PRACTICA

Foundation

Report

Rope Pump follow up, Motorized Rope Pump & Manual Drilling

in the Casamance region, Senegal

EROBON

Votre Eau
Votre POMPE
Votre Santé

Ziguinchor, November 2004

Action pour l'Entreprenariat et le Développement
EnterpriseWorks SÉNÉGAL

USAID

IDEA International Development & Environmental Assistance

Contents

1 Background

In March 2004 a training and introduction project of the manual Rope pump took place in the Casamance region of Southern Senegal. The training was organized by Enterprise Works Senegal, as part of a water supply project in the Casamance. Up till then the treadle pump was used for irrigation and for potable water people still depended on hand dug wells and the use of a rope and bucket. The rarely seen Mark II pumps where too expensive and not affordable for the households on average.

For the introduction of the Nicaraguan Rope pump models and training of Enterprise Works trainers on production and installation of the Rope pump, a project was established between **Enterprise Works Worldwide** and **PRACTICA Foundation**.

During this training also a Rota sludge manual drilling set was constructed. No further training on manual drilling was given.

1.1 Project

In July 2004 PRACTICA Foundation was invited by Enterprise Works Worldwide to visit Senegal for an additional training in November 2004 in the Casamance region. The training would be split into three segments. The present report is written after this three week training and evaluation project, containing:

- A follow up training and evaluation on the Rope pump
- Introduction of, and tests on the Motorized Rope pump
- A training on manual drilling (i.e. Rota sludge, auger and bailer methods).

1.2 Project Participants

PRACTICA Foundation is a Dutch based non-governmental organization (NGO) which promotes knowledge exchange, technology improvement, training in, and dissemination of, low cost water technologies in, and between, different development countries. PRACTICA has a board of three, a management team of three, two advisors and works on request of local NGO's and other organizations employing ten experienced associates (www.practicafoundation.nl).

Enterprise Works Worldwide (formerly Appropriate Technology International) is a non-profit organization that promotes sustainable, enterprise-oriented solutions to economic challenges in the developing world, primarily in Africa and Asia. For 25 years EWW has assisted small-scale producers in more than 60 countries, enabling farmers and other entrepreneurs to boost their productivity, tap broader markets, capture higher value of finished products, and better manage natural resources (www.enterpriseworks.org).

Arjen van der Wal, (International Development & Environmental Assistance), one of the Associates of **PRACTICA Foundation**, visited Enterprise Works (EW) Senegal between the 2nd and the 23rd of November 2004, to assist EW and provide the above mentioned training, evaluation and introduction program.

2 Summary

During the whole project training was provided to the potable water team of Enterprise Works in Ziguinchor. A decent evaluation and training in the Rope pump production, a introduction and testing of the Motorized Rope pump and a training on manual drilling were intensively followed by the team. It is their motivation and initiative that made this activity to a useful and successful project!

Following persons attended the training: Ousmane Dieme; Responsible of the water program, Assane Diouf; Artisan trainer, Kelountang Sagna; Artisan trainer, Oulimata Coly; Technical assistant, Alain Coly; Technician and driver; Patrice Beaujault; Country director Burkina Faso and Jon Naugle; Senior program officer Enterprise World Wide.

3 Follow up Rope pump

3.1 Introduction

In March 2004 a first training took place at the workshop of Abdoulay Lo in Bignona where Enterprise Works trainers and artisans where trained (please see the PRACTICA report 'Rope pumps in Senegal, March 04') in production and installation of the Rope pump. Actual production of the Rope pump started in June and since then 31 Rope pumps have been produced of which 11 are sold and installed in the field and 14 installed as a demonstration model (see table in appendix B for an overview). Most of the sold pumps where first installed as a demonstration model and a few weeks later, if users where satisfied, sold to the user (on household level), although by now more and more pumps are sold directly. The Rope pump is gaining interest from people in and around Ziguinchor because of its users-friendly operation and information on the pump is spreading through social contacts among people. Enterprise Works is developing marketing strategies for the Rope pump in the Casamance and promotes the Rope pump through flyers, radio bulletins and t-shirts and is connecting potential buyers with the independent workshop(s).

3.2 Production and name

At the moment of writing only one workshop had been involved in the production of the Rope pump to be able to manage quality control on construction and installation more easily in this first phase of introduction. After the evaluation which took place in this project, very soon artisans will be trained by EW trainers and production will start in workshops in/around Ziguinchor (Central-) and Kolda (Eastern-Casamance). Quality and functioning of each Rope pump will be monitored by EW's potable water team. Quality control is crucial in this phase of introduction where the Rope pump still has to build up a name as an accepted, reliable and sustainable pump by manufacturers, users and donors.

As part of the promotion, the name *EROBON* was chosen for the Rope pump. In local 'Diola' language: "*Source of water*".

3.3 Price

In general, installation of the Rope pump will be carried out by the manufacturer or EW. Rope pumps are sold, including installation in the field (average depth 10 – 20 meter), for CFA 40 - 45.000 (€61 - €68). Rope pump and installation including a concrete well-cover is sold for CFA 50 - 55.000 (€76 - €83). The price for construction of the pump itself (excluding PVC pipes, rope, pistons, transport, installation and users training), including a small profit for the manufacturer, is 25.500 CFA (€39).

3.4 Evaluation

During this project the Rope pump production, installation, use, maintenance, problems and users feedback of the past 6 months where evaluated. A number of 14 pumps where visited of which 12 in Ziguinchor, 1 in Kabar and 1 in Bignona. During the visits training was given to the potable water team on technical checking of pump parts (Rope pump technical checklist, see appendix C), operation, users evaluation and maintenance.

Production

In general it can be noted that the manufacturer is working very precise when constructing the Rope pumps. All visited pumps and all parts of the pumps (i.e. structure, bearings, axle-handle, wheel and cap) are identical which is a huge advantage when parts are worn out and have to be replaced. Although the pumps where well constructed some adjustments in construction, material choice and painting have to be made (see paragraph 3.5).

Installation

All pumps where well installed and out of 14 pumps, 12 where working fine, on 1 pump operation was difficult due to obstacles in the well and 1 pump didn't work due to a broken rope the day before (see paragraph 3.5). In general the ropes where installed and adjusted well and not much visible wear was noticed, even on the intensively used communal wells rope quality was fine.

Users and maintenance
The amount of users per pump varies a lot in Ziguinchor, depending on the willingness of the buyer to share his pump with others, the availability of other nearby water points and the amount of people living in the neighborhood. 11 Out of the 14 pumps are used by 6.6 households (30 – 35 users) on average. The other 3 pumps where estimated to be used by 150 – 400 users.
The Rope pump model, as introduced in Senegal, is in general suitable up to 10 households / 50 users. All pumps where privately owned, but in some cases people from the whole neighborhood would walk in to use the pump. In this case it is recommended to introduce a heavy duty model pump with ball bearings on each side of the axle. Its not recommended to use these ball bearings on all pumps as the price of the bearings, with hand made support, will add approximately 25% (CFA 6.000 / €9) to the price of the pump. An other alternative is the use of oil impregnated hardwood as a bearing.

In almost all cases users noted that visible water quality in terms of turbidity had improved since the installation of the Rope pump, when buckets where no longer used. The fact that use of the bucket will stir sand up from the bottom and bring in dirt from the surroundings of the well is generally well understood by families in the Casamance.

The visited pumps where in general well maintained and used in the right way. Use of the pumping lock and dangers of reversible pumping (without the lock) are well understood, although in some cases user and maintenance training was necessary (see paragraph 3.5).

3.5 Trouble shooting
Introducing a new pump in a country requires a decent monitoring and follow up on the produced pumps to be able to correct small mistakes in time before, because of these mistakes, people loose confidence in the pump and its working. Minor mistakes can have major consequences if not corrected in time. During the visits of the 14 pumps, following observations where made and need special attention in future production and monitoring (please see paragraph 3.6 for the mentioned recommendations / taken actions during training).

Axle and bearings
On 4 pumps, after approximately 3 months of operation, the axle had broken at bearing level on the side of the handle. A combination of the following 3 observations is noted as the reason for this failure:

I. The Ghanaian GI pipes used for construction of both the axle and the bearings are of a poor quality and too thin (wall thickness respectively 2mm and 2.5mm). When trying to bend a new piece of pipe, this type will break instead of bend. The thin wall thickness of the bearing creates to much space for the axle in the bearing to move up and down during pumping, increasing wear on the axle.

