GSB
Grupo Saneamento Bilibiza

ARRAKIS

Project : Water for Bilibiza
Country : Mozambique
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Period : February / March 2016

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Aqua for All

Drents Overijsselse Delta
uw waterschap

ROTARY CLUB DUIVEN

WALKING FOR WATER

Individuals

MARIE-STELLA-MARIS FOUNDATION

Wandelen voor Water

ROTARY INTERNATIONAL

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1 Back ground

The ”Water for Bilibiza” Project has a focus on low cost and locally produced technologies like wells and water pumps to be used by schools, small communities and by families for Self-supply. It also is focussing on water for irrigation by means of farmer clubs. Other activities are Sanitation (CLTS) Santolic and household water filters.

The objective of the project is to increase health and food security of the rural population around Bilibiza. Additionally the project aims to strengthen GSB technical capability, through the establishment of a workshop to promote latrines, drilling tools and Rope pumps and the use of table top water filters.
The project period (January 2015 to December 2016) is divided in 2 phases. For training in technologies and follow up on quality, Technical Assistance is provided by Henk Holtslag with technical missions. For the first phase the mission took place in May 2015. For the 2nd phase the mission took place in February / March 2016 and is described in this report.

2 Challenges

Some general challenges are:
Availability of materials. For example, to make good drill bits thick-walled GI pipes are needed but only thin-walled 2 inch GI pipes are available in Pemba.
Similar problems with galvanised sheet for the wheel covers of the Rope pump and low quality PVC Tee pieces and no reducers.
Floodings. In January 2015 there were huge floods, due to El Niño and some Rope pumps that were installed nearby rivers were washed away. The installation near rivers is done because of shallow water levels and soils where it is relatively easy to make drilled wells. Further away from rivers water layers are deeper and soils are often very hard or consist of consolidated material and rocks so it becomes very hard to drill tube wells. In January 2016 there were again (smaller) floods, so villages like 1 de Mayo and Natuco could not be reached, because rivers were too high to cross with a car. The bridge in the access road to Bilibiza was damaged in January 2016 and repaired in February 2016 as an initiative of GSB.

Floods in January 2016

Part of the village Bilibiza

3 CONCLUSIONS

1. **General.** Despite many problem like flooding, transport etc. there has been good development with the GSB SMART Centre
2. **SHIPO Drilling method.** The combination of SHIPO drilling and jetting have much potential to make deeper tube wells. The new drill bits, have much potential to drill in stone layers without wearing out the drill bits.
3. **Mzuzu drill method** The combination of a Soil punch and Tube bailer has much potential to make very low cost wells for small communities and for irrigation in soils with water levels of 5 to 15 meters and now 45 wells have been made with this option.
4. **Quality**; Three major challenges to scale up the technologies remain; A. Quality, B. Quality, C. Quality. There are still some details in production and installation that need improvement. For instance the different sizes and quality of PVC pipes, Reducers and Tees cause problems in installation and repairs of Rope pumps.
5. **Marketing** There may be a market for SMARTechs like Wells and pumps for Self- supply in peri-urban areas of towns like Pemba so the challenge is to create demand, and reach a critical masses of each technology, product.
6. **Groundwater recharge**. Of the hand dug wells and scoop holes some 50% run dry some weeks or months per year so much potential to make wells deeper with technologies like **underlining** and the **well pipe** and increase water with **Tube recharge**
7. **Water filters.** There seems a market for filters, especially in urban areas of towns like Pemba

4 Detailed Activities, results/ conclusions

Mzuzu drilling. After experiences and problems in the first phase, now over 45 tube wells have been drilled with this technology which now is managed by GSB. However the Mzuzu drill is limited to softer soils and shallow water layers of 10 meters or less so a new technology (SHIPO drilling) was requested by GSB

SHIPO drilling. 1 complete set was produced including Gi pump pipes, handle, basic set of drill bits and tested at the workshop. During testing many technical problems occurred due to poor materials quality, hard soils, lack of experience etc. but after repairs the system is technically working.

Rope pumps. In total now some 50 Rope pumps have been installed in the several projects of GSB and the quality has drastically improved as compared to 3 years ago although still some details need improvement like the wheel cover, the guidebox and return pipe. In this training two Rope pumps were produced which serve as Gold models. This means that they remain in the workshop as examples. Also existing jigs were improved and some new jigs were made like the jig for the pump structure and bushings. Also follow up training in installation and maintenance took place.

Groundwater recharge

After the training last year some 7 recharge systems were made in combination with a well and hand pump. Due to the flood several recharge pits were filled up with sand and mud. In general the impression is that, when the pits are cleaned in time, much water is recharged in the ground and that it has a positive impact on the water layer. For instance the borehole and pump that was made in the former training in front of the workshop did not have water last year but it now has water due to the nearby tube recharge system.

Water filters

The distribution of water filters to members of the farmers clubs in general went well and families appreciate and use the filters. Of the 8 houses visited in this mission, 7 families were using the filter. There are many request for filters but families now have to pay which is a problem for the very low income families. Despite the “High”cost some 50 filters were sold to rural families, mostly with a payment option. In Pemba 2 women now are selling filters with door to door visits. GSB is now preparing to import new filters.

