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**TRANSFORMATION TOWARDS SUSTAINABLE  
AND RESILIENT WASH SERVICES**

**The SMART approach: a solution for the hard to reach?**

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*With limited funds and a fast-growing population in sub Saharan Africa the question is, how do “the hard to reach” get safe and sustainable water access? One solution can be reducing the cost of wells, pumps, water storage, filters, latrines etc. A range of new low cost technologies that also can be produced locally are SMARTechs, SMART stands for Simple, Market-based, Affordable, Repairable Technologies and examples include household water filters, manual drilling, EMAS and Rope pumps, Tube ground water recharge to store rainwater in the ground, SaTo Pan latrines etc. These and other innovative technologies can be disseminated via WET Centres, SMART Centres, vocational education or other training facilities. The SMART approach is a combination of, a) cost reduction with innovative technologies, b) the focus on Self-supply, c) Household water treatment and d) capacity building. SMARTechs and the training of the local private sector in technical and business skills has proven to be a strong tool to reach the SDG6 while it also has positive effects on reducing poverty, increasing food security and creating employment.*

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**Reduce cost communal wells**

In many rural and peri urban areas in Africa people live in areas where groundwater levels are 40 meters or less and where the geology is such that wells can be dug or drilled by hand. Hand-drilling options include Augering, Sludging, Percussion and Rotary jetting. New hand drill methods like SHIPO and Mzuzu drilling can even drill through relatively hard layers. Hand drilled tube wells to 40 m deep combined with an imported hand pumps like an Afridev or Blue pump cost 2500 to 5000 US\$ and can supply water for 250 people so a cost of 10-20 US\$ /person). The cost depend on depth, casing diameter and geology. If constructed well, hand-drilled tube wells have the same quality as machine drilled boreholes but for the same depth cost 50 to 70% less. (UNICEF, EW Practica, 2009).

However, of the some 180 million people in Africa who are not yet served many live in areas with population density is less than 250people / square km. In these cases cost of water points can be reduced by hand dug wells or drilling small diameter wells and using low-cost and locally produced hand pumps. Examples are EMAS or Rope pumps which can pump from water levels to 35 meters deep and Mark 5 and Canzee pumps which can pump from 10 metres deep. In general, the maximum number of people for these pumps should not exceed 100 people. In Tanzania over the last 10 years some 3000 wells were drilled manually with Rota sludge and SHIPO drilling and equipped with Rope pumps delivering water to an average of 100 people. Compared to machine drilled wells and Afridev pumps, this combination reduced the cost/capita of rural water supply by some 50% If well-constructed and with a viable management in place, these water points deliver good water quality and have functionalities of 80 to 90% as confirmed by studies (Acra 2012, Mhango 2018). Many Rope pumps installed in Tanzania around 2006 on tube wells of 20 to 40 m deep are delivering water to 100 people or more and are still working well because the maintenance is well organized. In several communities a woman is responsible for the maintenance. When a new rope is needed, she collects money from users and buys the rope at a local pump producer in Njombe. (Maltha 2016). With technologies like hand drilled wells and Rope pumps many “hard to reach” can be served since they are produced locally so knowledge and spares are affordable and available.

### Issues to be addressed to bring low-cost water supply to scale

1. **Awareness.** Larger scale publicity so NGOs, Governments and the local private sector become aware of the new options. They should know examples like Tanzania, not just regarding successes but also on failures. There are “Simple is not easy” lessons from Rope pump projects in Ghana, Uganda, Ethiopia and Mozambique where the first introduction of the Rope pump failed due to errors in construction and maintenance structures. (Haanen 2016).
2. **Consider manual drilling.** If new boreholes are planned, investigate if manual drilling is possible since that can drastically reduce the investment cost of a water point.  
Many NGOs and governments have the perception that manual drilling only reach upper aquifers that can be contaminated. However new drilling technologies can go deep. If water is taken from shallow water layers, it is advised to use a household water treatment option.
3. **Supply chain;** Supply chains of a range of products like pumps, storage tanks, irrigation, filters etc. including lower cost options (SMARTechs) must be strengthened.
4. **Training;** Important actions required to build up supply chains are the 3 Ts (Training, Training, Training). Training masons, well diggers, metal workers in production, installation and repairs of technologies and training of entrepreneurs in marketing, business skills and quality control. Good quality products and services are essential, and can be achieved through certification of producers.
5. **WASH Training centres.** Each country should have at least one WASH innovation / training centre where knowledge is centralised and quality of products can be monitored in conjunction with the (Local) Government. Knowledge on new technologies could be included in National Vocational Training facilities as is starting in Tanzania and Ethiopia.