II. The outer edges of the bearing (1” pipe) are sharp. The seam in this Ghanaian pipe is big and the hole drilled for lubrication shows a burr on the inside. The sharp edges of the bearing, the seam and the burr will cut into the axle during operation, increasing wear on the axle.

III. Although all pumps are sold privately some of the pumps end up being a communal well pump for a high number of users. In these cases the household(s) who purchased the pump and received user training is (are) not able to control the use of the pump. Households reported ‘rough’ pumping among users or children who would hang on the handle during pumping, increasing wear on the axle.

Paint
Some of the pumps show traces of rust and on three pumps some paint had come off and parts where rusted badly on the non galvanized parts of the pump. Especially the wheel, which is getting wet frequently, needs more attention.
Evaluation at the workshop learned that parts where not cleaned or treated with sandpaper before painting, not all parts where precisely painted with anti rust, and paint (expensive) would be diluted with solvents (cheap) up to 25% (too much!). Painting took place on day time and painted objects would be placed in the sun to dry. Painting on ‘hot’ steel or in high temperatures will let the harder evaporate, creating a layer of paint which will stay soft and not well attached to the metal!

Pumping lock
In two cases the pumping lock was welded horizontally on the structure. The lock would not automatically fall open (back to the structure) by its weight or would even 'close' during pumping resulting in a lock being tightened with a rope to the structure and not being used at all. On all other pumps the lock was generally well used.

Grip lock on handle
The grip lock at the end of the handle was not always cut and bent in the right direction.

Broken PVC tromp at turning point
On one of the pumps, males where the only ones being able to turn the handle and operate the pump. Taking out all PVC pipes learned that a rope and bucket where caught by the rope of the Rope pump, creating resistance and breaking the tromp of the riser pipe (3.6.2).

Broken riser pipe
EW reported two cases of a broken riser pipe in the deeper hand dug wells requiring the use of ¾ and ½ inch pipes. These pipes are thin, flexible and venerable to reverse pumping (at this moment the rope force can take the turning point to the sides of the well or even force the turning point in upward direction, breaking the riser pipe). In hand dug wells with a groundwater table up to a depth of 10 meter, where the stiff 1 inch pipes are used, this problem doesn't occur. Also tube wells are not venerable to this phenomenon as the turning point has no space to move around in (3.6.2).

Piston production & riser pipe size
The first 1000 pistons of each size (respectively 1, ¾ and ½ inch) where imported from Nicaragua in June. Although outer diameters in inches are supposed to be the same (international standards), there are big differences between outer and inner diameters of the low pressure type PVC pipes. A pipe fitting the Nica-pistons could not be found and all pistons sizes where adjusted by use of a file. Different inner diameter pipe sizes and manual adjusted piston sizes created, on some of the pumps, too much space between piston and pipe, resulting in flow loss.

3.6 Conclusions/Recommendations/Actions

3.6.1 Production

Axle
All axles have to be replaced from ¾" GI pipe (wall thickness 2mm) Ghanaian quality into ¾" GI pipe (3mm) French quality, which can be obtained in Dakar. The French GI pipes will be set as a standard for future production in all workshops.

Bearings

I. Also all bearings have to be replaced from 1" GI pipe (wall thickness 2.5mm) Ghanaian quality into 1" GI pipe (3.5mm) French quality, which also will be the standard for future production.

II. Pumps for communal use (>10 households or 50 users) will only be sold manufactured with impregnated hardwood- or ball bearings (a first test model of each will be installed in the field to monitor its functioning).

III. Attention has to be paid to construction of the bearings. The sharp edges, seam and burr have to be filed out until the inside and edge of the bearing show a smooth surface.

Painting
It's recommended to paint at early morning or late afternoon when the temperature of steel objects is cooler (25°C). Steel temperatures during day time easily reach 32 - 38°C in the shade. Newly painted objects should be kept in the shade until they're dry, as steel temperatures easily rise up to 60°C when exposed directly to full sunlight. Paint should not be diluted unless it's old and too thick to paint with. Painting of the pumps should be carried out in the following three steps:

I. Remove all welding slack and visible grease with solvent, remove rust and treat all parts to be painted with sandpaper. Make sure hands are free of grease.

II. Paint all parts with antirust, including the inside of the clamps on the wheel which have to be painted after welding them to the spokes, but before the spokes are welded to the wheel bearing. Be sure that welds are painted well. Let painted objects dry in the shade.

III. When the antirust is completely dry (make sure hands are free of grease when moving the object), paint the structure with the final paint. Let painted objects dry in the shade.

Pumping lock
The pumping lock should be welded awry on the structure which enables the lock to fall open by its own weight when pumping starts. Its functioning should be checked after construction of the pump when handle, wheel and structure are put together.

Grip lock on handle
After the different pump parts are put together and the definitive pumping direction of the wheel (and so the handle) is ensured, check if the grip lock is still cut and bent in the right direction.

Piston production & riser pipe size
First of all it is important to determine the most frequent available sizes of the low pressure type PVC pipes at all different places in the Casamance where pumps will be produced. As a result of this inventory the most frequently available sizes of pipe (measured on inner diameter) can be set as a standard for future piston production. To avoid confusion, the terms '1, ¾ and ½ inch' will be rejected (as metric figures are the standard in Senegal). After choosing a standard for each size (called: "grande, midi and petit") the piston moulds (already manufactured) can be adjusted to the right size. Pistons of each size could be put on a small chain (like a key fob) and be used as a tool for purchasing PVC riser pipes.

The workshop of Abdoulay Lo managed to start its own piston production using moulds and an extruder. The first pistons produced were made out of regular 'plastics' derived from chair seats, buckets and cans. Some of these pistons were likely to break after 2 months of use on the Rope pump. At the time of writing production was started using PE (poly ethylene) pellets from EW's plastic recycle program in Dakar, which will be used for future production of all pistons. The space between piston and pipe should not be less than 0.5 mm and not exceed 1 mm on each side of the piston.

3.6.2 Installation

Concrete well covers
An inventory of EW learned that almost anything you can imagine (rope, buckets, wood, cans, shoes,….) can be found at the bottom of an open hand dug well. These object can form a threat to the Rope pump itself and its functioning. Besides these objects, an open hand dug well is very venerable to the entree of bacteria and mosquitoes. It's therefore recommended to promote the use of a full concrete well cover, keeping the well free from debris, bacteria (and diseases), mosquitoes (and their offspring) and creating a safe barrier for children. The well cover consists of two halves (the type EW already introduced. Two halves make the well cover easier to handle, for example when a pump has to be repaired). The surface of both halves should run in a small slope from the middle (line) to the sides of the well, preventing surface water and dirt to enter.

Turning point
For the deeper wells, requiring ¾ and ½ inch riser pipes, the turning points are too light and have to be made heavier. This is easily done by enlarging the U-shaped round bar (approx. 5 cm on both ends) and inserting the bottom part (5 cm) of the turning point in a 20x20x15cm concrete block.

Well surroundings
In some areas (intensive use) the surrounding of the well became very wet during day time and the presents of algae's was noted and can be seen as a good indicator for the presents of a good environment for bacteria growth. This water can infiltrate in the soil at well level and re-contaminate groundwater in the well. Therefore it's recommended to promote the use of a concrete slab around the

well preventing the water to infiltrate directly. This water could be led, by means of a small channel, to a dug hole, approximately 4-5 meter down stream (if known) of the hand dug well. In this way, well surroundings stay dry and therefore free of algae's and bacterial growth will be reduced. The water will infiltrate at 5 meter distance from the well and be filtered by the soil before (if groundwater flow is not known) entering the well again.

3.6.3 Users-training and maintenance

I. Users-training should be given on the correct use of the pump (i.e. force on handle, height of axle; belly button height (to be adjusted by concrete step), use of lock; turning back could be dangerous for children, no reverse pumping, lubrication; daily/weekly a drip of clean oil depending on user intensity) and users should be made aware of the risks of wear during communal use of their pump, on its parts. In one case for example the owner of the pump asked a little money per bucket to be able to buy spare parts if necessary (sharing costs of the spare parts).

II. Flyers could be distributed together with the pumps describing use and maintenance procedures. As a lot of people can not read, it is recommended to use drawings.

3.7 Follow up

EW has done a decent job when it comes to monitoring of the Rope pump during the first months of introduction. Both manufacturer and EW hold a list of selling dates, price, pump numbers and buyers. EW frequently visits the pumps and evaluates with users, using an evaluation form. Please find an inventory of the 31 pumps produced so far in appendix B.