Santolic / Latrines, Sanitation

During field visits several schools and houses with latrines were visited. For schools concrete latrine covers were installed and for families in villages some 5 demonstration latrines were installed and village masons trained in the production of concrete latrine slabs. Also Santolic sessions are held in villages. The Santolic method seems to work and in project villages and Bilibiza now some 50% of the families have some kind of a latrine, mostly home made with poles and clay but increasingly families pay a mason to make a concrete slab.

SMART Centre

Discussion on being a member of SMART Centre group, Logo, website, meeting in Tanzania.

Monitoring

Visiting installed pumps where possible, to see the results and discuss challenges, lessons learned etc. Discussing and completing the monitoring sheet with the GSB manager Bachir Afonso, see Annexes.

Sustainability of water points

To make sure the Rope pumps remain functioning the maintenance like oiling bushings, adjusting rope, etc. is essential. Similar to the Afridev pumps, also for Rope pumps it is a challenge to get ownership of the Community for the pump. Compared to the Afridev pump the maintenance of a Rope pump is easier since the technicians are nearby and spares are low cost and locally available.

In some cases this maintenance is a challenge like in the village 1 de Mayo. The GSB technician went there 5 times to repair pumps and trained the pump care takers in maintenance. Even after these efforts some pumps were not maintained at all. After some time GSB decided to take away one pump as a warning measure. If the community is interested in the pump they will get the pump back on the condition that they will take care of maintenance.

Pump Care Taker (PCT)

An option to guarantee that pumps are maintained is having a Pump Care Taker

This person can maintain the pump and pay for repairs with income generated from water sales. The PCT approach is working very well now with a Rope pump in Bilibiza. The pump was installed in Sept 2015 and an agreement was made with a PCT, in this case Mrs. Teresa. Some 50 to 100 people per day come to collect water and pay 1 MTS (0.03US$) per bucket. With this she has income for her work and money for repairs and maintenance. Also she paid 4000 MTS for the pump to GSB as part of the cost of the well and pump. Because of the intensive use, the rope has been changed 2 times already but the pump and bushings are fine since they are oiled every 2 days with new oil. This PCT model is possible because the pump is near the village Bilibiza where people have some money and see the benefits of having water from the well instead of water from the nearby river. GSB will now try to expand this business model to other and new pumps. In general a condition of GSB is that pumps are well maintained and if not, the pump will be taken away.

Water quality

The water quality of the pump or Mrs Teresa was tested with a 3M test and showed 2 colonies spots. The water from the nearby open well showed over 200 colonies of coliform. So it is clear that water from the closed tube well is much better than water from an open well.

Mrs. Teresa counting money received with selling water from the Rope pump

Afridev pumps

The existing rural water supply in Mozambique consist of machine drilled boreholes of 40 to 80 metres deep and an hand pumps, mostly Afridev pump imported from India. In the Quissanga District where Bilibiza is, some 35000 people live in small villages and in total some 40 Afridev hand pumps have been installed in the past 20 years by the Government. However over 80% of these pumps are not functioning, often because

some parts of the pumps are broken like foot valves and pump rods. Because technicians and spares have to come from far, repairs are expensive. Also in most villages there is a lack of management and / or willingness to pay. To solve part of this problem GSB now also starts to repair Afridev pumps.

Spin off from ARRAKIS projects

The projects and funds of Arrakis are relatively small, compared to other projects of GSB nowadays. However the fact that GSB now can make project proposals for large donors like Anadarko and others is because of the Arrakis projects that kick started the introduction of the SMARTechs and the start of the training centre. Now the large customer Anadarko selected out of 4 NGOs, GSB as the best organisation to work with This because of the innovation, work, quality and impact of the work of GSB. In 2016 GSB realises a 150.000US$ project for Anadarko to expand farmers clubs, repairing Afridev pumps etc. and for 2017 and on GSB is developing an even larger project.

Recommendations summary

Detailed recommendations were given to GSB, Bachir Afonso in discussions after the Mission but in summary include;

1 SHIPO drill, motor pump

- Make sure drill set, soil punch and bailer have good teeth and well produced like the Gold model. Try both types with loose swivel and fixed swivel. Start in easy soils to get experience
- Do more exercise with mounting etc.
- Follow the rules as trained during the last training
- Start using the Drill bit with tungsten bits that was handed over in the meeting in Tanzania. If test with the tungsten bits work out, more tungsten drill bits can be send

2 Rope pumps

- Use galvanise sheet for cover!! Order sheets from shop in Pemba and control quality.
- Install further away from rivers that may flood
- Purchase better quality of Tees, Reducers, and elbows. Order in large quantities from shop in Pemba or market
- Make models as ‘gold model’ in workshop
- Seal casing pipe with cement after installation

3 Tube recharge

- Clean the existing recharge systems
- Training in cleaning maintenance, maintain system at centre as example!!
- Monitor effect on groundwater level

4 Water filters, maintenance and in use

- **I**ncrease sales in Pemba
- Include fast flow hose in filters.
- Use low cost Petrifilm tests to show communities the efficiency of the filter
- Try the system Try & buy. Offer household to use the filter for free for 1 month, pass by after a month. If the people like it they can pay , if they don’t like it they give back the filter and it can be used for other families