### Scale self-supply (improve existing, make new family wells)

In Africa, some 180 million people still collect water from unimproved sources like lakes, rivers or open hand dug wells. (UNICEF 2017). Hand dug wells are often made by families at their own expense and is called Self-supply. Many of the estimated 3-4 million hand dug wells in Africa dry up in the dry season. Open wells can be improved with a hand pump and well cover but even without a well cover a hand pump on an open well improves water quality by 60%. (Gorter 1998). Dry wells can be prevented by options like *Tube recharge*, (a 10US\$ groundwater recharge system to inject yearly up to 500 m<sup>3</sup> rainwater in the ground near wells). Underlining and slotted well pipes are options to make wells deeper without the danger of collapsing. An example of scaling Self-supply is Ethiopia with a national policy to reach some 20 million people through improving and making new family wells combined with low cost pumps like Rope pumps. With the Mzuzu drill method wells can be made till 25 m deep and with EMAS, Baptist or SHIPO drilling to 40 meters deep or more. Investing in family wells has several advantages as compared to investing in communal wells like:

1. **Families are willing to invest.** Families can dig wells and are willing to co fund materials so in areas with shallow water layers cost/cap. similar to communal wells
2. **Convenience/ Time saving.** Since water is at the doorstep women and / or children do not need to walk 0.5 km or more to a communal pump.
3. **Hygiene:** water nearby results in more use of water for use for hand washing, hygiene, cleaning the dishes, toilet etc.
4. **Food production.** Water can be used for life stock, crop irrigation, etc.
5. **Income.** Reduction of health cost, income from vegetables etc. gives extra income. Studies in Nicaragua indicate that a well in the garden of poor farmers can double income. A Rope pump of 100 US\$ on that well increases incomes even more by an average of 220US\$/year. (Alberts. 2002).
6. **Ownership.** Families maintain their pump. Functionality of 90% or more. (Maltha 2015, Mhango 2018).
7. **Communal supply.** Families who have water share it with an average of 35 other people, neighbouring families. (Maltha 2016, Mhango 2018)

### Water ladder

With a well and a pump, families can climb the “Water ladder”. An example: Around 2001, many families in Sebaco, Nicaragua received or bought a 100 US\$ Rope pump for domestic use and cattle watering. In 2015 these families had more trees around the house, improved houses and many are now connected to a piped water system. (Holtslag 2016). With the increased incomes effected by the Rope pump, families now have money to pay for a connection to a piped water system. (Many families still use Rope pumps for the garden).

In short improved family wells result in; safely managed water source at premises (SDG6) + more food security (SDG2) + more income (SDG1). If a family wells is used for irrigation there is also an impact on employment since work is created for irrigation, packing, transport and sales. To guarantee that water from family wells is safe it is strongly recommended to treat the water with HWT like boiling, chlorine or a filter.

#### Issues to be addressed to improve access and to bring family wells to scale

1. **Upgrade existing hand dug wells:** Upgrade open wells with a well cover, an apron and hand pump. Cost of these upgrades, that can transform open wells to an “improved water source are 50-150US\$. Water from shallow wells and from communal wells that is transported and stored should be treated with boiling or a filter for the part that is used for drinking.
2. **Make new low cost wells:** Where water levels are less than 40 meters deep and soils permit digging or hand drilling, new hand dug or hand drilled wells can be made. Some ideas to bring low-cost wells to scale include;
  - **Mapping.** Use existing or produce “drillability” maps indicating where hand drilling is possible. Organisations like UNICEF and Practica have performed surveys on potential for manual drilling in West Africa but mapping could be expanded to all countries.
  - **Smaller diameters.** The volume of soil removed from a 0.9 metre diameter well is 45% less than that of a well of 1.2 metres.
  - Well ventilator to bring fresh air in the well during digging such that wells can be made deeper. Other technologies are *Underlining, Well pipe, Soil punch & Tube bailer, Tube recharge, Well reducer rings*. (SMARTech catalogue. 2016)
  - **Scale Manual drilling.** Manual drilling is safer and sometimes cheaper than hand digging. For instance, with the EMAS method in Bolivia tube wells are made at a cost of 400US\$ for 40 Meters deep well, including drilling, casing and hand pump and over 30.000 wells have been drilled even to 80 meters deep. (Buchner 2015). With the Mzuzu, drill complete wells of 10-25 m deep can be made at a cost of 250US\$ including casing and pump.
  - **Use “Family power”:** With the “Well Club” concept of Water for All International, (WFAI) families themselves have drilled over 4200 wells in Bolivia. The organisation WFAI trains a few persons of a group of 10 families (a “Well Club”) who all want a family well. Then the families do all the work and help each other. The cost for a well is 100 to 250 US\$ for materials so 20 to 30US\$/capita, excluding cost of training and organisation
  - **Compare drill options.** Test different options in similar geological situations to see which is the most cost-effective option and to see which option has most potential for the local private sector to become a business.
  - **Use 30% Water budget for Self-supply.** NGO/Governments wanting to reach SDG6 could invest 30% of WASH budgets in family wells. For instance if families themselves invest in a well and apron, that cost some ca 600 US\$ they an NGO could supported with a hand pump and cover that cost 150 US\$. For a family of 5 people this would mean that a support /person of 30 US\$ which is similar or less than the subsidies that people received who already have a water point with a machine drilled borehole.

