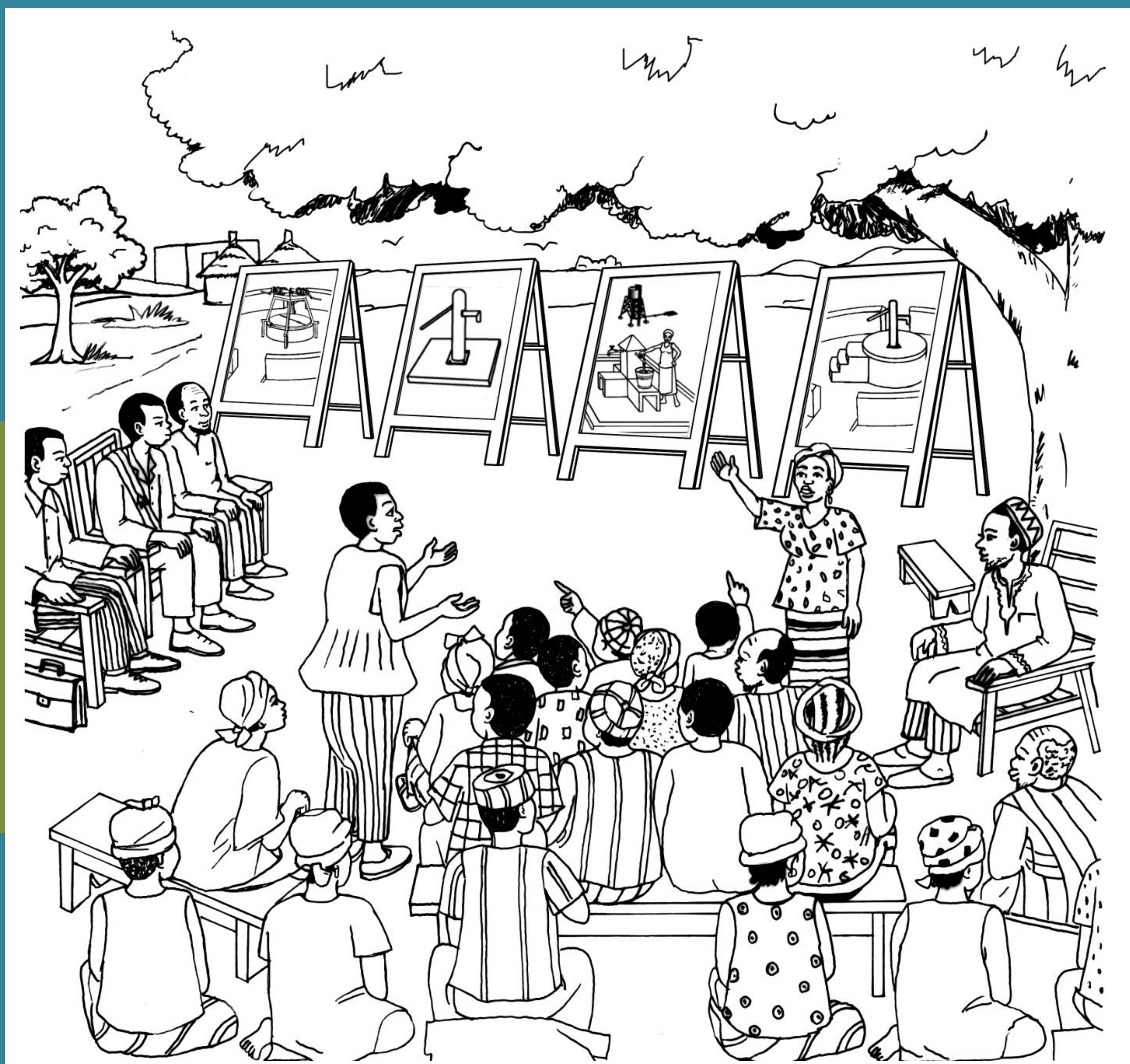
The Global Water Initiative

A Partnership Funded by the Howard G. Buffet Foundation

WEST AFRICA

Making the right choice: comparing your rural water technology options

Ref.: 2012-07-E



GWI Technical Series: Hardware Quality

CRS CATHOLIC RELIEF SERVICES

SAHEL CONSULTING

September 2012

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About this series

The **GWI Technical Series: Hardware Quality for Sustainable Water & Sanitation** is a Global Water Initiative tool that was developed in West Africa by Catholic Relief Services (CRS) and Sahel Consulting as a response to common difficulties in rural water & sanitation projects.

Each document in the series addresses a particular aspect of technology choice, design, build and maintenance. All these aspects are important in delivering a reliable and lasting community water/sanitation resource within an increasingly decentralised context.

We aim to influence those with the power and responsibility to get water and sanitation to the rural poor.

We also want to influence the communities themselves to become proactive and break away from their past role as passive beneficiaries.

The tools have been designed and field tested for use with communities, development workers, commune leaders and government technical services. They focus specifically on gaining an informed understanding that will lead these key decision makers to choosing the correct technology, supervising construction to assure quality, putting in place correct operation and maintenance systems, and assuring that revenue generated is adequate to keep that service going.

These tools are not a method in themselves, they presume that anyone using them is already engaged in a robust participatory process.

The **GWI Technical Series: Hardware Quality for Sustainable Water & Sanitation** includes:

A practical guide for building a simple pit latrine	ref.: 2011-01-E
Assuring Quality: an approach to building long-lasting infrastructure in West Africa	ref.: 2012-01-E
Monitoring checklists : water points and latrines	ref.: 2012-02-E
Community monitoring of borehole construction: a training guideline	ref.: 2012-03-E
Contracting for water point construction: Provisional and final acceptance forms	ref.: 2012-04-E
The essential steps before handing-over a borehole (with hand pump) to the community	ref.: 2012-05-E
Community monitoring during the construction of a gravity-	

fed, solar powered water supply: a training guideline	ref.: 2012-06-E
Making the right choice: comparing your rural water technology options	ref.: 2012-07-E

Please use any of the documents freely. They can be downloaded from http://www.crsprogramquality.org/publications/tag/water-manualsuser-guides.