The actions and recommendation mentioned in paragraph 3.6 will be carried out by the manufacturer and/or EW and effects will be closely monitored by the EW potable water team.

4 Motorized Rope Pump (MRP)

4.1 Introduction

The manual operated Rope pump is very useful for supplying potable water, water for cattle and small scale irrigation. For larger irrigation fields the flow rate is too low. In Nicaragua pilot tests took place on a motorized version of the Rope pump resulting in a much higher flow rate and a relatively low fuel consumption. By now the Motorized rope pump in Nicaragua is powered by a Spanish engine. The pilot test includes about 30 pumps and results are promising. The costs of a Spanish engine, imported in Nicaragua, are US$ 250. The initial cost for the whole MRP in Nicaragua is US$ 350.

The last models build in Nicaragua are equipped with a new 1.5 hp Chinese engine. By using this Chinese model on a Motorized Rope pump, the price of the MRP will be reduced by US$ 100. Although this looks promising, there are still no long term results in the use of this engine and long term quality has to be monitored and guaranteed before introducing this engine on a larger scale.

To be able to gather more reliable results with this new engine (monitored by EW), a Chinese engine was used for first introduction of the MRP in Senegal. Price of this engine, shipped to Senegal, ends up between US$ 90 – US$ 100. Including import tax and profit for the importer the price will be around US$ 150. The price for a complete MRP powered by a Chinese engine in Senegal is estimated between US$ 200 – US$ 250, making it an attractive proposition for farmers. At present Treadle pumps (US$ 70) are used for small scale irrigation on wells with a water level of maximum 8 meter below ground level. For larger scale irrigation and deeper water tables an electrical deep well pump (US$ 800 – US$ 1200, excluding generator for power supply) is the only alternative in Senegal.

4.2 Tests & data

Most small engines are designed to work on full power. However on the MRP the engine is driving the pump at idling speed with very low power output, in the past resulting in fouling of the spark plug. Tests in Nicaragua and Holland have taken place to overcome these problems and adaptations where made in two-stroke fuel mixture and sparkplug type.

4.2.1 Technical data

Structure & transmission

Pump wheel	35 cm (14 inch)
Motor wheel	90.5 cm
Motor pulley	3.6 cm
Transmission ration	1:25
Idler pulley	8 cm, brass
Round belt	Poly Urethane (PU), 7 mm

Please find drawings of the MRP in appendix A. Parts are numbered and listed, final drawings and drawings of individual parts will be made after feedback from the field during the long term testing period, the coming six months.

Engine

Fuel	1:50 (2%) two-stroke fuel
Spark plug	NGK, type: BR4HS
Engine speed	120 rpm (motor wheel) is 3000 rpm (engine)

The two-stroke fuel mixture is changed from the regular 1:25 into 1:50 (fuel : two-stroke oil (2%)) creating a ‘poor’ mixture making the sparkplug less sensitive to fouling.
The original spark plug (hot type) was changed into a ‘cold type’ sparkplug. This sparkplug is well isolated and temperature of the sparkplug remains high during operation, although the engine is running just above idling speed. A high temperature of the sparkplug prevents fouling.
An optimal temperature of the cylinder head (120-125°C) is reached at an average speed of 115 – 120 rpm on the motor/pump wheel.

4.2.2 Tests in Senegal

First tests where carried out on a hand dug well with a water level of 18 meter and a total depth of 20 meter. The pump was installed using a 1 inch riser pipe (27 mm pistons), creating a rope force of 8,8 kg during operation of the pump. During the tests, water would be used for household and irrigation purpose. Because of the large water draw down in the hand dug well, circulating the water (1.5 h) was necessary after 1 hour of irrigation, in order not to empty the hand dug well and still having a representative continuation of the test. Plans where already made to increase the yield of the well by drilling a tube well with wrap filter on the bottom of the well.

In the Casamance, on average during dry season, 8 liter/m^2/day is needed for irrigation. During the tests, working on a speed of 120 rpm, a flow rate of 0.8 liter/second or 2.9 m^3/hour was established. This flow rate would irrigate 360 m^2/hour (3000 m^2/day) on average.

During this project 10 tests where carried out and time, rpm, temperature, water discharge, drawdown, fuel consumption, sparkplug functioning and visible observations closely monitored and written down. During the whole test cycle the potable water team was trained in correct use and background of the engine, tests/monitoring and implementation of test results and observations.

4.3 Evaluation

4.3.1 Conclusion

Fuel
During the tests contamination in terms of suspended solids in the fuel where noted. Fuel obtained at the pump is regularly clean. Most of the time contamination has its origin in fuel cans which are former cans for fish oil, cooking oil or basically any other fluid that has to be transported. Farmers in later stage will use the same (cheap) cans to transport their fuel for the engine and so it was decided to do the same during the test, creating representative results. These particles sometimes block the nozzle (noticed by the sound of the engine and a decreasing rpm level of the pump wheel) and could be removed by acceleration (the particles are getting sucked through) or cleaning the carburetor.

The two filters that come with the engine (i.e. located on top and bottom of the fuel tank) are not fine enough to block these particles. Making the filter fine with a piece of cloth would help, but creates the risk that users throw it out as fuelling takes more time.

In Ziguinchor a small fuel filter was found and future tests will run using the fuel filter between the tank and carburetor. The test will show the duration of use before the filter has to be replaced. Fuel consumption at time of writing using the Chinese engine is between 0.6 and 0.7 liter/hour (depending on rope force / water level).

Spark plug
During the tests the isolated NGK BR4HS was used, but could not be purchased in Ziguinchor. Three types of spark plugs where found in Ziguinchor: NGK BR7HS, KLG 912D and BOSCH W8S. The most suitable plug can be selected by field testing during futures pilot project.

Accelerator
As counting the rpm level of the motor wheel might be difficult for farmers (counting in French goes slowly for unlettered persons) it is advised that the potable water team will mark the optimal position of the accelerator during installation.

4.3.2 Adaptations/Advice

Spill protection
A spill protection made of sheet metal will be added to the frame to prevent fuel leakage during filling of the tank.

Fuel filter
A small fuel filter will be added on the tube between tank and carburetor.

Wheel cover
A wheel cover will be placed on top of the pumping wheel to prevent exposure of the pump rope to direct sunlight. This and the above mentioned actions will be taken by one of the potable water team members before continuation.

Round belt welding
The PU round belt should be re-welded when pre-tension of the belt is getting less than 1.5%. This point is reached when a person needs no tension at all when placing the belt on the motor pulley. The team was trained in welding of the round belt, keeping following in mind:

I. Heat the end of a piece of inox- or CLEAN sheet metal until it's red at the end.
II. Be sure that both sides of the belt are clean and cut straight.
III. Hold both pieces on each side of the sheet metal at the cold part and shift in the direction of the hot part until the ends of the belt start melting.
IV. Be sure that the melted belt does NOT start to smoke. This means the iron is too hot and the belt will burn instead of melt, creating a weld which stays soft and is full of bubbles (not strong enough!)
V. When both ends are melted well, shift them off the sheet metal and hold them together for at least 1 minute without moving, before cooling the weld with water and cut smooth with a piece of razor blade. Wait at least 10 more minutes before using the belt on the MRP.

4.3.3 Monitoring / Pilot project

Another 5 Chinese engines will be imported by EW and another 5 pomp structures will be constructed as a copy of the original one. Pumps will be installed and monitored by the EW potable water team. Having 6 pumps in different situations and with different use will provide more information on the functioning of the Chinese engine as power supply for the MRP.

During a test period of 6 months the pumps will be used by farmers or communal water supply 'guards' (tanks are often used as communal water point in a village, the tank can be filled a few times a day by a responsible person ('guard') by use of the MRP) and monitored by EW.

For correct monitoring of the pumps and engines a checklist is designed (please find in appendix D) including a test report and table for the farmer to record his running hours and fuel consumption. The test reports will be send to Practica Foundation by e-mail, enabling Practica to provide feedback to EW if needed. In this way a lot of information can be gathered in 6 months time, making, if results are good, the pump ready for larger scale distribution.

5 The Rota sludge / Manual drilling

5.1 Introduction

What counts for the Rope pump, counts for manual drilling. After a first introduction there are a number of small mistakes that can be made. During the first project in March a Rota sludge manual drilling set was constructed, but unfortunately, due to time pressure, only theoretical- and no practical training was provided.

Nevertheless the drilling expert of EW and a local drilling contractor had practiced the use of the Rota sludge on 4 drillings, all completed with a tube well.

