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IMPROVING ACCESS AND SUSTAINABILITY

The Tube recharge
Rainwater storage at a cost of 1 US$ per cubic meter

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BRIEFING PAPER

Artificial infiltration of rain water can become a cost-effective storage option. This paper presents an example from Njombe, Tanzania, where the cost of a 18 meter deep hand dug well, a Rope pump and an infiltration pit (Tube recharge) was 500 US$. Each year approximately100 cubic meters of rain water is infiltrated and "stored" around the well and 50 cubic meters is pumped up for domestic use, livestock and garden irrigation. This system has functioned for 3 years, and whereas before the well was dry for 3 months of the year, now the well has water throughout the year.. Over a period of 10 years, the cost of water with this combination is 1 US$ / cubic meter. This is approximately one fifth of the cost of water from a cement tank of 10 cubic meters. More investigation is needed but, where technically possible, the Tube recharge can be a sustainable and low cost option for rain water storage.

Introduction

To increase access to water, the combination of a well, a hand pump and groundwater recharge has a good but as of yet untapped potential. For instance, 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 deep reservoir with a PVC tube to channel water below the surface, and a sand and cloth filter to avoid clogging of the tube. 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.

Technical description

The Tube recharge system consists of a pit of 1 meter deep and 1 to 5 meters or more in diameter and is installed at a distance of 5 meters from a hand dug or drilled well that dries up in the dry season. The pit volume depends on the rain pattern; in areas with few but heavy rains the pit should be large. Inside the pit a recharge hole with diameter of 6 to 10 cm is made with a "Soil punch". This is a punch with a 3 meter heavy pipe and lightweight extensions. By punching and extracting soil with a soil punch holes can be produced . (See Photo 1). The depth of the recharge borehole is 3-8 meters, where the depth should be such that it passes the clay or silt layers 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. The lower section of the hole is then filled with gravel or small stones and sand on top. A cloth filter is placed on top of the sand filter and can be taken out and cleaned 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 filters 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 "injected" 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 rain 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 be enough to have water in the whole dry period.
Water can be lifted by a rope and bucket or low cost and locally produced hand pumps like Rope pump of 80 US$ or EMAS pumps of 50 US$.

Water quality

The recharge hole does NOT go into the aquifer so as to avoid the infiltration of potentially contaminated surface water into the aquifer. In general it is strongly recommended that if water from shallow wells is used for drinking, that water should be treated before drinking. This is certainly true for wells that are combined with a Tube recharge. 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 around 20US$.

Target groups for a Tube recharge

The Tube recharge technology is targeted at family wells (Self-supply) for reasons of ownership, and effect on increased water volumes that benefits the family. More productive wells motivate families to invest time in making the pit and do the maintenance. In general tube recharge is effective for families in rural or peri urban areas where (hand dug) wells dry up 1week or more per year.
The Tube recharge is effective in areas where rainwater runs off because of compact top soils or other reasons.
Tube recharge is of interest in urban or peri urban areas also since with the fast urbanization, with roofs, roads, erosion etc, water does not have time to infiltrate into the ground and aquifers become depleted. It could become a regulation that water from the roofs is either collected in water storage tanks or is recharged back in the ground as is required by law in some states in India,.

Results 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 2011
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.
A cost indication of a complete new system is;

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$**

All tools can be produced with local materials. A day's training is needed to teach how to make a Tube recharge. Also follow up for quality control is needed.

Capacity building, SMART Centres

The Tube recharge is one of a range of conventional and new innovative technologies as promoted by the SMART Centres in Njombe, Tanzania (SHIPO) and in Malawi (Mzuzu). A SMART Centre is a Water and Sanitation training 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 SHIPO SMART Centre in Tanzania are some 30 Manual

well drilling and pump companies trained and functioning and 5000 Rope pumps installed of which 50% 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 Tube recharge or a Rope pump are simple, experience indicates; "simple is not easy". In technology "the devil is in the detail" and details can go wrong. If not produced right, the Tube recharge clogs up, the handle of the Rope pump breaks, etc. To scale up a proven technology it needs to be of good quality, and to get good quality requires long term follow up with the private sector producers. Another condition to scale up dissemination is a critical mass of good examples. Once 5% of families in an area have well-functioning well or pump or another product which benefits them, neighbours will see this and will also want to invest in the products.

Conclusion

More research is needed to know how and in which situation the Tube recharge works.
However, where technically possible, the combination of a well, a low cost hand pump and a recharge system is a cost- effective option and much cheaper than rainwater harvesting tanks. This technology is fit for areas with ground water levels of 35 meters or less and where geology permits to make holes in the ground to extract the water (no rocks). The idea of the Tube recharge is a part of the so called 3R concept (Retention, Recharge, Reuse) as promoted by organizations like MetaMeta. To see the applicability more investigation and demonstration is needed. Where this technology is functioning it can motivate families to invest in Rainwater harvesting and so at family level reduce the effects of climate change. The increased and year round access to water can result in improved health, increased incomes and more food security.

Recommendations

- **Mapping**;, Mapping areas where shallow wells dry up in the dry periods, areas where runoff is excessive, and area where soils are not consolidated will give an indication of areas suitable for 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.
- **Research and 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.Mzuzusmartcentre.org

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

Photo 1. A recharge hole is made with a Soil punch. This hole passes the compact clay layer and in this case is 5 meters deep

Photo 2. The hole is filled with gravel and covered by a sand filter that is then covered with a cloth filter. A rope is attached to the cloth filter to pull it up for cleaning

Photo 3. When it rains the pit fills up and water is infiltrating in the ground

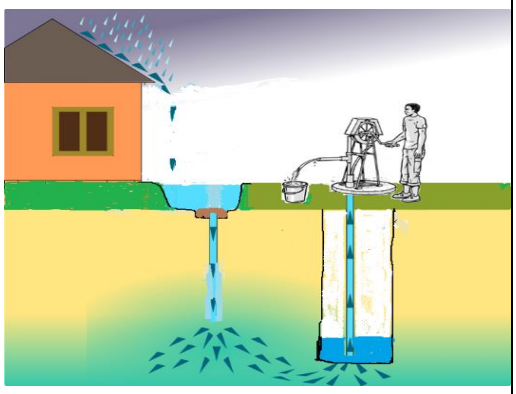

Photo 4. A drawing of the Tube recharge. Water from a roof and/ or ground collects in the pit

Photo 5. Tube recharge near a family well in Njombe that previously dried up in the dry season.

Photo 6. Now the same well has water all year round and is used for domestic use and garden irrigation

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