for cleaning after each rain or as needed. (See Photo 2). When it rains, water that otherwise would run off to rivers goes into the pit and infiltrates via the cloth filter, the sand filter and the PVC pipe into the recharge hole. Because of the pressure of 3 to 8 meters the water is “inyected” in the ground. The water will saturate the soil and sooner or later trickle down into the first aquifer. (See Photo 3 and drawing). In this way each time it rains, 1 to 10 cubic meters is filtrating in the ground. Part of the water will flow away in the aquifer but another part may stay around the well, thus increasing the water volume that can be pumped up. Depending on the conditions, this extra water volume can avoid that the well runs dry in the dry period. Water can be lifted by a rope and bucket or low cost and locally produced hand pumps like a Rope pump or EMAS pump costing $50 to $120.

Water quality
A major issue with the Tue recharge is the danger of contamination of the aquifer groundwater especially if ground run off water is used. However a well made Tube recharge does NOT go into the aquifer so contaminated surface water will not directly enter into the aquifer. To avoid any risk it is strongly recommended that the part of the water that is used for drinking is treated. Effective Household Water Treatment options are boiling, chlorine or a household water filter. Effective water filters are now for sale in Tanzania and Malawi at a cost of 20US$. This is recomended not only for for wells with a Tube recharge but for all water from shallow wells.

Examples and cost

There are approximately 70 Tube recharge systems installed. A few in Northern Ghana in 2007, some 30 in Malawi and Zambia in 2009 and 15 in Tanzania since 2009

Many of these system were not installed and maintained correctly but of those who were, wells now have water all year round whereas before these wells were dry for one to three months per year.

The following example comes from a family in Njombe, Tanzania. A family installed a Tube recharge on their hand dug well of 18 meters deep. Each year over 100 cubic meters of rain water is infiltrated and "stored" around the well. Each year over 50 cubic meters is pumped up for domestic use and garden irrigation. This system now has been working for 6 years and the well did not dry up. In former years, this well did dry up 2 to 3 months per year.

The total cost of the 18 meter deep hand dug well, the Rope pump and the Tube recharge system installed was 600 US$ and consist of ;

Hand dug well 15 meters deep range from 150 - 350 US$. Average	250 US$
Rope pump, family or pole model	80 US$
Renting a Soil punch (Total cost Soil punch of 6 meters is some 80US$)	20 US$
Material cost Tube recharge. (3/4"PVC pipe, sand, gravel, cloth filter)	10 US$
In case of labor for a Tube recharge, 4 man days a 10US$	40 US$

Total cost of a well, hand pump and a ground water recharge	**500 US$**

In a period of 10 years, the total volume of water used is 500 Cubic meters so the cost of this storage averages to 1 US$ / cubic meter. This is 10 to 30 times less than the cheapest water storage tank of plastic or cement.

Capacity building

The Tube recharge tools can be produced with local materials. Training is needed to teach how to make a Tube recharge. Also follow up for quality control is needed. The Tube recharge is one of a range of innovative technologies as promoted by the SMART Centre in Malawi (Mzuzu). A SMART Centre is a Water and Sanitation innovation centre which concentrates knowledge in one place, demonstrates conventional and new options and trains local entrepreneurs in production, quality control, business skills etc. Almost all technologies can be produced with local materials and the private sector can sell to NGOs as well as to families. This creates employment and a "profit based sustainability" since actions will go on after training or projects stop. There now are SMART Centres in Tanzania and Malawi and one starting in Mozambique. The results after 7 years of the SMART Centre in Tanzania are some 30 Manual well drilling and pump companies trained and functioning and 10000 Rope pumps installed of which 40% for Self-supply. With the new technologies the cost of rural water points reduced by 50% or more. Via the SMART Centres some 20 Tube recharge systems have been installed in the last 3 years.

Information on these and other technologies on websites of the SMART Centres

Discussion

Although technologies like a Rope pump and a Tube recharge are simple, experiences are "simple is not easy". Many details can go wrong. If not done right, the recharge hole gest clogged or the system does not have enough capacity. To guarantee good quality training an quality control is needed. In Malawi such training is realized in the so called SMART Centre in Mzuzu.* They train the local private sector to guarantee there is a "profit based sustainability" so actions go on after the project funds stop. Another condition to scale up dissemination is to create a critical mass of good examples in a certain area. Once 5% of families in an area have well-functioning systems and see the benefits, neighbors and others may follow and invest themselves.