5.2 Training

During this project the same drilling crew was selected for training on the Rota sludge. Besides the Rota sludge, the auger- and percussion drilling systems where part of a theoretical and practical training.

Main subjects of the training included:

I. Training on the technique itself including explanation and self-experience in the difference between drilling, by only using your muscles, and the technique itself requiring the team to think in 3 dimensional pictures of the bore hole. This 3-d thinking learned the team to connect feeling with understanding of what happens inside the bore hole during drilling.

II. Water pressure. This subject was experienced very difficult as it is abstract and difficult to understand. Some examples of situations that were familiar to the team where used to explain the importance and necessity of water pressure during the drilling process using the Rota sludge and bailer technique. Further the use of cow dung, to plaster the drilling hole wall, was discussed.

III. A lot of attention was paid to the necessity of a decent drilling log. A drilling log is not only used to detect the exact depth of a good aquifer, but also provides a needed description of the impermeable layers above the aquifer in which the filter will be installed. Building in a tube well, the importance of the right size gravel and the importance of a cement block at the level of an impermeable layer where discussed. Especially in areas with salt and fresh water or in crowded areas, like Ziguinchor, it's important to seal-off impermeable layers again, preventing bacteria (latrines) in the upper layer or first aquifer, or salt water, from entering the tube well.

IV. Drilling site selection and the risks of drilling close to the latrines (or the latrine of neighbors).

V. Filter screen, wrap filters and gravel pack.

5.3 Evaluation

The team made good progress in drilling and in general the difficult theory was understood. A drilling was made up to 27.5 meters depth. Nevertheless the drilling hole was not kept full with water during a Sunday, resulting in a collapsed drilling hole the next morning, still containing drilling pipes up to a depth of 24 meters. Although this was not part of the training it was a good learning experience and once again the use and necessity of water pressure was discussed.

Fortunately the team succeeded in a flush drilling, using a motorized centrifugal pump and a huge water tank. The Rota sludge drilling equipment was taken out of the bore hole and a tube well was installed.

It's very important that EW trainers continue training and monitoring of the drilling crew during the next 4 drillings. In general it can be noted that at least 4 boreholes are needed before a crew is capable to drill with the Rota sludge on its own.