We would be most interested to receive feedback from you on the usefulness of this material.

The series is published in French and English. If you translate the material into another language please send a copy to lambert.nikiema@crs.org, jeanphilippe.debus@crs.org, suecavanna@sahelconsulting.org.uk.

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About the Global Water Initiative

The Global Water Initiative (GWI), supported by the Howard G. Buffett Foundation addresses the challenge of providing long term access to clean water and sanitation, as well as protecting and managing ecosystem services and watersheds, for the poorest and most vulnerable people dependent on those services. Water provision under GWI takes place in the context of securing the resource base and developing new or improved approaches to water management, and forms part of a larger framework for addressing poverty, power and inequalities that particularly affect the poorest populations. This means combining a practical focus on water and sanitation delivery with investments targeted at strengthening institutions, raising awareness and developing effective policies.

The Regional GWI consortium for West Africa includes the following partners:

- International Union for the Conservation of Nature (IUCN)
- Catholic Relief Services (CRS)
- CARE International
- SOS Sahel (UK)
- International Institute for Environment and Development (IIED).

GWI West Africa covers five countries: Burkina Faso, Ghana, Mali, Niger and Senegal. Some activities also take place around the proposed Fomi dam in Guinea. For more information on the GWI, please visit: www.globalwaterinitiative.com.

Introduction

Who is this Guide for?

This guide is intended for those planning the development of basic rural water supply systems. It has been developed for West Africa but can be adapted for other areas. It assumes local participation where users are not only beneficiaries, but are also consulted in the process of selecting an appropriate technology for their particular community. The Guide seeks to provide the key elements of information that will allow community people to make an informed decision regarding which technology and water supply system best fits their situation.

Identifying those villages within a Commune that most need a new water supply:

In order to include a given village in a Commune-wide water supply, the Technical Services will identify which villages most lack water from their records. A physical survey of the area then follows to confirm which villages have a poor water supply. A final list of the villages to be prioritised for that year is drawn up by the Commune.

The next step is village level discussion. The community is visited by the elected Commune leaders and the technical officials in charge of water. Together with the villagers, they carry out a guided discussion on the various water technology options and jointly decide which type of water supply best suits that particular community.

Choosing the right technology is vital:

Encouraging communities to carefully weigh up and consider the main factors before choosing a technology is very important. The discussions should centre around the main variables. Discussions should include the population size and the physical distribution of that population, the service level needed, community customs & use of water (i.e. animals in large numbers competing with humans for water & needing a lot of water all at the same time), where the ground water is found in this area & the possible means of abstracting the water, if a given type of supply being considered will provide a high enough yield, the level of Technical Services available and if these are near enough to help solve any problems with the complexity of that particular type of water supply, the availability of maintenance & repair people for any pumping equipment, and finally the cost of the system and deciding if the community can afford to sustain it, with external technical and financial support, such as from local government, technical services, NGOs, associations, diaspora, twinning with cities abroad, etc.

Using this Guide in the field:

This Guide is designed for the use of those who facilitate these community discussions in the village. They must already have both the technical knowledge to interpret the information, and the facilitation skills to transmit technical information to communities. This must be done in such a way that the community can fully understand the options opened to them and make an informed choice.

The key components of this Guide:

Each water supply option is laid out in four sections:

1. The basic technical description of the water system
2. The level of service (water quality, quantity, etc.)
3. The cost considerations of both the capital investment and the life-cycle costs/affordability of that technology
4. The technical skills required from both within and from outside the community for day-to -day maintenance and repairs.

1. BOREHOLE FITTED WITH HAND/FOOT PUMP

Description

This technology is a narrow hole drilled by a drilling machine down to where groundwater is found in sufficient quantities (maybe as deep as 100 meters plus).It is not the depth of the borehole that determines if a hand/foot pump is suitable, but rather the level to which water reaches within the borehole. Most hand/foot pumps can pump to the depth of 45 to 60 meters. If the water level is lower than this it is unlikely that such a pump is the right solution. A cement superstructure is built to protect both the borehole and the pump from damage and pollution.