5 Latrine slab

- Make slab as gold model, each village one gold model

6 School wash tank

- Observe experiences

7 Sustainability, maintenance of pumps

- Expand PCT system as much as possible, make contracts with PCT and/or communities while the Pump remains property of GSB, if the pump is not maintained it will be taken away

8 SMART Centre group

- Make business plan including enough funds for Research and development of for instance further improvement if Mzuzu drilling, Solar pumps, School wash tank, irrigation etc. Also include funds for non technical aspects like business training. For instance by R. Haanen for Zambia

Annex 1 Monitoring Capacity Building

BASE LINE & MONITORING GSB-CAPACITY in project L14004 Water for Bilibiza May 2015		ARRAKIS	
Strengthen local partner GSB to become a WASH production & training center with a modest training facility			
	Before the project		
	May 2015 Described by HH & BA	**February 2016, by HH&BA**	
OBJECTIVE	**BASELINE**	**RESULT**	**INDICATORS**
A strong local partner GSB with knowledge, training and promotion capacity in innovative low cost and locally produced Technologies for Water and Sanitation for both Communal and Self-supply.			
Knowledge and Quality of products:			
Manufacturing, installation and maintenance of Hand Rope pumps	No qualified technicians in Bilibiza in production of Rope pumps	Number + quality level. One relatively good welder, pump producer. 2 welders in training	Names of technicians. 1 welder medium advanced (Venacio Almeida), 2 in training (Juma Eduardo, Bernardo Serafim)
Maintenance and repairs of Hand Afridev pumps	No qualified technicians in Bilibiza	1 qualified technician working for GSB	Name. Daniel
Development of supply chain of new Table top water filters and spares	2 Sales points (Bilibiza and Pemba)	10 persons Trained in use maintenance, ao drillers. 2 persons trained in o&m and also in sales	2 persons trained in sales in Pemba; Nhamo Assido, Fatima Casimiro
Improving Existing hand dug wells and making new hand dug wells	No qualified well diggers in Bilibiza	Number + quality level. 4 well diggers, advanced.	Names of diggers: Domingoes Ignacio, Bicheye Jamal, Antonio Gilberto, Mosa Idrissa
Manual drilling with Mzuzu Drill method	4 technicians with first basic skills. Nelson Antumane, Samuel Alberto, Nacir Inacio, Jamal Pedro	number + quality level. 4 drillers, medium advanced. 12 driller assistants	Medium advanced drillers: Domingoes Ignacio, Bicheye Jamal, Antonio Gilberto, Mosa Idrissa 12 drilling assistants, (Bicheye tamimo, Antumane Bwana, Pira Amani, Nelson Joao,
Training capacity in innovative low cost and locally produced Technologies for Water and Sanitation for both Communal and Self-supply.	1 semi qualified trainer in Drilling, Rope pumps, Sanitation, SANTOLIC and water filters.	4 more qualified trainers in Drilling, Rope pumps, Sanitation, SANTOLIC and water filters.	Names: Bachir Afonso as super visor, trainer in all technologies. Juma in pumps and sanitation Juma Educardo, Zura Sinesio
	2 Local technicians trained in production and maintenance of low cost WASH products	8 Local technicians trained in production and maintenance of low cost WASH products, with potential to become entrepeneurs	Names: Welders; Venacio Almeida , Juma Eduardo, Bernardo Serafim. Drillers; Domingoes Ignacio, Bicheye Jamal, Antonio Gilberto, Mosa Idrissa. Filters; Nhamo Assido, Fatima Casimiro

CONTINUATION

OBJECTIVE	BASELINE	RESULT	INDICATORS
Training Capacity in Hygiene: SANTOLIC and hyginene training for NGO's and villagers,	3 trainers with medium skills in SANTOLIC and hygiene	3 people medium to well skilled in performing training in SANTOLIC and hygiene	Names; Juma Educardo, Zura Sinesio, Bachir Afonso.
Training Capacity in conservation farming: Farmers Club members	2 trainers with skills in conservation farming and agriculture.	6 persons performing training in conservation farming	Names ; Nunu Tadeu, Gremo, Bachir Afonso, Arlindo Lorenzo plus 3 new people contrated for the Anadarko project
Increased number of large clients	Japanese Embassy, Ministerio de sience y tecnologia. Ministry of Agriculture,	Names of large clients: Anandarko	Growth in turnover from … in 2015 to 200.000US$ in 2016
	Japanese govt (20 villages)	Japanese govt (20 villages)	
	Start up of Arrakis (Water for Bilibiza-3villages)	Arrakis (Water for Bilibiza-3villages)	
	??	??	
		??	
Improved liason between FC and finance institutes	No structural approach to liase between FCs and GAPI or Govt	structural approach, improved contacts between GSB-Gapi and Govt & FC's	Nr of farmers obtained finance/loans from Govt or GAPI
	Number of FC that obtained financial support	Number of FC that obtained financial support	Names of FC with finance/loan from Govt or GAPI
Improved busines approach			
Cost calculation methods for drilling pumps etc	Limited capacity to calculate cost	Some increase in capacity to calculate cost	More exact cost calculation
Marketing methods	Limited action and knowledge on marketing	More action on marketing. Tel number on Rope pumps, pump	
Cost calculation for car maintenance and	Limited capacity	Support form Tcheizi mutemba	
Increased participation of women (gender)in:			
Team of GSB	1 Women in the GSB team.	1. women in team	33% of the GSB team is women
Sales of Table Top filters, other activities	1 women trained	2 women trained	Growth in nr of women trained by GSB
Improved fysical facilities			
Equipped workshop	No workshop in place. Garage of BA is used	Training , production workshop and storage in place	ca 35 square meter of Sheltered Working area and 35 square metre for storage
Equipment	Basic equipment	More workshop equipment like a work bech and vice, drill machine and more tools	Basic equipment to produce and maintain all SMARTechs
Storage facilities	No Storage facilities	Extended Storage facilities	Sufficient storage for continues production
Transport pick up car	No transport in place. Truck of BA is used	Transport pick up car Toyota in place	Car of sufficient quality to execute the projects.