Appendix

A Drawings MRP

B Inventory Rope pumps

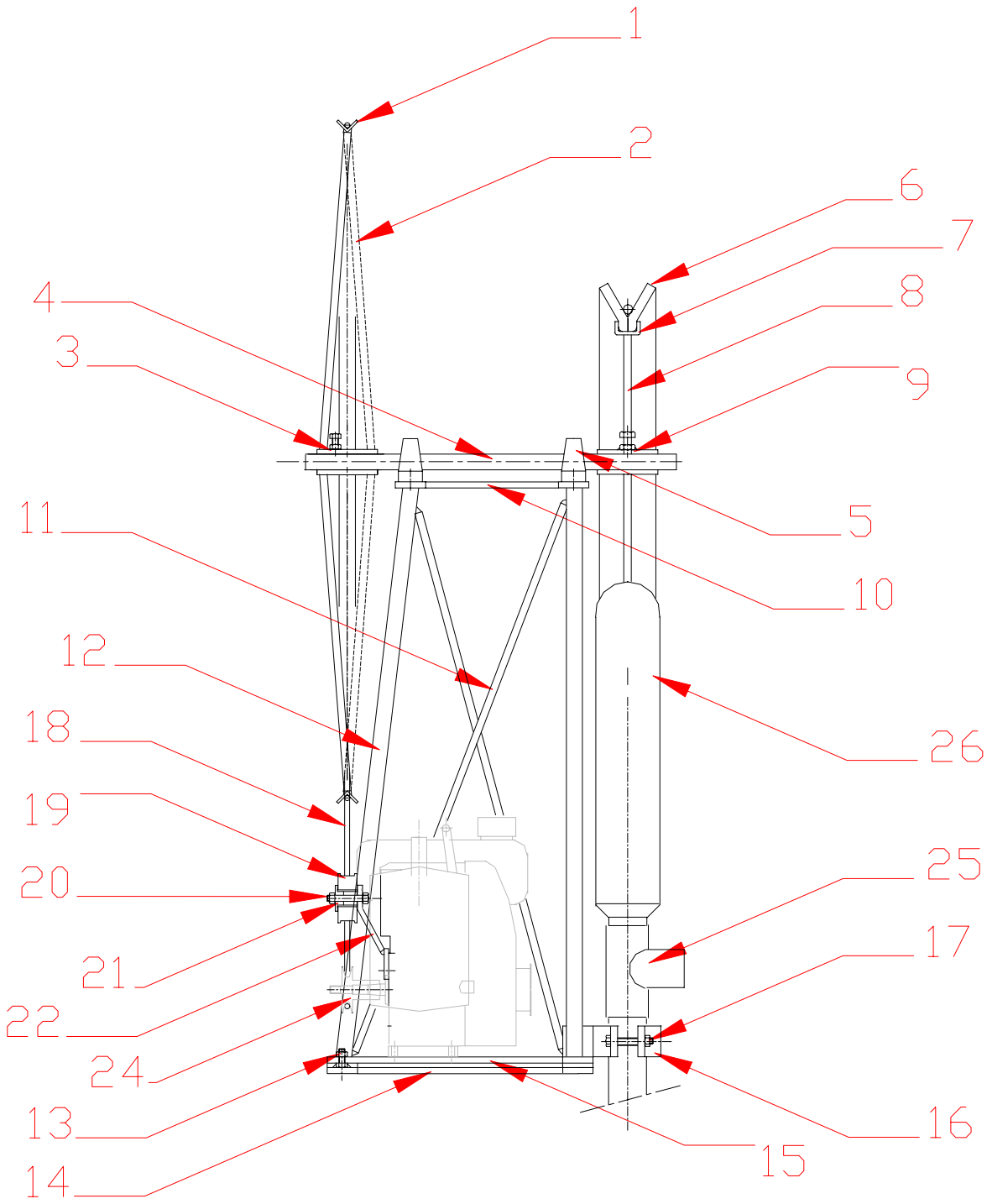
C Checklist Rope pumps

D Checklist MRP

E Daily report

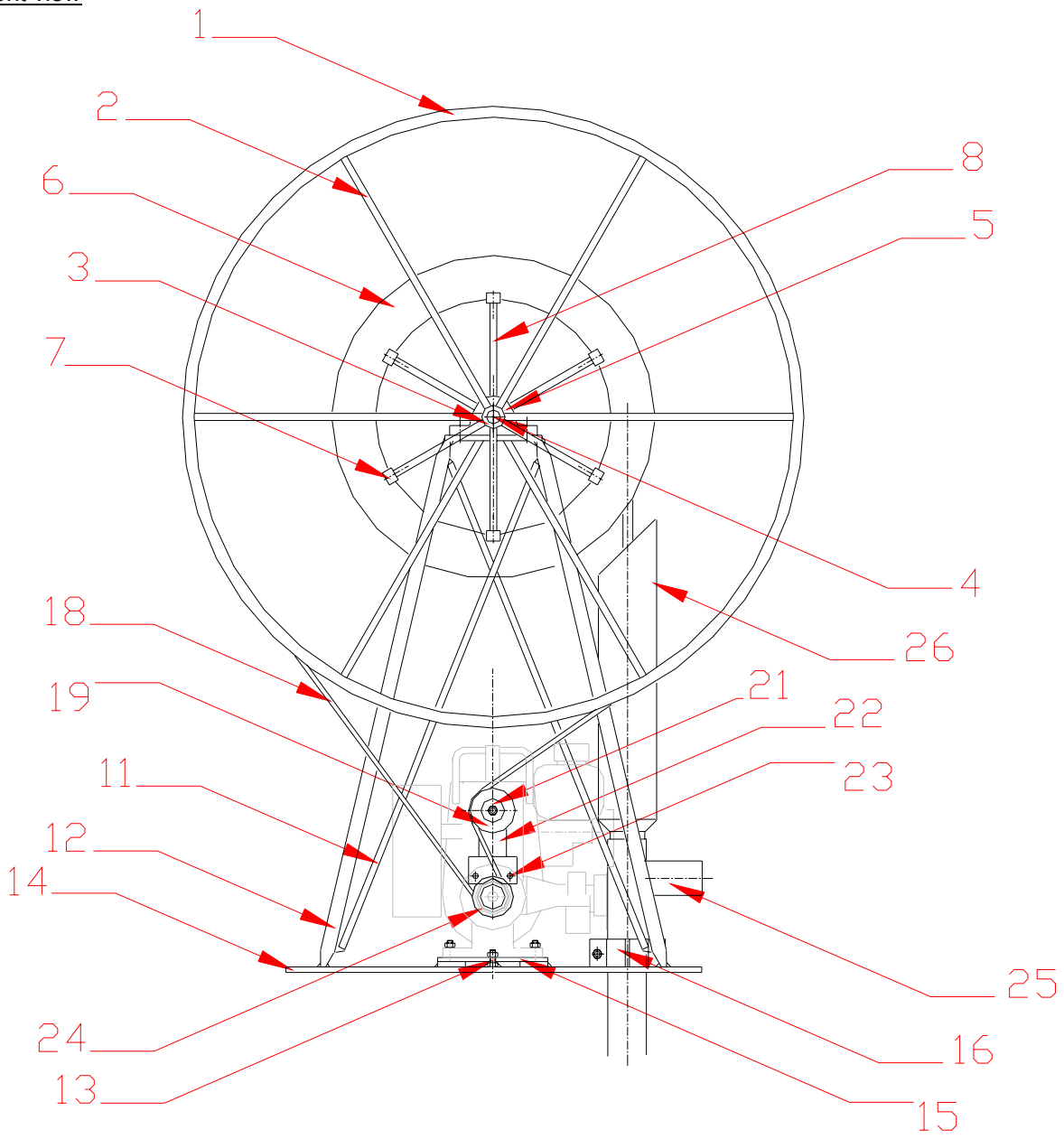
Appendix A Drawing Motorized Rope Pump

Side view



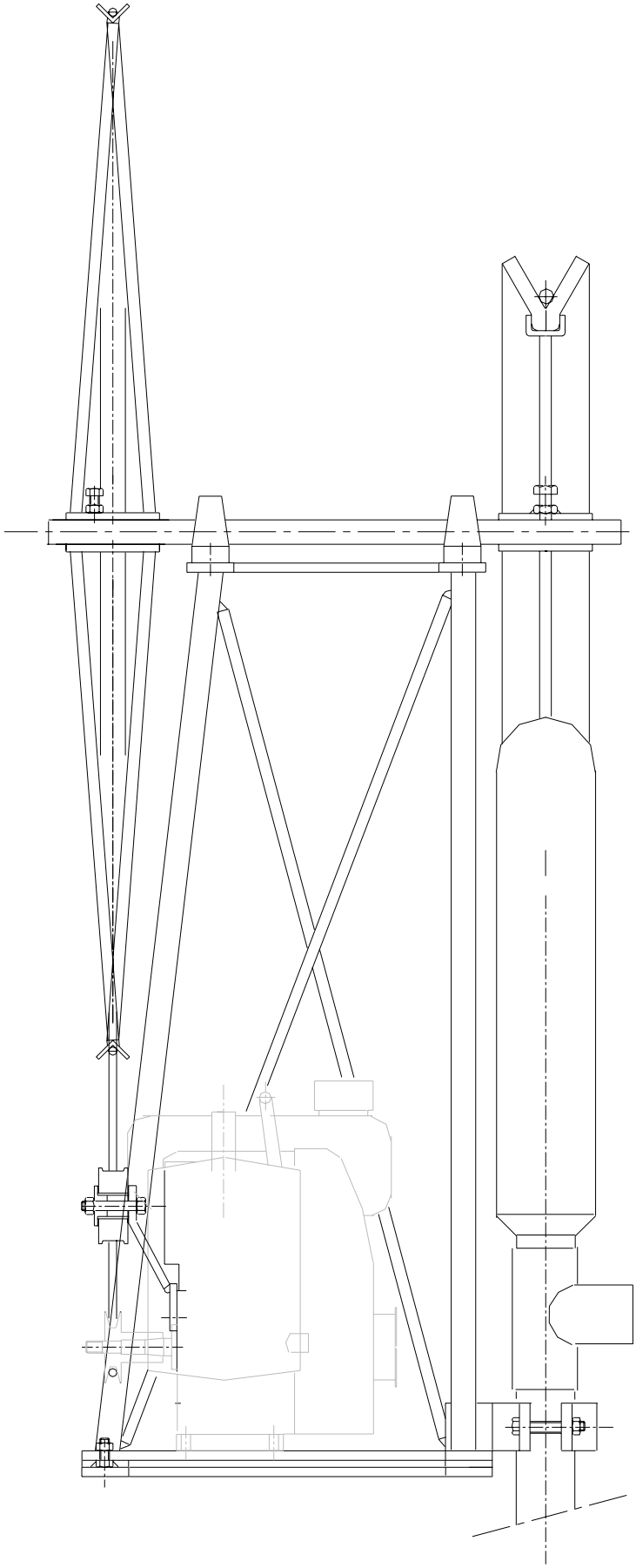
Drawings by Solartec

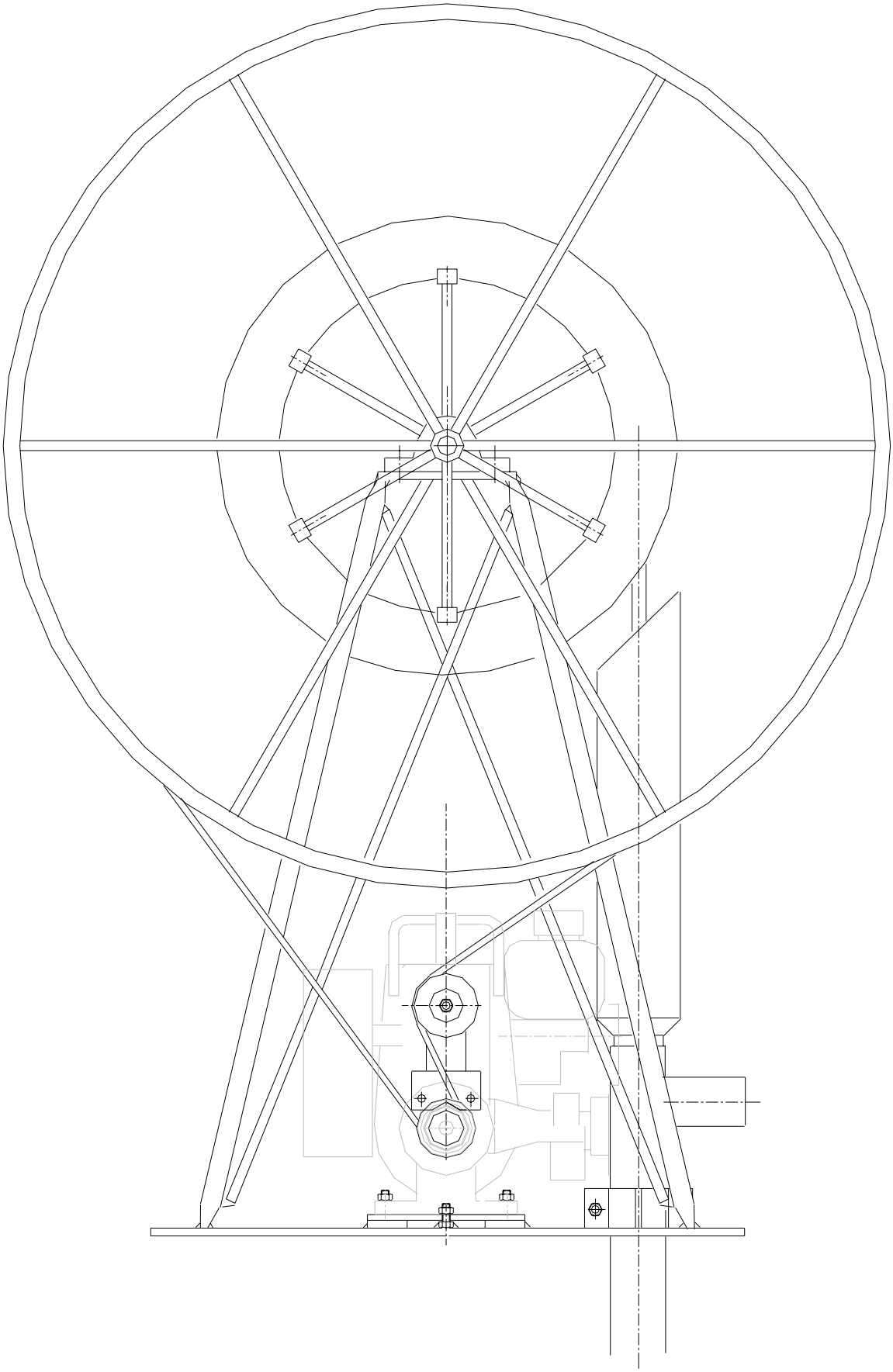
Front view



1	Motor wheel, angle iron 20 x 20
2	Spoke motor wheel, round bar 10
3	Bearing motor wheel, pipe 21/33 + bold & nut M8 x 25 (2)
4	Axle, round bar 20
5	Ball bearing, 20
6	Pump wheel, outer car tire 14 inch
7	Clamp pump wheel, iron strip 4 x 25
8	Spoke pump wheel, round bar 10
9	Bearing pump wheel, GI pipe 21/33 + bold & nut M10 x 25 (2)
10	Bearing support, iron strip 8 x 40
11	Frame Support, reinforcement bar 10
12	Structure, pipe 15/21
13	Bold & nut M8 x 25 (engine M8 x 40)