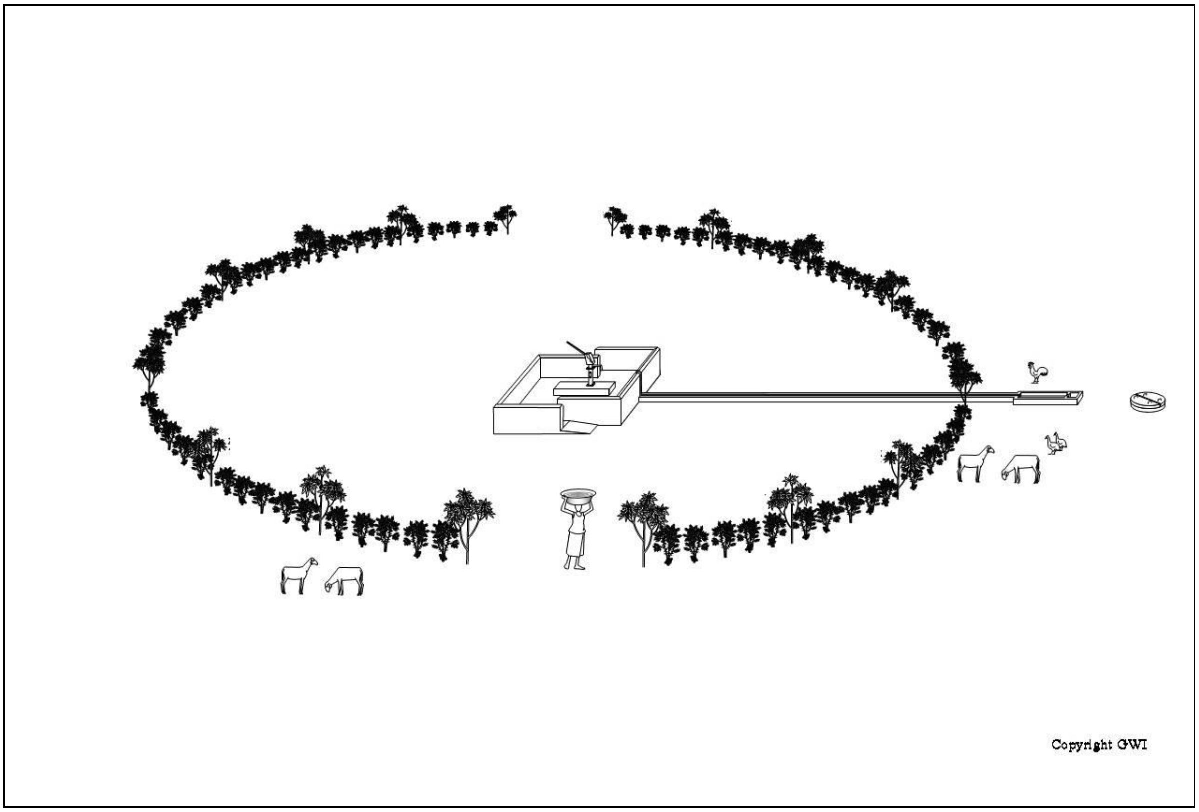

Figure 1: borehole with hand pump

Where to find groundwater

Boreholes that will yield water cannot be drilled at random. Groundwater is not found in all places. A specialist (hydrologist) must find an area below the ground where water is likely to be found. This choice of location must be made after rigorous research but gives no guarantee of drilling being successful.

For example, in sedimentary soils water can be fairly easily located, but in rocks water can only be found where the rock is fractured.

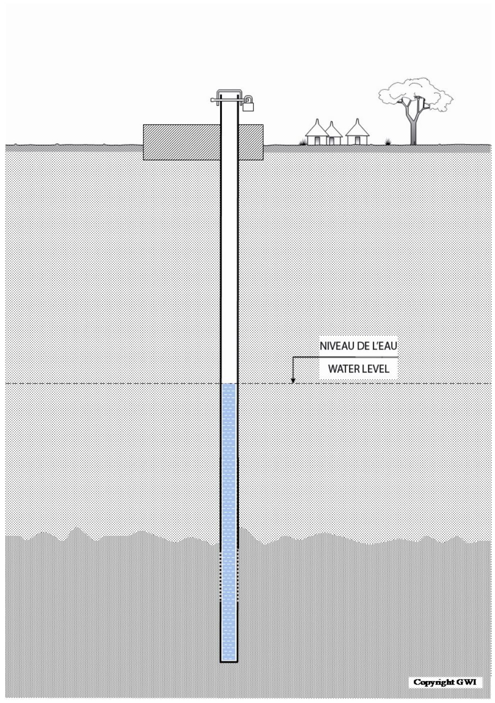

Figure 2: siting in sedimentary soils

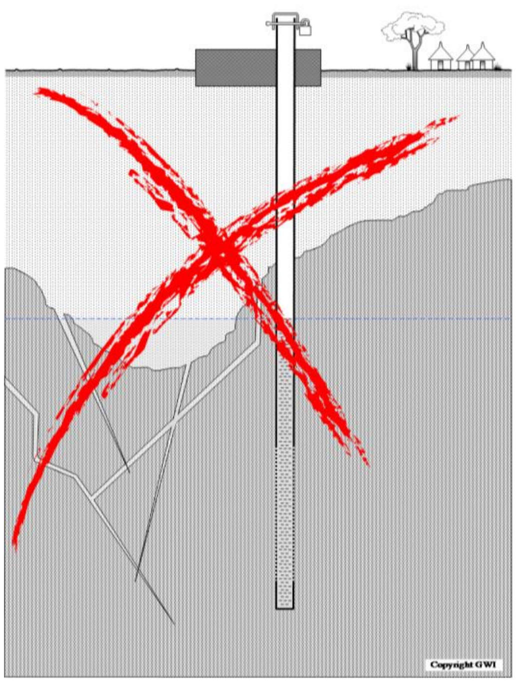

Figure 3: wrong siting in fractured rock

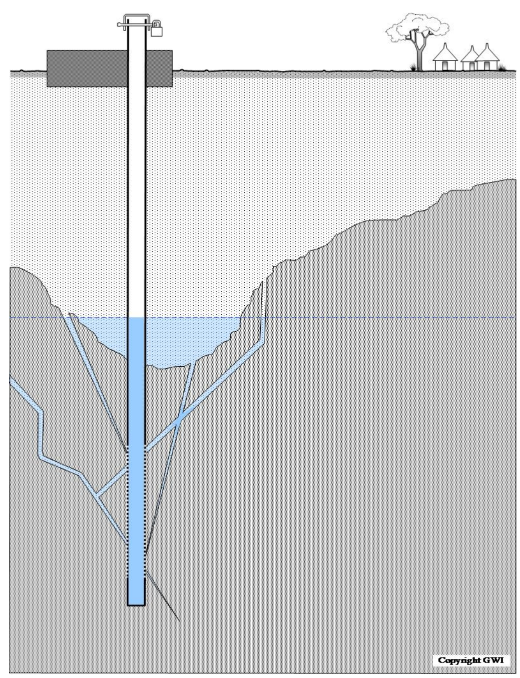

Figure 4: right siting in fractured rock

Once the borehole is drilled, the amount of water it produces (yield) is measured. The yield must be within the minimum national recommended standard (700 litres/hour in Burkina Faso) to make it worth installing a pump. If the yield is too low the borehole cannot be 'developed' and will be sealed over or 'capped'.