Annex 2 Pictures

	
Field trip to visit pumps installed	One of the Pumps installed in 2015. delivering water to some 80 people from small communities in the area
	
The well above is combined with a Tube recharge. Problem of the recharge is, that it is not cleaned frequently	One of the 40 Afridev pumps in the Quissanga district, Repaired by GSB
	
The river in Bilibiza has increased a lot by the intense rains. 2 years ago a well and Rope pump was installed where the bush is in the river. The flood in 2015 has washed away the pump.	Now a new well is drilled besides the river and a Pump installed . This if the pump managed by Sra Teresa

Annex 2

	
The pump at the river side with the Pump care taker . The pump is very well maintained	Pump near Natuco village
	
Moe effects of the flood. The Rope pump installed on this tube well was take off before the floods and the well closed with a cap. After the rains the pump will be installed again	Here a hole for a Tube recharge system that was completely filled up with mud by the flood
	
Rain water harvesting tank build in a former project. Despite broken gutters it is still used.	One of the 20 School latrines build with funds from the Japanese embassy

Annex 2

	
Inspecting a school latrine in Bemvindo installed 6 years ago in a Arrakis funded project. The Super structure has gone but the slab is still used.	In the Santolic program GSB trains village masons in making latrine slabs.
	
Family latrines build after the Santolic training	Families who do not have funds for a Concrete latrines slab start with a simple clay / pole latrine cover
	
Santolic Training CLTS) Demonstration of a Concrete latrine slab in a community where until now there is only open defecation	Visit to families who bought filters. This family pays the filter with monthly payment of 2 US$.

Annex 2.

	
Pump problems. In this case the pump should have a Platform so the handle is at the height of the belly button	Here the pump pipe support is too short
	
This Rope pump replaced a broken Afridev pump. The cost of repairing the Afridev pump was more than installing a new Rope pump.	Repairing an Afridev pump. GSB is now involved in repairing 10 Afridev pumps.
	
Tube recharge. Here a Tube recharge pit at the GSB Training Centre	This pit was made in 2015 and the Rope pump near this pit, who did not have water in 2015 now in March 2016 has some water.

Annex 2 .

	
Training in SHIPO drilling with Jetting	Swivel. This type of Swivel was worn out in 2 days so other solutions are needed
	
Morning meeting. Every morning yesterdays problems were discussed and new topics explained.	One of the problems is quality in the workshop. Here worn out and broken welding cable
	
Training in Rope pumps	Welder and drill specialist Juma & Henk

Annex 2.

	
Jigs and tools that were improved in the training	Training in making a School wash tank.
	
Making a metal ring for the wash tank	The School wash tank (Bili wash tank) installed in a school in Bilibiza
	
The wash tank in Use	The group trained in the training in March

Annex 2,

Pictures drilling in Bilibiza

SHIPO drill with jetting

The Grip has 2 pipes instead of a bolt and fixed with a rubber strip

Support for drill pipes to keep the pipes hanging while changing the drill pipe

The house of Bachir where I sleep .
Lots of children and in the evening they watch TV .

Annex 3. RECOMMENDATIONS.