14	Structure support, iron strip 8 x 40
15	Engine support, iron strip 8 x 40
16	Raiser pipe clamp, iron strip 8 x 40
17	Bold & nut M8 x 62
18	Round belt, Poly Urethane (PU) 7mm
19	Idler pulley, brass 22/60
20	Bold & nut M8 x 54
21	Idler pulley bearing, iron 8/21/34
22	Idler pulley support, iron strip 8 x 40
23	Bold M6 x 20
24	Motor pulley, v-shape 36
25	PVC T & reducer
26	PVC pipe





Appendix B: Inventory Rope pumps

Fiche récapitulative détaillée de ventes de pompes à corde pour l'année 2004 — **MISE A JOUR 23/11/04**

N°	Artisan	N° de pompe	Client (prénom et nom)	Nom bénéficiaire	Date d'intallation	Coordonnées GPS	profondeur pompe/eau	Niveau eau	Débit(l/h)	PVC	Village/Quartier	Zone	Bénéficiaire			Utilisation	Prix d'acquisition	Prix de vente
													Néménage	Total	Femme			
1	Abdoulaye Lô	15	Abdoulaye Lô	Abdoulaye Lô			17,8				Château d'eau	Bignona	10	40	30		pompe de la formation	test
2	Abdoulaye Lô	7	EnterpriseWorks	Alassane Badji	31-mai-04	N12°34-264' W16°16-748'	7	1,3	2.400,00	32	Yamatogne	Ziguinchor	40	396	218	Vendu	25.000 F	40.000 F
3	Abdoulaye Lô	4	EnterpriseWorks	Ismaïla Cissé	10-août-04	N12°33-871' W16°17-977'	5,7	3,4	3.095,00	32	Lyndiane	Ziguinchor	5	36	18	Vendu	25.000 F	40.000 F
4	Abdoulaye Lô	23	EnterpriseWorks	Nala Kounta	25-août-04	N12°34-579' W16°16-159'	1,2	2,2	3.600,00	32	Santhiaba	Ziguinchor	18	98	51	Vendu	pomp de la formation	40.000 F
5	Abdoulaye Lô	16	EnterpriseWorks	Omar Mballo	7-sept.-04	N12°41-617' W14°59-996'	9,3	9,3	1.800,00	25	Boguel Samba	Kolda	5	60	37	Vendu	25.000 F	45.000 F
6	Abdoulaye Lô	17	EnterpriseWorks	Mamadou Salif Baldé	8-sept.-04	N12°59-543' W14°35-906'	6	11	2.700,00	25	Fass Kaone	Kolda	15	139	73	Vendu	25.000 F	45.000 F
7	Abdoulaye Lô	19	EnterpriseWorks	Modou Ngom	15-sept.-04	N12°34-042' W16°16-270'	9,3	1,7	3.600,00	32	Kadjor	Ziguinchor	4	43	21	Vendu	25.000 F	40.000 F
8	Abdoulaye Lô	22		Ismaïla Faty	22-sep-04	N12°56-944' W16°43-567'	7,6	0,7		25	Katol-Dianakabar	Kaffountine	2	11	2	Vendu		45.000 F
9	Abdoulaye Lô	13	EnterpriseWorks	Ousmane Badji	10-juin-04		8	1	2.400,00	32	Kodjor	Ziguinchor	3	15	8	Vendu	25.000 F	40.000 F
10	Abdoulaye Lô	25	EnterpriseWorks	Marcelo Alphonso								Guinée				Vendu		45.000 F
11	Abdoulaye Lô	24	EnterpriseWorks	Imam Mbaye Kébé	11-okt-04	N12°24-442 W16°15-281	2,6	3	3.600,00	32	Kandé Léona	Ziguinchor	6	34	18	Vendu		50.000 F
													108	**872**	**476**		150.000 F	430.000 F

Fiche récapitulative détaillée de location ventes de pompes à corde pour l'année 2004 — **MISE A JOUR 23/11/04**

N°	Artisan	N° de pompe	Client (prénom et nom)	Nom bénéficiaire	Date d'intallation	Coordonnées GPS	profondeur pompe/eau	Niveau eau	Débit(l/h)	PVC	Village/Quartier	Zone	Bénéficiaire			Utilisation	Prix d'acquisition	Prix de vente
													Néménage	Total	Femme			
1	Abdoulaye Lô	13	EnterpriseWorks	Ousmane Badji	10-juin-04		8	1	2.400,00	32	Kodjor	Ziguinchor	3	15	8	Locat° Vente	25.000 F	location vente
2	Abdoulaye Lô	11	EnterpriseWorks	Nassia Bandjiki	14-juil.-04	N12°34-152' W16°15-990'	10	1	1.400,00	25	Tilène	Ziguinchor	8	25	10	Locat° Vente	25.000 F	location vente
3	Abdoulaye Lô	14	EnterpriseWorks	Sindji Mané	2-sept.-04	N12°34-391' W16°16-658'	5,6	1,6	3.600,00	32	Boucotte Saint-Maure	Ziguinchor	4	22	10	Locat° Vente	25.000 F	location vente
4	Abdoulaye Lô	18	EnterpriseWorks	Ibou Mané	9-sept.-04	N12°34-329' W16°16-670'	5,5	1,8	3.600,00	32	Boucotte Saint-Maure	Ziguinchor	2	10	5	Locat° Vente	25.000 F	location vente
													14	**57**	**25**			

Fiche récapitulative détaillée de démonstration de pompes à corde pour l'année 2004