Lining the borehole

The borehole is lined with a perforated casing (a pipe with holes that allows water to enter from the sides) at the level of the water influx. The other parts and the lowest part of the casing are not perforated and the bottom is closed with a cap.

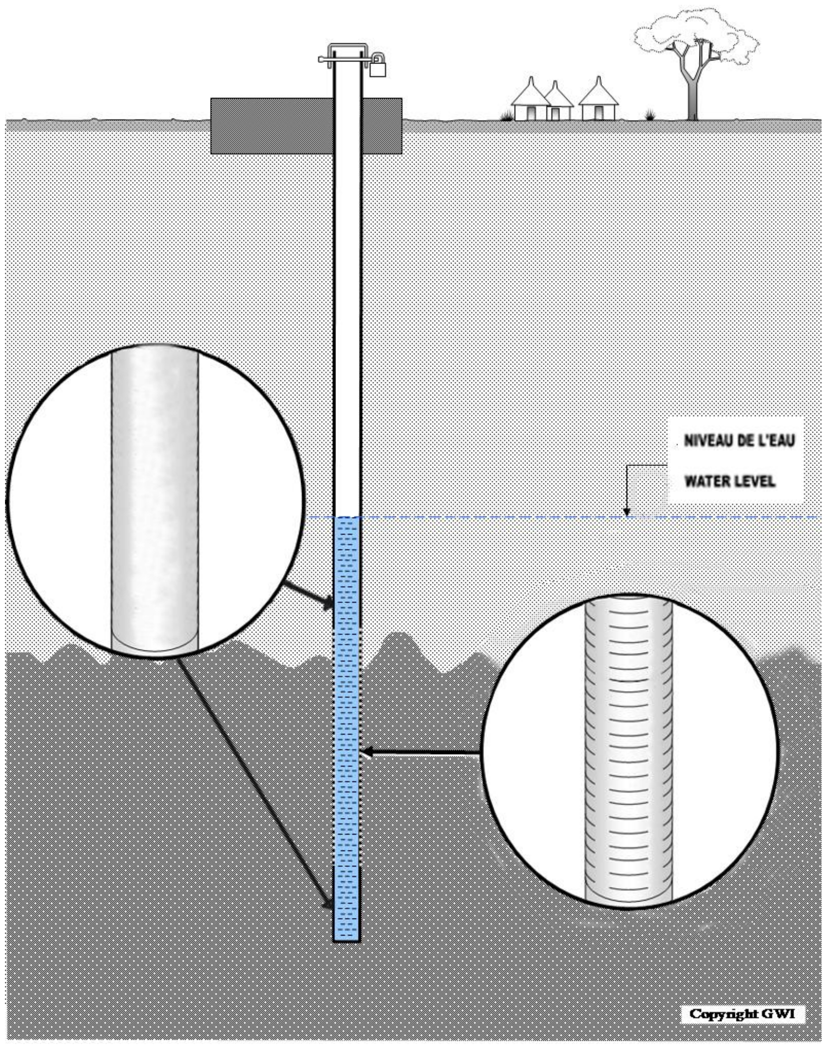

Figure 5: borehole casing and screen

Selecting the hand/foot-pump

A pumping system such as a manual/foot pump, allows users to draw water from the borehole. There are many types of pumps. The most common in West Africa are:

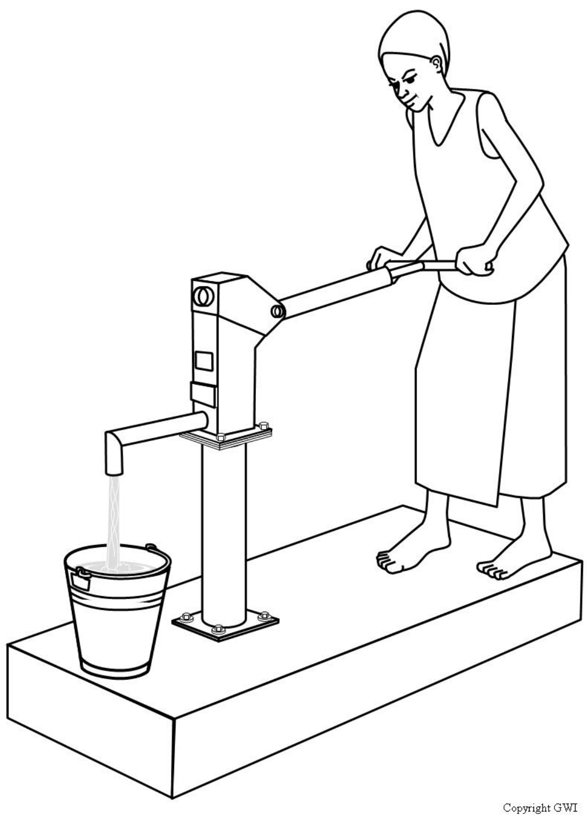

Figure 6: Afridev pump

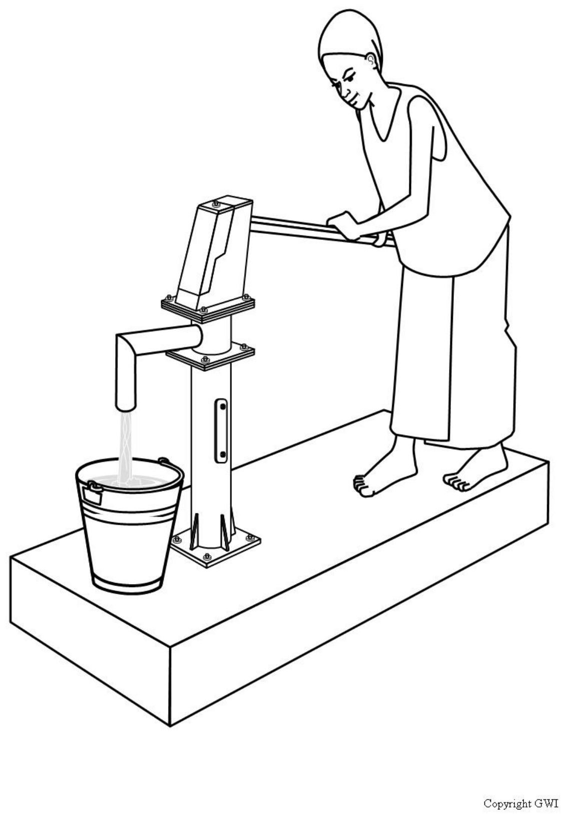

Figure 7: India Mark II pump

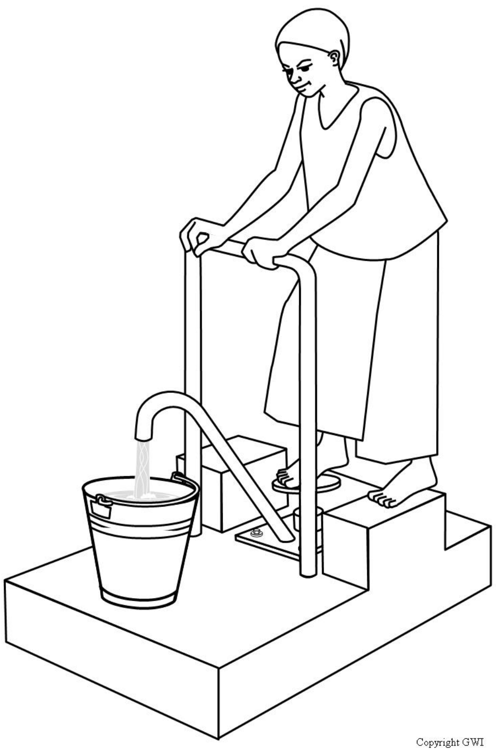

Figure 8: Vergnet pump

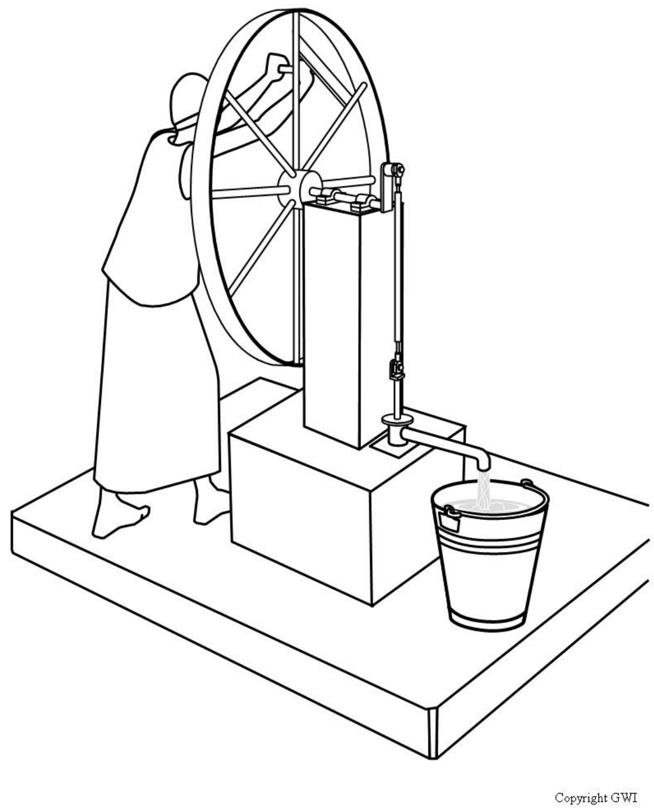

Figure 9: Volonta pump

The Superstructure

Cement structure must be built around the borehole and pump. It will include:

- concrete foundations;
- A concrete apron ;
- A low wall;
- A drain to carry water to the trough and/or the soak-away pit;
- A soak-away pit;
- A cattle drinking trough.