3.1 General

1. **Training.** Make sure that technologies are well produced and installed and users are trained in use and maintenance. If for instance if pumps are not working well, the first image will be bad and a bad image will be very difficult to “repair”. Repeat the message to all entrepreneurs that, **bad products = bad image = less sales**
2. **Train trainers**. It would be good if the most capable technicians in pump production would become trainers themselves so give them training in training.
3. **Selection**. For future training select people that are, or can become, entrepreneurs.
4. **Preparation**. Make sure each pump producer has a plastic laminated Check list of “Pump off workshop” and “Pump installed”. Make sure each Drill team has plastic laminated Check lists “Tools and material for drilling”, “Drilled well” and “Pump installed”.
5. **Marketing**. Scaling up sales requires good examples. For instance for pumps install Rope pump in places where many people pass by like along roads, near shops. Create demand by installing a critical mass (in a certain area 5% of families with a pump or other product)
6. **Publicity**. Invest!. For instance demonstrate technologies on agriculture fora, during the water week. Organize presentations in National GAS meetings. Publish the evaluation reports of the Rope pump.
7. **Show case.** The SMART centre now has a range of technologies. Make sure all are working and kept in good shape.
8. **Other Technologies** EMAS pump and other EMAS products like wash basins, toilet seats and water tanks can be complementary technologies so include them in the product range? Install examples of other common pump models in Mozambique like Afridev, and go on training in repairs of these options.
9. **Promotion.** Rather than health promote wells and pumps as convenience and income generation advocate that **Water = Money**. Family pumps maybe used for productive use so incomes increase by 100 to 300US$ per year as proven in other countries
10. **O&M.** Work on increasing sustainability/ functionality of pumps by promoting, get experience with the PLOM model. Private Level Operation and Maintenance (a pump operator that sells water , gest income and organises the repairs. So discuss with NGOs the shift from VLOM to PLOM
11. **Scaling up Self-supply.** Where families do not have and will not have subsidised communal supply in the future, consider supporting families with a subsidy for Self- supply. For instance If the family pays for the well and well ring, a project could support with a Pump. Than the subsidy per capita will be ca 20US$ which is similar to subsidies now for communal wells.

3.2 SPECIFIC RECOMMENDATIONS

Drilling

1. **SHIPO drilling/jetting**. Start to use jetting since this has many advantages and can further reduce cost of tube wells and increase business potential. Get experience as soon as possible.
2. to increase the market train in, offer various options e.g 2 inch casing (½ pump), 3 inch Casing (¾ inch pump) and 4 inch casing 1 inch pump.
3. **Back washing.** After drilling back washing can be done by pumping water down in the casing with the drill pipes. Test this more to see if this washing is more effective than the conventional way.
4. **Fine sand.** In very fine sand a Filter cloth around the filter screen needs to be installed
5. **Preparation**. Drillers should take in account the recommendations like always have enough and sharp drill bits on site, spare clay of dung, fish tool ready, Swab tool, make drill log, etc
6. **Quality**. Drillers should **only use drill sets made by qualified drill producers**. If demand for drill sets grows, welders in other regions should be trained.
7. **Training** For drillers long term guiding is needed (3 to 5 years) on aspects like where to find water, geology, installation of filter screen, pump installation etc.
8. **Filters.** Drillers, Pump producers could demonstrate, sell water filters?
9. **Rope pump maintenance** Drillers should have the skills in and basic repairs to train users

Dry wells, groundwater recharge

With the effects of climate change it is increasingly important to focus on groundwater recharge in the rainy season.

1. **Dry wells.** In case of dry wells there are options like Underlining, Well deepening with well pipe, and Tube recharge. Other non technical options like planting vetiver grass, countour dikes etc. See publication 3R, "Securing water in the tana basin", Meta Meta
2. **Well pipe.** A promising option to deepen wells is a **Well pipe,** a 4 inch PVC pipe with a filter screen that is placed on the well bottom. It is pushed down by removing sand inside the pipe with a **Tube bailer**. In this way it can be pushed down 1- 5 m.. Material cost 10 - 50 US$.

Hand dug wells

1. Train diggers in making wells with small diameter 80 to 90 cm, and complete it with a well ring of 80 cm inside diameter so a well cover of 90 cm fits on.
2. In wells deeper than 5 meter promote to supply fresh air to diggers with hand powered **well ventilator.** Try the new **PVC air pumps**.

Well covers / heads

1. **Prefabricated well covers.** Promote these. Covers should have structure with 4 bolts (M10x25 galvanised) to mount Rope pumps and a piece of 4 inch PVC pipe of 3 mm wall for the pump and return pipe. All maintenance can be done via this pipe so no manhole needed.
2. **Well covers.** Make well covers for hand dug wells with diameter of 90cm.(to facilitate transport) For tube wells, well covers can be 70 -80 cm. The well cover and apron should be such that **water never leaks back into the well**. Covers should be made with mixture 1 cement 2 sand 3 gravel with good quality(Cement not to wet, compacted, kept wet under plastic for 7 days,) In case people want to access the well for cleaning, the well cover can be removed and replaced and sealed later on with some "weak" cement (mix 1 cement 6 sand).
3. **Manholes.** Do not make covers with manholes. Experience is that when the pump is broken, people start using buckets again which is back to zero.

4. **Well reducer rings** For wells with a larger diameter, should be made with inside diameter of 80 cm or less so a **prefabricated well cover of 90cm** fits on. Well reducer ring should be strong enough to support a well cover and a pump. Test with 3 people standing on the well cover. Where bricks of blocks are expensive consider to make well rings with sheets and cement. see picture. Eventually special well ring blocks can be made that are tapered to reduce the use of cement on the site.
5. **Soak away.** Opposite the pump outlet to avoid at all times water pools near the well.