MISE A JOUR 23/11/04

N°	Artisan	N° de pompe	Client (prénom et nom)	Nom bénéficiaire	Date d'intallation	Coordonnées GPS	profondeur pompe/eau	Niveau eau	Débit(l/h)	PVC	Village/Quartier	Zone	Bénéficiaire			Utilisation	Prix d'acquisition	Prix de vente
													Néménage	Total	Femme			
1	Abdoulaye Lô	12	EnterpriseWorks	Siège EW			10,5				Colobane	Ziguinchor				test et démonstration	pompe de la formation	démonstrat°
2	Abdoulaye Lô	10	EnterpriseWorks	Pape Badiane	12-juil.-04	N12°34-168' W16°16-123'	10;5	1	1.400,00	25	Tilène-Kadjor	Ziguinchor	5	20	16	Récupérée	25.000 F	démonstrat°
3	Abdoulaye Lô	14	EnterpriseWorks	Yaya Sané	7-juil.-04	N12°34-676' W16°17-297'	6,7	1		32	Colobane	Ziguinchor	4	14	13	Récupérée	25.000 F	démonstrat°
4	Abdoulaye Lô	2	EnterpriseWorks	Touty Sagna	29-juil.-04	N12°34-674' W16°16-710'	10,5	2	1.400,00	25	Boucotte Sindian	Ziguinchor	10	24	20	Récupérée	pompe de la formation	démonstrat°
5	Abdoulaye Lô	5	EnterpriseWorks	Moussa Bâ	5-août-04	N12°33-928' W16°16-536'	8			32	Néma Kadior	Ziguinchor	4	15	12	Récupérée	25.000 F	démonstrat°
6	Abdoulaye Lô	6	EnterpriseWorks	Maïmouna Diémé	11-août-04	N12°33-645' W16°17-257'	11,9	1	1.300,00	25	Boucotte Sud Néma	Ziguinchor	4	35	21	test et démonstration	25.000 F	démonstrat°
7	Abdoulaye Lô	8	EnterpriseWorks	Amy Diaïté	12-août-04		9	1,45		32	Lyndiane	Ziguinchor	10	28	14	Récupérée	25.000 F	démonstrat°
8	Abdoulaye Lô	1	EnterpriseWorks	Cheick Bodian	18-août-04	N12°84-73' W16°13-159'	10,5	2,25	1.540,00	25	Badionkoto	Bignona	3	16	4	test et démonstration	pompe de la formation	démonstrat°
9	Abdoulaye Lô	9	EnterpriseWorks	Malang Ndiaye	19-août-04		4,4	1,2	2.700,00	32	Escale	Bignona	2	20	4	Récupérée	25.000 F	démonstrat°
10	Abdoulaye Lô	10	EnterpriseWorks	Baba Diédhiou	26-août-04		1,83	2,88	3.560,00	32	Kandé Léona	Ziguinchor	9	30	20	test et démonstration	25.000 F	démonstrat°
11	Abdoulaye Lô	20	EnterpriseWorks	Astou Sané	14-sept.-04	N12°34-446' W16°15-487'	1,6	3,7	3.960,00	32	Kandé Léona	Ziguinchor	3	10	4	test et démonstration	25.000 F	location vente
12	Abdoulaye Lô	5	EnterpriseWorks	Elisabeth Diouf	12-oct.-04	N12°29-296 W16°33-032	4,4	2,35	3.600,00	32	Campement Emmanay	Oussouye	13	6	4	test et démonstration		démonstrat°
13	Abdoulaye Lô	9	EnterpriseWorks	Opa Diatta	13-oct.-04		5,6	2,05	3.375,00	32	Essinkine	Oussouye	3	8	4	test et démonstration		démonstrat°
14	Abdoulaye Lô	8	EnterpriseWorks	Christophe Diabone	13-oct.-04	N12°29-183 W16°32-595	8,65	1,55	3.857,00	32	Essinkine	Oussouye	7	15	6	test et démonstration		démonstrat°
15	Abdoulaye Lô	2	EnterpriseWorks	Malamine Diédhiou	14-oct.-04	N12°29-318 W16°32-339			3.176,00	32	Sarademba	Oussouye	5	13	6	test et démonstration		démonstrat°
	Abdoulaye Lô	3	Stock															
	Abdoulaye Lô	21	Stock															
	Abdoulaye Lô	26	Stock															
	Abdoulaye Lô	27	Stock															
	Abdoulaye Lô	28	Stock															
	Abdoulaye Lô	29	Stock															
	Abdoulaye Lô	30	Stock															
	Abdoulaye Lô	31	Stock															
													82	**254**	**148**			

Appendix C: Rope pump technical checklist (English)

Date of visit:	…….	
Name technician:	…….	
Pump number:	nr……	,produced by……..

User(s)

Name owner:		
Name of area:		
Number of users:		
Comments of users:		

Pump

Installation date:		,installed by…….
		Comments
Water level:		dry / wet season
Well depth:		
Well type:	hand dug well / tube well	
Well cover:	concrete / open / other:	
Piston size:		
Piston quality:	OK / cracks / holes / all present /	
Rope quality:	OK / warn out / broken /	
Rope tension:	OK / loose / tight /	
Rope connection:	OK /	
Grip on wheel:	OK / slipping /	

PVC

T:	OK / broken / clean / dirty /	
Reducer:	OK / broken / clean / dirty /	
Raiser pipe:	OK / broken / clean / dirty /	
Tromps:	OK / broken / clean / dirty /	

Structure

Welding:	OK / broken /	
Painting:	OK / come off /	
Rust:	Yes / no / little / much	
Axle:	OK / damaged	Wall thickness:
Bearing:	OK / damaged	Wall thickness:
Handle (grip):	OK / PVC broken /	
Grip lock:	wrong direction / right direction	
Height of handle:	OK / too height / too low /	
Wheel:	OK / damaged /	

Pumping

Pumping:	easy / difficult / resistance /	
Turning point:	OK / clean / dirty / rusty /	
Water discharge:	OK / very little / …….	Turbidity: high / low / clear

Problems:

Actions taken:

Pompe à corde - contrôle technique (Franche)

Date de la visite:	…….	
Nom et prénom du technicien:	…….	
Numéro de la pompe	No…….	Fabriqué par:……..

Utilisateurs

Nom et prénom du propriétaire:		
Village ou Quartier:		
Nombre d'utilisateurs:		Ménages / utilisateurs
Remarques des utilisateurs:		

Pompe

Date d'installation		Installé par……..
		Remarques
Niveau d'eau:		saison sèche / saison de pluie
Profondeur du puits ou forage:		
Type de puits	puits busé/ forage	
Couvercle du puits:	béton / ouverte / autre:	
Taille des pistons:		
Qualité des pistons:	Bonne / cassée / trouée / manquante /	
Qualité de la corde:	Bonne / usée / cassée/	
Tension de la corde:	Bonne / pas assez tendue / trop tendue /	
Attache de la corde:	Bonne/	
Glissage sur la roue:	Rien / glissant/	

Tuyau PVC

T:	Bon / cassé/ propre / sale	
Réducteur:	Bon / cassé/ propre / sale	
Tuyau qui monte:	Bon / cassé/ propre / sale	
Trompette	Bon / cassé/ propre / sale	

Structure

Soudure:	Bon / cassé/	
Peinture:	Bon / décolle	
Rouille:	Rien / un peu / beaucoup	
Axe:	Bon/ usé	Épaisseur du tube:
Roulements:	Bon/ usé	Épaisseur du tube:
Poignée du manche (pvc)	Bon/ PVC cassé	
Arrêtoir	bonne sens/ mauvaise sens	
Hauteur de la manche:	Bon / trop haut/ trop bas /	
Roue:	Bon / cassée/ tordue	

Pompage

Débit:	Bon / moyen / très peu / ……..	
Turbidité:	très troublé / troublé / claire	
Pompage	facile/ difficile / résistance / *	
	*(Si le pompage semble trop difficile ou si vous sentez une résistance peut-être il sera nécessaire de démonter la pompe. Si la pompe est démonter voir en dessous).	
Trompette	Bon / cassé/ propre / sale	
Guide	Bon/ propre /sale / rouille /	

Problèmes:

Actions faites :

Appendix D: Motorized Rope pump 'Technical checklist' (English) 1

Date of visit:	…….	Checklist nr:……..
Name technician:	…….	
Pump number:	nr……	

User(s)		**Comments**
Name owner:		
Name of area:		
Use of MRP:	irrigation / potable / other:	
	size of irrigated area:	
Comments of user:		
Pump		
Installation date:		,installed by…….
Water level:		dry / wet season
Well depth:		
Well type:	hand dug well / tube well	
Well cover:	concrete / open / other:	
Piston size:		
Piston quality:	OK / cracks / holes / all present /	
Rope quality:	OK / warn out / broken /	
Rope tension:	OK / loose / tight /	
Rope connection:	OK /	
Grip on wheel:	OK / slipping /	
Transmission		
Round belt tension:	OK / loose / tight /	
Round belt welding:	OK / almost broken / broken /	
Round belt observation:	Traces of slipping:	Yes / No /
Motor wheel	Straight:	Yes / No /
	Position on axle:	OK / out of line /
Idler pulley	Visible wear:	Yes / No /
	Lubricated:	Yes / No /
Motor pulley	Visible wear:	Yes / No /
Engine		
Sparkplug	Type (code & number!):	
Sparkplug observation:	Carbon:	Yes / No / much / little
	Oil:	Dry / little / much
	Color:	White / light brown / dark brown / black
Cooling air intake	Blocked:	Yes / No / half
Exhaust pipe	Direction (extension):	to well / from well
Exhaust pipe observation:	Clean / Oil /	
Fuel tank	Clean / traces of dirt and sand /	
Carburetor (inside)	Clean / traces of dirt and sand /	
Other observations:		
Actions:		

Motorized Rope pump 'Test report' 2

Date of visit: …… Checklist nr:……..
Name technician: ……
Pump number: nr……

Starting the engine	**(without pump)**	
Choke:	On / Off	
Gas:	Low / half	
Number of pulls to start engine:		
Idling running time:		

Running a test:
(filling fuel tank completely!)