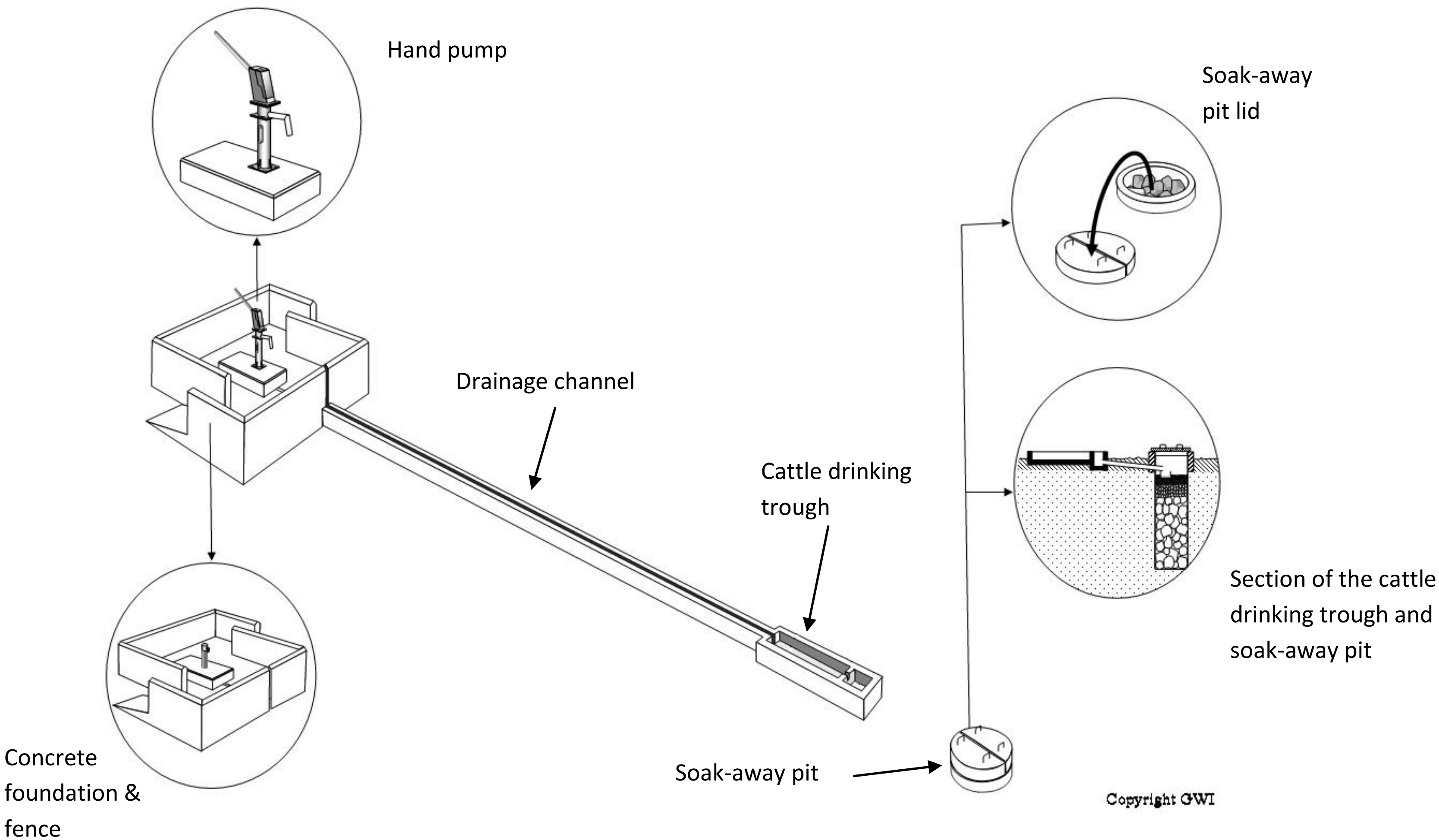

Figure 10: the superstructure design details

Water Service level

Water quality

Groundwater delivered by a borehole is generally of good quality. The water comes principally from rainwater that is filtered through the various layers in the ground. However, though the water may be free of bacterial contamination, it can be unfit for human consumption because of naturally occurring chemical contaminants (i.e. arsenic). Sometimes the water can be polluted by harmful bacteria or harmful chemicals as a result to human activity. Laboratory tests for water quality (both chemical and bacteriological) must be done to see if the water is fit to be used as drinking water for humans.

Water Flow

The yield is the amount of water that can be taken from the borehole over a given period of time. It varies depending on the nature and the capacity of the groundwater that feeds the borehole. The maximum yield of the borehole will be determined using the data collected during the pumping trial once the borehole has been fully developed.

However, the capacity of the borehole to deliver enough water will also depend on the capacity of the pump. For example, hand-pumps are capable of pumping about 5 -10m3 maximum per day (25 - 50 barrels of 200 litres per day).

Level of service

With a hand/foot pump, water drawing is time-consuming. Water-point users need to pump one at a time.

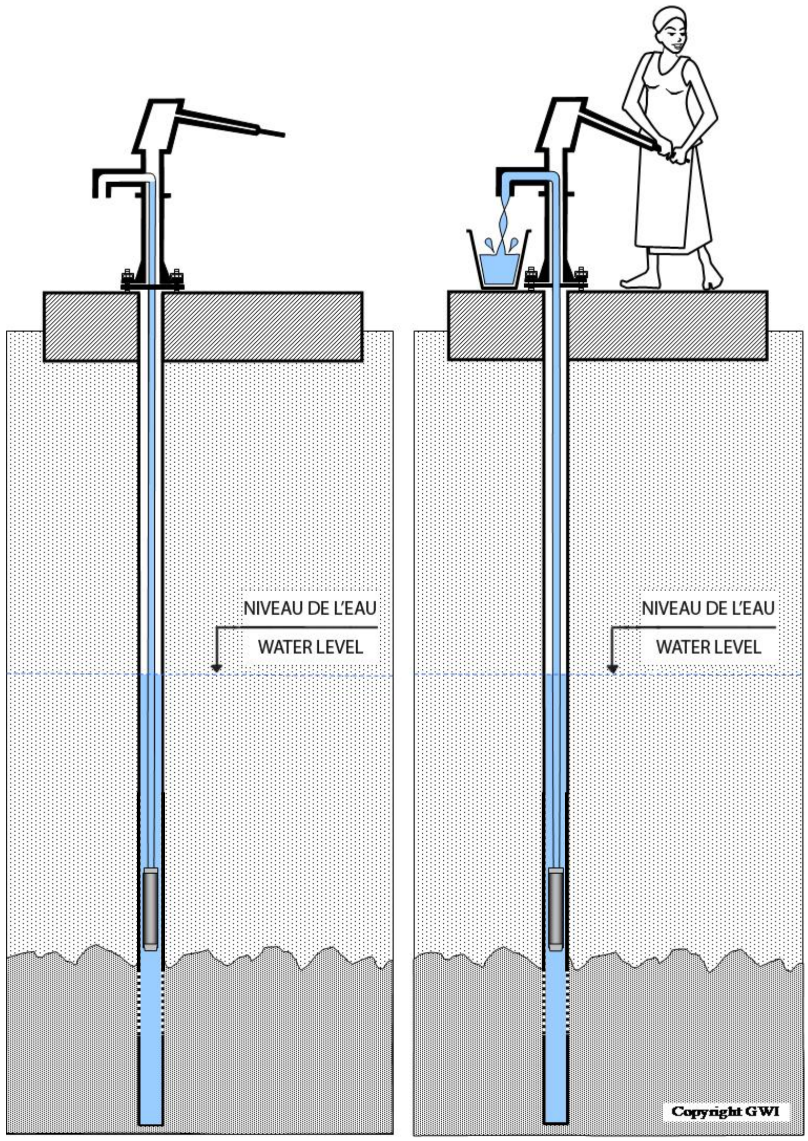

Figure 11: drawing water from a borehole with a hand pump

These pumps are designed for domestic water (drinking, cooking, washing, and personal hygiene). Occasionally a few animals or small vegetable gardens may also be watered.