Disinfection of wells

1. After a well or borehole is finished it should be disinfected with "shock chlorination" (Waterguard or another chlorine brand can be used. 1 bottle of 150 ml is for 300 liters of water)
2. Test water quality on biological contamination, simple low cost options are Hach pillow test or Petri film of 3M
3. In general Chlorination only works for a short while. If the water in the aquifer is contaminated because of a nearby toilet or other reasons, the water in the well will be contaminated as soon as the Chlorine is finished. With shallow wells always promote house hold water treatment.(Boiling, Chlorine or filter)

Pumps

1. **Pump range** Install the 3 Rope pump models at the Demo site. Offer a range of Rope pump models with different prices so customers have choices. If they have limited funds they can start with the Model 3 (50 US$?) lateron they can buy a well cover model.

   Model 1 A frame, Cost ? 100-120 US$ For communal and family use
   Handle ¾", Bushings. If ball bearings are used make sure they are good quality, grease nipples

   Model 2 A frame, Cost ? 60-80 US$ For Family use
   Handle ½", no bolts, cover optional.

   Model 3 Pole model, Cost? 30– 60 US$ For Family use
   Handle ½" or ¾" Mounted on poles besides the well. With or without Well cover. To avoid termites treat with diesel or used car oil, or carbonise the poles above a fire or wind plastic sheet around the part in the ground. Try which option works best
1. **Gold model.** Make pumps now as the gold model at the Workshop. All pumps should have a name plate. See also Annex on standardization

Standardisation of pumps

1. Standardise important parts of the pump like metal pipes, PVC Pipes, Tee, reducer, pistons, and bushings so these parts become interchangeable nation wide.
2. Make all outlet pipes 1 ¼" so it fits in jerry cans. So Tee of 1.1/4"and reducers accordingly
3. See detailed recommendations on standardisation in Annex 3

Certification

1. Guarantee the quality of wells and pumps by certifying or endorsing the producers of these technologies.
2. This certification should be effected by a governmental body. Until there is such a body the SMART Centre can support with some kind of endorsement of pump producers that prove to make a good quality. For instance a certificate saying approved by the SC
3. A workshop should first produce and install 20 good pumps before that workshop is endorsed.
4. The SMART Centre can publish a list of endorsed workshops on website so other NGOs know where to go if they want a good quality product.

Maintenance

1. The most important maintenance of Rope pumps is adjusting the rope (not too tight not be too loose) and oiling the bushings **weekly with new oil!!**. This to avoid wearing of the bushing or handle. (It has been proven in Nicaragua that, if made well and oiled in time, metal bushings can last for 20 years)
2. A pump installation should include a (laminated) maintenance sheet and a 0.3 l bottle with new oil (10W 40). Do not use grease or used oil!
3. Promote in local languages the maintenance by a slogan like **"No oil - No pump''**

Repairs, installation, replacement

1. In general repairs like adding a piece of PVC pipe, repairing pump structure, replacing bushings etc should be by local technicians who can do this work on a commercial base.
2. Technicians can be of the pump producing company, pump installers, metal workshops etc who can do repairs as one of their activities.
3. **It should not be done by NGOs or local government, since this will prevent a sustainable commercial supply chain from building up!!**
4. NGOs and governments should rather invest their water funds in awareness training of the local private sector, quality control, building up supply chains, evaluation and monitoring, enabling environment like micro credits facilities, contracts opportunities, marketing, tax exemptions etc.

EMAS pumps , Products

- Start demonstrations of EMAS pumps in real situations and see if there is a market.
  The same with other EMAS products, see pictures in Annex 3

Rope pumps for communities

A major problem with pumps for communal use, including Rope pumps, is the maintenance and repairs. Often; what belongs to the community belongs to nobody. Some thoughts:

1. The recommended maximum number of families (households) per pump in other countries is 150 people per Rope pump.
2. Similar to other pumps, make sure the users are capable **and willing** to pay, not just for daily maintenance but also for repairs and…. replacement. (Life cycle cost).
3. Try always to install communal wells / pumps at a family. They appreciate the water near the house and tend to do the maintenance.
4. Shift from VLOM to PLOM where possible. See above No10

Water quality

See Annex 2

Irrigation

1. **Promote the SHIPO drip system**!! (Imported laterals and connectors, local polypipe)

2. The Rope pump can be directly connected to the pump outlet without a tank, or be combined with a Tank.
3. Promote via pilots eg. 5 drip system of 100 to 500 m2 in the same area. Cooperate with NGOs in agriculture, Farming Gods way?, others?
4. Install a few systems on sloped areas to show that it is possible
5. If interest grows, try to get a local business interested to import. Make sure there is enough profit!!

Water filters/ House hold water treatment

1. **HWTS** If water quality is not 100% guaranteed safe to drink, it is advised to the use Point of use treatment like boiling, Chlorine or a Filter at the household level. In general filters seem the most effective in reducing water borne diseases like diarrhoea because of a high consistency of use.
2. **Demo**. In the Centre demonstrate different models, Sawyer, Tulip Siphon, SODIS others? Experiences in other countries is that the Table top model is most user friendly
3. **Create demand.** The Centre can assist with studies, pilot projects in certain areas with different sales models e.g.: the Try & Buy concept. Go on promoting filters in emergencies.

Research & studies

For several reason it would be good that the SMART centre makes publications; does studies like the study done by R. Rosedahl on economical impact of Rope pumps. Sometimes there are students interested in an internship.