#### Improving water quality with HWTS

The yet unserved, (the “hard to reach”) now have water from unsafe sources. A way to make the part used for consumption clean and safe is point of use treatment with Household Water Treatment and Safe storage (HWTS). One option is chlorine but a limitation is that it does not eliminate Cryptosporidium and many

people do not like the taste which results in a low consistent use. If water treatment is not used all the time there are virtually no health benefits. (Brown, 2012). Water filters are more effective and examples include NAZAVA filters in Indonesia, Tunsai filters in Cambodia or Tulip filters in Ethiopia, Malawi and Tanzania. The cost of filters can be low if locally produced like Tunsai filters (with a pot shaped ceramic filter element) in Cambodia and some 20 other countries. (Potters for Peace 2018). Production of filters with candle shaped filter elements has started in Indonesia, Malawi, Kenya and Ethiopia. These are high quality and attractive table top filters with retail prices of 15 to 23 US\$. In Malawi a program is starting that aims to provide safe drinking water for all people, including the poorest, at a one-off donor investment of 2US\$ per person.(Aqua for All). Large scale dissemination of effective water filters would be a first step and by far the most cost-effective short term option to reach the goal, “safe drinking water for all”.

### **Issues to be addressed to bring HWTS to scale**

1. **Awareness & marketing:** Large scale campaigns about the social-economic benefits of HWTS combined with the importance of hygiene. Families can be “seduced” to invest in a filter, not with health arguments but with aspiration, peer pressure, and trust. (Hystra, 2012). This is a task of Governments and NGOs.
2. **Supply chains:** A range of attractive, effective and affordable options must be available in stores or other sales outlets so people can buy spares and choose the option they like and that they can afford. (Heierli, 2012). Distribution can go via utilities who cannot always guarantee safe water. They could sell filters as an extra service for their clients as now is happening in Ethiopia. (Aqua for All 2018). Testing new dissemination models is a task for utilities, NGOs and the private sector.
3. **Payment options and support for the poorest:** Families who cannot pay at one time should have payment options via mobile phones, micro credits, etc. One option can be the so called Try & Buy system, where families can try a filter for a month before they pay it. (SMART Centre Malawi, 2018). Support families, recognized by the community as the poorest, with a one-time subsidy like programs with bed nets or ARV distribution to HIV/AIDS patients. Subsidized filters should NOT disturb markets but support the supply chain for instance by using vouchers that a family can use to “buy” a filter in a shop.
4. **National policies to scale up HWTS:** To scale up HWT it is essential that Government, NGOs and private sector cooperate and that there are policies in place. For instance Ethiopia and Malawi now have national policies that include strategies to drastically scale up HWTS. (Aqua for All).

### **Capacity building – WASH Centres in each country**

Good quality of products and installations is essential for a sustainable water supply. Government and NGOs can play a role in developing supply chains, training the local private sector in production and repairs, developing policies, as well as in monitoring and control of quality by means of certification. For all these actions the private sector, NGOs and governments need to have the right information. To demonstrate and training in technologies and approaches, there is a need for at least one WASH training centre in each country. The Centres are repositories where knowledge is concentrated, where there are demonstrations of established as well as new technologies and where there is capacity for training in technical and non-technical aspects of sustainable WASH solutions.

An example of such a WASH centre is the SHIPO SMART Centre in Tanzania. The result of this centre is that 0.5 million people have improved water sources by means of 3000 hand drilled wells and 11.000 Rope pumps - of which some 6000 wells with pumps were purchased for Self-supply. These were made by 35 private pump and drilling companies. (Maltha, 2015).

New technologies, lessons learned and innovative approaches are in place. What is lacking is scaling. SMART Centres (coordinated by MetaMeta) or WET Centres(coordinated by CAWST) can play an intermediate role but eventually knowledge should be included in National Vocational Training Centres and within higher levels of education. As the saying goes, to help the poor do not give a fish but a fishing rod. We need to make the next step of teaching how to make the fishing rod, so in the future families, communities, companies can solve part of the water problems with locally produced and affordable solutions.

### **Suggestions**

Create one or more WASH training centres in each country. Centres with knowledge, demonstration and capacity for training. Examples of such centres are the SMART Centres in Tanzania, Malawi, Mozambique and Zambia and WET Centres in Nepal, Ethiopia, Zambia and other countries.

### **Conclusions**

- To reach the “the hard to reach”, lower cost water technologies are essential.
- The SMART Centre approach results in a “**profit based sustainability.**” For the local private sector, production and repairs of WaSH products generate income so maintenance continues after projects stop.
- Supported Self-supply has much potential to assist in reaching SDG6 but at the same time SDG1 (Reduction of rural poverty), SDG2 (Increase food security) and SDG8 increase employment.
- New technologies and approaches are in place and there are lessons learned since 10 years. What is needed now is a massive scaling of the concept by capacity building. What is needed is a Marshall Plan for capacity building.

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**Figure 1. Manual drilling of a well of 35 m deep**



**Figure 2. Making a hand dug well deeper with a tube bailer**



**Figure 3. EMAS pump fit for families**



**Figure 4. Table top water filter as produced in Ethiopia, Malawi and Kenya**

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