Costs

Boreholes with hand pumps are expensive not just to build but also to look after once they are in use. We expect such a water supply to last for 15 years before it needs major rehabilitation. This 15 year cost responsibility belongs to the community.

There are three types of main costs of the borehole and hand/foot pump supply:

What?	How much?	When?	Who funds?
Borehole and pump capital expenditure (Capital Expenditure: CapEx).	About 7,0000,000 CFA ($ 14,000 US) in Burkina Faso. Varies depending on the depth.	One off at start	External donor and community cost share.
Ongoing operation and maintenance expenditure including small repairs (Operation and Maintenance: Expenditure, OpManEx).	About 140,000 CFA ($280 US) / year in Burkina Faso for an India Mark II pump. Varies depending on the type of pump.	Ongoing from day one.	Community.
Major repairs and spares replacement (Capital maintenance expenditure: CapManEx).		From the 5th to 7th year after the new pump was installed	Community, commune, and other external supports.

Operation and Maintenance

A well maintained pump will still need to have key parts replaced as they wear. This replacement cost is built into the “ongoing operation and maintenance expenditure” above.

Major rehabilitation of a borehole can be very expensive and may largely cost more than most communities would be able to pay for without external support.

The people skills required

Good organisation is necessary for the management of the water-point: Key groups are the Water Users’ Association (WUA), the Water-point Management Committee (WPMC), etc.

Insuring proper operation and maintenance of the borehole and pump requires the following tasks to be carried out:

From within the Community:

- Fund raising according to a specific budget (a transparent and accountable system);
- Preventative maintenance of a) the pump - day to day maintenance carried out (village pump care takers) and b) the superstructure (village mason)

- Organisation of water point users and information.
- Monitoring.

From outside the community:

- Regular pump maintenance / spare replacement / repairs (area mechanic);
- Supply of spare parts;
- Major repairs on superstructure;
- Technical assistance to monitor, troubleshoot, and train.

In conclusion:

It is important to make sure that the community has understood the key aspects of this technology. After you have presented the factual information above, the following questions can help guide the conversation with the community and will allow specific questions, doubts, and points of clarification to be discussed.

Q1.	:	Is water from a borehole with a hand/foot pump always clean?
Q2	:	If the pump breaks, can we draw water out of the borehole with a bucket?
Q3	:	How many people at a time can draw water?
Q4	:	What are the main elements of a borehole?
Q5	:	What is the community responsibility to ensure operation and maintenance of a borehole?
Q6.	:	How much money does the community need to collect each year to maintain a borehole?
Q7	:	How many households would be using this pump? So how much would each household have to pay each year? And how much each month?
Q8	:	What resources would you need from outside your village to keep this pump alive?
Q9	:	What advantages and disadvantages do you see to a borehole with hand/foot pump for your community?

2. BOREHOLE AND GRAVITY DISTRIBUTION WITH SUBMERSIBLE PUMP

Description

This supply consists of a source of water (generally a borehole), an electric submersible pump powered by solar energy, a diesel generator or electric mains a water tower and a gravity distribution network and multiple tap-stands. This relies on a high yielding borehole, delivering a minimum of 5m3 per hour.