Study topics can be.

1. Functionality of Rope pumps after 2 years or more, Both for communal use and Self supply
2. Impact on groundwater with Tube recharge
3. Experiences with House hold water filers both siphon model and table top model
4. Monitoring
5. …….

Annex 4 Water quality Rope pumps

Some perceive water from a Rope pump as not fit for drinking since via the rope, water from the well could be contaminated. Some think that it is better that Rope pumps are completely covered. It has been observed that:

- Semi open Rope pumps (with a wheel cover as e.g. the IDE model) have the advantage of disinfection by the sunlight (UV rays).Completely covered pumps do not.
- UNICEF Malawi- tested Elephant pumps, (a closed version of Rope pump) and water from the outlet sometimes was more contaminated than water in the well. This could be caused by humidity and higher temperature inside the pump structure which creates an environment for algae or bacteria growth.
- In general, if Rope pumps are well installed and water is not flowing back in the well, there is little or no difference between water quality pumped up by piston pumps like Afridev or Indian mark 2 or by Rope pumps (Confirmed by evaluations of hand pumps in Tanzania, ACCRA 2012, Rope pumps Ghana 2005)

In general it is not so much the pump that has influence on water quality from wells but the groundwater itself, (latrines nearby, contaminants in the aquifer) or the well cover seal, soak pit of the well or borehole. Where groundwater can be biologically contaminated or where there is danger of recontamination it is recommended to treat water at the household level with options like boiling, chlorine or with water filters.

Annex 5 IDEAS FOR SCALING UP RURAL WATER SUPPLY

Water ladder

Many family wells are open (unprotected) and water is taken out with a rope and bucket and the bucket is often re contaminating the well. To improve this situation introduce the idea of the **water ladder**, meaning; make improvements step by step, based on what is affordable for a family. For instance a simple 50 $ EMAS or Pole model Rope pump already improves the water quality by 50% or more, even without a well cover. Regarding quality, all families can at least have safe drinking water with point of use treatment; So Steps of the water ladder could be;

Step 1 Treat water at the house (Chlorine, boiling or water filter of 15-25US$)
Step 2 A well (hand dug or hand drilled)
Step 2 A windlass with rope/bucket, the bucket hanging on a pole (10-30US$)*
Step 3 A hand pump (EMAS or Rope pump model3 40-60US$)
Step 4 A cement well cover (eventually with bolts for mounting A frame pump model), apron and soak pit (20-50US$)
Step 5 An improved hand pump like Model 1 Rope pump or EMAS pump,tank 2 m to have water pressure for shower, kitchen. (50-150US$)
Step 6 An electric, solar or engine pump (100-? 1000US$)
Step 7 Connection to piped water system used for drinking and domestic use. Own well remains for garden irrigation, animals etc

References;

- Study on Self supply potential Sierra leone March 2013. (S. Sutton)
- Publication “Encouraging change” (S. Sutton)
- Paper “ideas to scale up Rural water supply (H. Holtslag J. mc Gill) On websites SMART Centres (www.smartcentregroup.com) and Connect.

Annex 6 EMAS Technologies Suggestions for future technologies

	
Water storage tank combined with **Tube recharge**. The tank is full in rainy season	Demonstration of an **EMAS pump** as produced in the training. It can pump up to a tank so there is the “luxury” of water pressure.
	
2 EMAS pumps installed at Family level. Picture from Sierra Leone. EMAS pump could have a market also in Malawi	One pumps is used for selling water to neighbours. The other to fill up a tank for the shower
	
EMAS Products as produced in Sierra Leone **Tanks, toilet seats, wash basins**	Trainer Showing a part of an **EMAS Pump**

Annex 7 Standardization

Rope pumps are now produced in some 30 countries worldwide and in each country models are different and in general similar to models as used in Nicaragua where the commercial versions of Rope pumps started. Compared to pumps like Afridev, Indian mark 2 etc. there is less need for standardization with Rope pumps. If the pump is produced and installed with some 10 basic design criteria, all models work. However it is recommended that Rope pumps in each country or region are standardized in such a way that parts that wear out like bushings, handles, wheels, PVC Pump pipes and pistons, have similar dimensions to make them inter changeable. For Tanzania the following standardization is recommended

Diameters of pump pipes (rising mains):
Use these pump pipes to optimize pump efficiency
0 – 10 meters water depth , - 1”
10- 20 meters water depth , - ¾”
20- 35 meters water depth , - ½”

Outside diameter (OD), Inside diameter (ID)
1” OD: 32mm ID: 29 mm
¾” OD: 25mm ID: 22 mm
½” OD: 20mm ID: 17 mm

Besides pipes there is need for standardization of other parts like Tees, Reducers and end caps for casings. This could be discussed with pipe producers. The benefit for them is that there will be a large demand if they guarantee a good quality with the same wall thicknesses and diameters. An example; There may be a potential of 100.000 Rope pumps in Tanzania. In general each pump has 2 pump pipes so a potential market for 200,000 pipes.