Time	**Rpm**	**Temp cylinder**	**Temp carburat.**	**Water disc.**	**Water lev.**	**Observations ***
:						
:						
:						
:						
:						
:						
:						
:						
:						
:						
:						
:						
:						
:						
:						
:						
:						
:						
:						
:						
:						
:						

*
Observations: smoke / sound / ect

Extra measurements

Measuring point	**30 minutes**	**60 minutes**	.. **minutes**	**end of test**
temp motor pulley:				
temp idler pulley:				
temp round belt after wheel:				
temp round belt after motor pulley:				
temp round belt after idler pulley:				

Fuel	**Time:**	:	:	end	**Total**
	Refill:	……ml	……ml	……ml	**……ml**

Problems:

Actions:

Motorized Rope pump 'Running hours & fuel consumption' 3

Date of visit: …….. Checklist nr:……..
Name technician: ……..
Pump number: nr……

User(s)
Name owner: ……..

List

Date	Time start	Time stop	total running hours	Fuel add.	Comments (rpm, round belt welding, sound, problems, recorded by, other…….)
	:	:		……ml	
	:	:		……ml	
	:	:		……ml	
	:	:		……ml	
	:	:		……ml	
	:	:		……ml	
	:	:		……ml	
	:	:		……ml	
	:	:		……ml	
	:	:		……ml	
	:	:		……ml	
	:	:		……ml	
	:	:		……ml	
	:	:		……ml	
	:	:		……ml	
	:	:		……ml	
	:	:		……ml	
	:	:		……ml	
	:	:		……ml	

Pompe à Corde Mécanisée (PCM) 'Liste de vérification' (Franche) 1

Numéro de rapport d'essai:……..

Date du visite: …….
Nom et Prénom de Technicien: …….
Numéro de la pompe: No……

Utilisateurs		**Remarques**
Nom et Prénom du Propriétaire:		
Nom du village:		
Utilisation de la pompe :	irrigation / l'eau potable / autre:	
	superficie irriguée:	
Remarques de l'utilisateur:		

Pompe		
Date de l'installation		Installé par: …….
Niveau d'eau:		saison sèche / saison de pluie
Profondeur du puits ou forage:		
Type de puits	puits busé/ forage	
Couvercle du puits:	béton / ouverte / autre:	
Taille des pistons:		
Qualité des pistons:	Bonne / cassée / trouée / manquante	
Qualité de la corde:	Bonne / usée / cassée/	
Tension de la corde:	Bonne / pas assez tendue / trop tendue	
Attache de la corde:	Bonne/	
Glissage sur la roue:	Rien / glissant/	

Transmission		
Courroie ronde:	Bonne / pas assez tendue / trop tendue	
Soudure de la courroie ronde:	bonne / presque cassé / cassé	
Observations de la courroie ronde:	Marques de glissage	Oui / Non
Grande roue:	Droite :	Oui / Non
	Position sur l'axe	Bonne / mal alignée
Poulie tendeur	Usure visible:	Oui / Non
	Lubrifiée:	Oui / Non
Poulie moteur:	Usure visible:	Oui / Non

Moteur			
Bougie	Type (code et numéro)		
Observation de la bougie	Carbone:		Oui / Non /Beaucoup / Un peu
	Huile:		Sec / un peu / beaucoup
	Couleur:	Blanc /	marron clair / marron foncé / noir
Filtre air:	Boucher:		Oui / Non / Partiellement
Échappement:	Direction (extension):	vers le puit /	vers l'extérieur du puits
Tuyau d'échappement:	Propre/ Huile		
Réservoir de carburant:	Propre / traces de saleté		
Carburateur (dedans):	Propre / traces de saleté		

Autres observations:
Actions:

Rapport d'Essai de la Pompe à Corde Mécanisée 2

Date de la visite: …… Numéro de rapport d'essai:……..

Nom et prénom du technicien: ……

Numéro de la pompe No……..

Démarrage du moteur (sans pompe)		
Choke:	Oui/ Non	
Position d'accélérateur	Bas/ Milieu	
Combien de coups pour démarrer:		
Duré de fonctionnement du moteur (sans la courroie)		

Essaie de pompage

(Remplissez le réservoir complètement)

Heure	TPM	Température de la cylindre	Température du carburateur	Débit d'eau	Niveau d'eau	Observations *
:	Démarrage					
:						
:						
:						
:						
:						
:						
:						
:						
:						
:						
:						
:						
:						
:						
:						
:						
:						

Autres données à collecter:

Le moment à prendre les données	30 minutes	60 minutes	.. minutes	Avant l'arrêt
Température poulie de moteur:				
Température de la poulie tendeur:				
Température de la courroie à la sortie de la roue :				
Température de la courroie à la sortie de la poulie du moteur :				
Température de la courroie à la sortie de la poulie tendeur :				

Carburant	**Heure**	:	:	fin	**Total**
	Remplir:	……ml	……ml	……ml	**……ml**

Problèmes _____

_____

Actions: _____

Nombres d'heures d'opération et la quantité de carburant utilisée 3

Numéro de rapport d'essai:…..……..

Date de la visite: …….
Nom et prénom du technicien: …….
Numéro de la pompe No……..

Utilisateurs
Propriétaire: …….

Liste

Date	**Temps du Démarrage**	**Temps d'arrêt**	**Heures totales d'opération**	**Quantité de carburant ajouté**	**Remarques** (TPM, soudure de la courroie ronde, bruit, problèmes, observateur, autres…….)
	:	:		……..ml	
	:	:		……..ml	
	:	:		……..ml	
	:	:		……..ml	
	:	:		……..ml	
	:	:		……..ml	
	:	:		……..ml	
	:	:		……..ml	
	:	:		……..ml	
	:	:		……..ml	
	:	:		……..ml	
	:	:		……..ml	
	:	:		……..ml	
	:	:		……..ml	
	:	:		……..ml	
	:	:		……..ml	
	:	:		……..ml	
	:	:		……..ml	

Appendix E: Daily Reports

02/11 Arrival and discussion with Christophe Poublanc (country director EW Senegal), Dakar.

03/11 Dakar-Ziguinchor. 'Kick-off' meeting with Patrice Beaujault (country director EW Burkina Faso) and the potable water team of EW Ziguinchor.
Start training and inventory rope pumps and construction of MRP frame, Ziguinchor.

04/11 Manual drilling training at drilling site, Kaffountin.
Visit to Rope pump manufacturer Abdoulay Lo, Bignona.

05/11 Training and inventory rope pumps, Ziguinchor.
Site selection for MRP tests, Ziguinchor.

06/11 Theory training on MRP and engine, purchasing PVC pipes, T and reducers.
Construction and installation of MRP in the field, training and first tests MRP, Ziguinchor.

07/11 Visit drilling site and chain pumps, Kaffountin. Rope pump visit, Kabar.

08/11 Adjustments to, training and tests on MRP, Ziguinchor.

09/11 Tests on MRP and training and inventory rope pumps, Ziguinchor.

10/11 Tests on MRP and training and inventory rope pumps, Ziguinchor.

11/11 Collection of Rota sludge drilling set and tests on MRP, Ziguinchor.
Evaluation rope pump inventory and training at the workshop of Abdoulay Lo, Bignona.

12/11 Rota sludge drilling site selection and theory training, Ziguinchor.
Purchasing PVC pipes for irrigation with MRP, test on MRP, Ziguinchor.

13/11 Installation of Rota sludge drilling rig, training on Rota sludge drilling, Ziguinchor.
Tests, training and evaluation on MRP, Ziguinchor.

14/11 Evaluation with Jon Naugle, Enterprise Works Worldwide and Patrice, office.

15/11 Preparation checklists rope pump and MRP, drawings MRP, ect., office.

16/11 Training on Rota sludge drilling and tests, training and evaluation on MRP, Ziguinchor.

17/11 Evaluation rope pump inventory and training at the workshop of Abdoulay Lo, Bignona.
Training on Rota sludge drilling, Ziguinchor.

18/11 Theory training on: Rota sludge, Manual drilling techniques, Drilling logs, Installation tube well, Water pressure, Pumps, Irrigation, Hygiene, Concrete well cover / slab, Evaluation rope pump inventory, User and maintenance training, Training techniques and MRP evaluation, office.
Training on Rota sludge drilling, Ziguinchor.

19/11 Training on Rota sludge drilling and tests, training and evaluation on MRP, Ziguinchor.

20/11 Evaluation rope pump inventory and training at the workshop of Abdoulay Lo, Bignona.
Tests, training and evaluation on MRP and training on Rota sludge drilling, Ziguinchor.
Training on round belt welding, office.

22/11 Training on Rota sludge drilling, Ziguinchor. Training on round belt welding, discussion, evaluation and follow-up: Rope pumps, MRP and Rota sludge, office.

23/11 Ziguinchor-Dakar. Evaluation with Christophe and Assan, office Dakar.
Departure.