Conclusions

- Where technically possible, the combination of a well, a low cost hand pump and a recharge system is a cost-effective options.
- The Tube recharge is 10 to 30 times cheaper than rainwater harvesting tanks.
- This technology is fit for areas with ground water levels of 35 meters or less where geology permits to make low cost wells and water can be pumped up with low cost handpumps like EMAS pumps or Rope pumps.

- The idea of the Tube recharge fits in the so called 3R concept (Retention, Recharge, Reuse) as promoted by organizations like MetaMeta.(Ref 3).
- The Tube recharge therefore deserves investment in further investigation and demonstration.
- A wide-scale application of this innovative technology could increase water access for millions of people and so result in improved health, increased incomes and more food security.

Recommendations

Research. More investigation is needed to indicate in which situation the Tube recharge will work.

Mapping. Maps that indicate where shallow wells dry up in the dry periods, areas where runoff is excessive, and areas with compacts soils that are fit for r Tube recharge

Training. Train local welders how to make a good soil punch and train well-diggers or masons how to make a good quality Tube recharge. Start with a few and if there is potential for this technology, then increase numbers of trainees.

Demonstration. Install systems in areas that seem to have potential and do longer term (1 to 2 years) testing to measure the volume infiltrated and stored. Promote the systems that are functioning properly.

References

Knoop. L , Steenbergen. F, Sambalino. L. 2012 *"Securing water and land in the Tana basin".* www.bebuffered.com

Information

Information on 3R (Retention, Recharge, Reuse) www.bebuffered.com www.waterchannel.org
SMART Centre SHIPO www.shipo-tz.org ,
SMART Centre Mzuzu www.smartcentremalawi.com
SMART stands for; Simple, Market based, Affordable, Repairable Technologies
Information; Smart Water storage Solutions on www.akvo.org
Other booklets in the Smart series on Sanitation, Water harvesting Hygiene, Finance and Disinfection
www.akvo.org, www.irc.org

Acknowledgement

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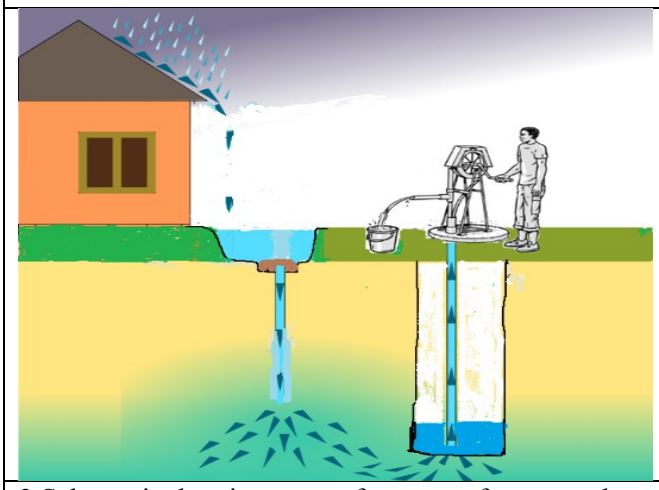
Pictures Tube recharge and Rope pump

1 Here a pit of 5 m3. A recharge hole is made with a Soil punch. This hole passes the top compact clay layer and in this case is 6 meters deep

2 The sand filter pit (25 cm deep, 60 cm diameter) is made and PVC pipe of 3 m long with filter slots at both ends (see manual Tube recharge) is placed in the recharge hole and it is filled with course sand/ gravel.



3 Schematic drawing, water form a roof or ground run off fills up the pit, and via the cloth and sand filters filters in the ground (not in the aquifer). The water trickles into the aquifer and can be pumped up with a low cost handpump.

4 The sand is covered with a cloth filter folded around a metal ring made of round bar 10 mm. Bricks are placed on top to avoid the cloth from floating. A rope is attached to be able to take out the filter for cleaning

5 The pit fills up during the rain. After some hours the water has infiltrated in the ground via the cloth and sand filter. This is repeated every time it rains

6 The cloth filter has to be cleaned when clogged. Material cost of this Tube recharge 5-10 US$

7 A Tube recharge system installed at a family in Njombe in Tanzania in 2011

8 The water from the roof and run off water from the area around the house is led to the pit.

9 Each rain the pit fills up and water infiltrates in the ground via a cloth filter and a sand filter

10 When the cloth filter is dirty it is cleaned by lifting and shaking it. Before the Tube recharge, this well dried up 2 months a year. Since 2011 the well has water all year round. The water is used for 1 cow, a family of 6 persons and irrigation of a garden of 300 m2