Name plate
Another part of standardization is the nameplate on the pump. It is proposed that name plates should have:

- Logo (that cannot be copied) of pump producer and /or association
- The name of the pump producer
- The telephone number of the pump producer
- The Pump Number (total of pumps manufactured) and the year that the pump was constructed. E.g. 021-12 = the 21st pump produced, pump produced in 2012.

(Each workshop should have letter and number punches),

Well yield / capacity
Besides the water quality an indicator of a well is the water volume that can be pumped.
Proposed water requirements for rural areas is 40 ltr / person for domestic use of which 3 ltr /day should be safe to drink. If water is used for irrigation or other productive use, the yield should be more. In all cases the yield of a well should be enough for the numbers of users.
It would be useful if the person responsible checks what the national WASH policy is – however that may not consider water for productive use

Number of users per rope pump

The number or users for Rope pumps differ much per country and situations, there are examples of Rope pumps used in schools by 500 students for 10 years however in general to limit the wear, the recommended maximum number of users is 150 people.

Standardization for 3 models or Rope pumps for hand dug wells and boreholes as used in other countries Use for Self-supply and small communities

Parts	**Minimum standard; model 1 & 2**	**Minimum standard; model 3 & 4**
Wheel cover		
-sheet cover	0,4 mm Galvanized sheet Preferred 0.6 mm	Wheel cover is optional
-Sides	Bent rim if less that 1 mm	
-Mounting	Bolts M6 or pop rivets ∅ 5mm, 2 at each connection	
- Bolts cover to Support	M6 x 15 galvanized or M10	
-Cover Support	12mm rebar or 20x20x2 mm Angle iron or Gi ½"	Cover optional
Wheel		
- Diameter	14"	14"
-Number of spokes	6	4, with clamps in between
- Material of spokes	Rebar ∅10 mm or galv. Pipes	Rebar ∅10 mm or galv. Pipes
-Tire quality	Good quality, straight, soft rubber	Good quality, straight, soft rubber
- Bolts /Nuts	M10x25 Galvanized	Optional if uses bolts than M10x25 Galvanized
Handle		
Pipe	∅ ¾" Galvanized steel pipe. Wall thickness min. 2,2 mm	½" Galvanized steel pipe. Wall thickness min. 2 mm
Handle grip	1" PVC pipe	¾" PVC pipe, wall thickn.1.5 -2 mm
Bushing	1", wall thickness 2,5-3mm Galvanized steel pipe	¾", wall thickness 2,2 – 2,5mm Galvanized steel pipe
Clearance	0,5- 0.7 mm	0,5-0,7 mm
Length bushing	60 mm	60 mm
Bushing strip	Strip 25x3 mm	NA or 25x3mm
Diameter of the oil hole	∅ 6	∅6
Welding / Painting		
All welded parts	Clean weld slack, Paint with anti oxide +gloss paint	Clean weld slack, Paint with anti oxide +gloss paint
Pump structure		
-Pipes	½" Galvanized steel pipe Wall thickness 2 mm	½" Galvanized steel pipe. Wall thickness 1.6 mm
Bushing support	Angle iron 25x25x2 Angle iron	NA
Block system	Hook of Rebar or Gi pipe	NA or Gi Pipe
Outlet pipe and return pipe support	Make of ring of Gi pipe	NA or ring of Gi pipe
Name plate		
	Aluminium . Data incl. Producer, Tel No, Ser. No	Aluminium . Data incl. Producer, Tel No, Ser. No

Rope/ pistons	1m distance, 0,5-0.8 mm clearance	1m distance. 0,5-0.8 mm clearance
Pump PVC parts		
Pump Pipe diam 1 – 10m 1” 10- 20m ¾” 20- 35m ½”	Outside diam. - Inside diam. 32mm- 28 mm 25mm- 21 mm 20mm- 16 mm	Outside diam - Inside diam 32mm- 28 mm 25mm- 21 mm 20mm- 16 mm
Outlet pipe		
-Outlet pipe 1 1/4”	Outside diam - Inside diam 40mm- 36 mm	Outside diam - Inside diam 40mm- 36 mm
-Tee 1 1/4”	Good quality, tight fit with reducer	Good quality, tight fit with reducer
-Reducer 1 1/4” - 1”		
-Reducer 1 1/4” - ¾” -Reducer 1” - ½”		
- Elbow 1 1/4”		
- Return pipe	Poly Pipe or PVC pipe. 1 size bigger than pump pipe	Poly Pipe, PVC pipe. 1 size bigger than pump pipe
Well head. Cover, Apron, Soak pit		
Well cover	Diameter 1 meter	Diameter 1 meter
	Reinforced with rebar min 8mm distance 15 cm	Reinforced with rebar distance 15 cm
	PVC pipe 4 Inch length 15 -20cm	PVC pipe 4 Inch length 15 -20cm
PVC Cap, cover	Round or Flat top Cap	Round top Cap
Top of casing above Ground level	20 cm	NA
Top of Casing to Apron	10cm	NA or 10 cm
Diameter apron	1 – 1.8m	1,8-3,0 m
Dist. apron to soak pit	3 -5m	3 -5m
Outlet Pump	Opposite soak pit	Opposite soak pit, including elbow
Apron slope to soak pit	0-5cm	5 cm
Apron height	5-10 cm	5 – 10 cm