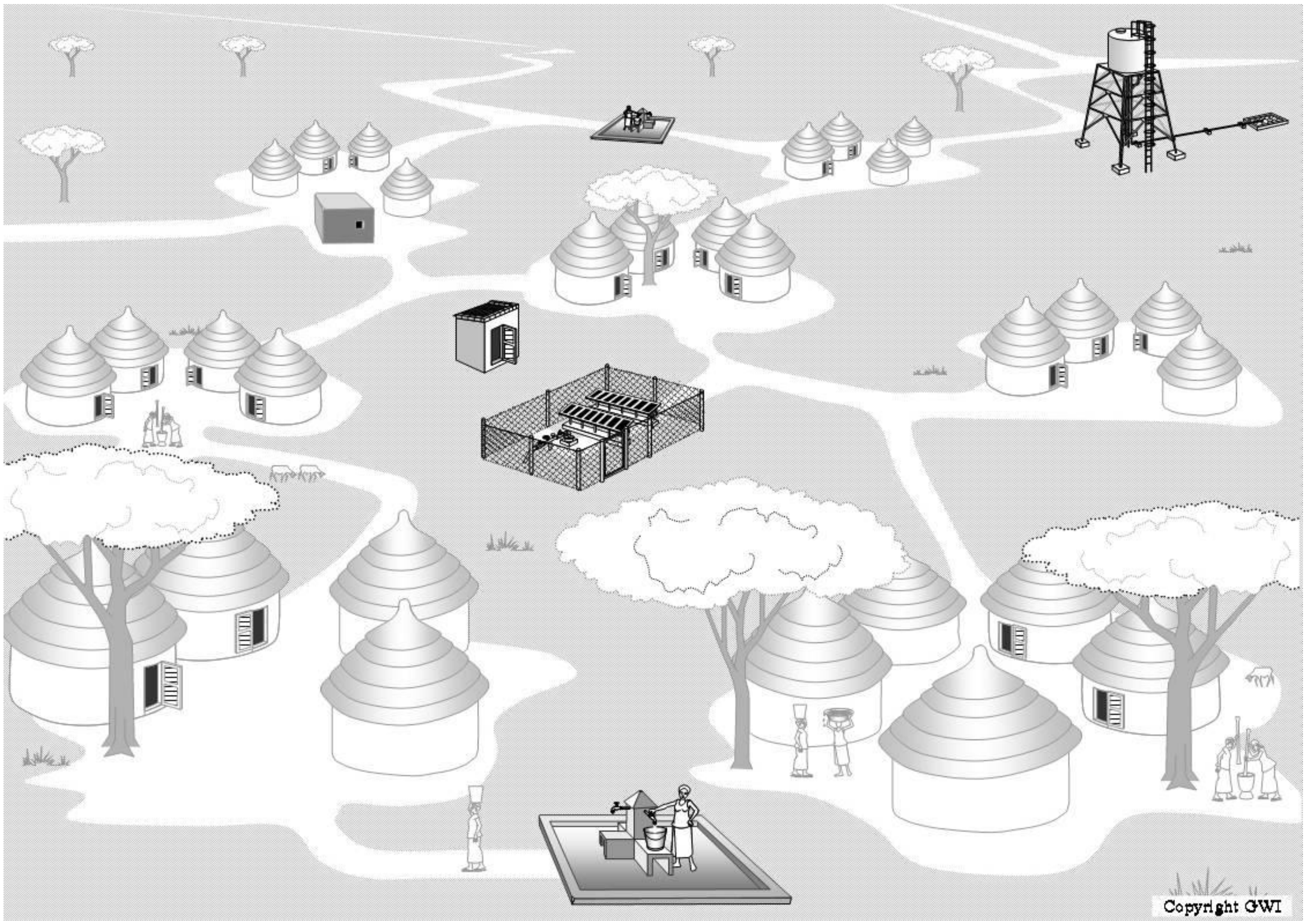

Figure 12: a solar powered village water supply system

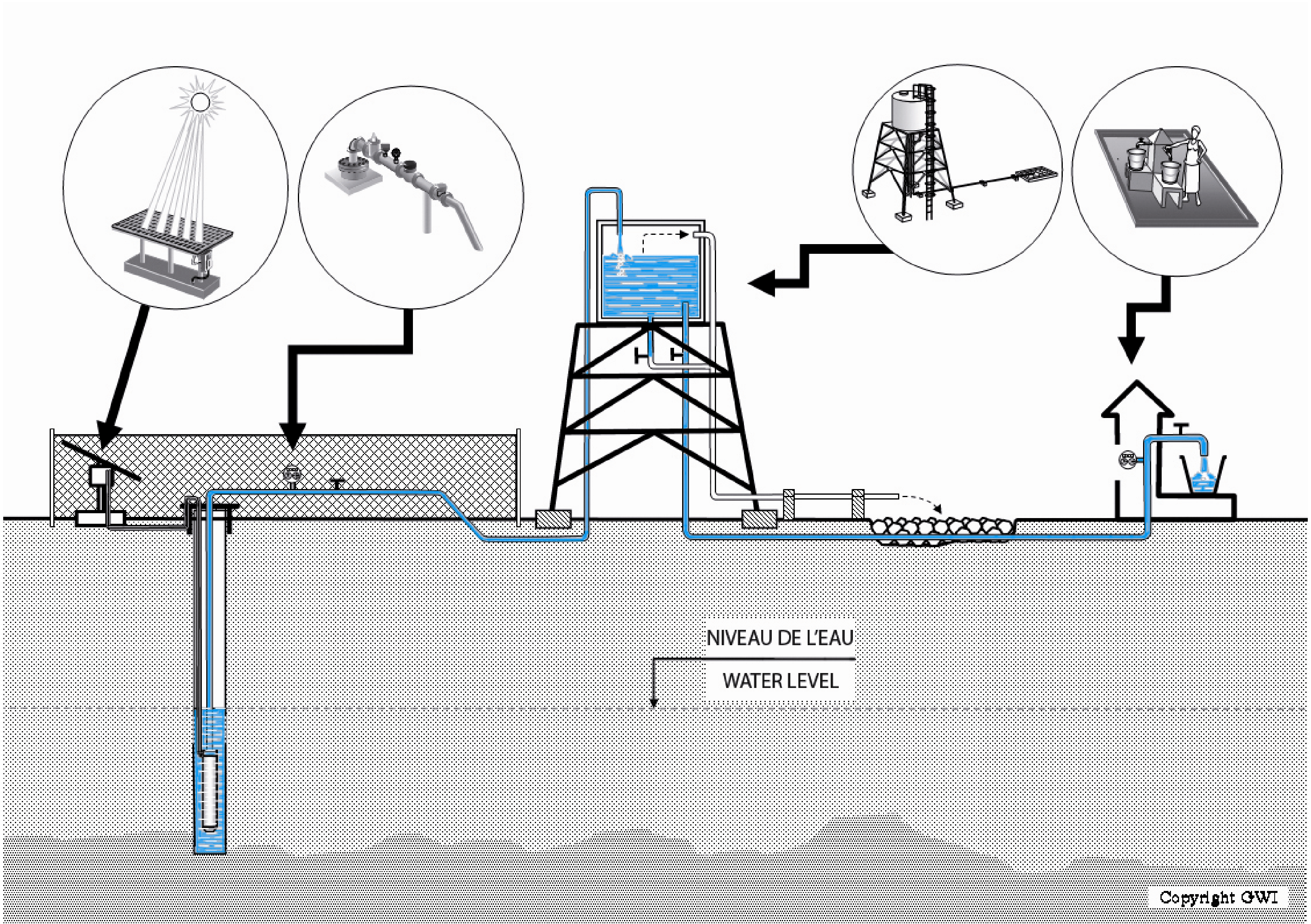

Figure 13: the technical components of the solar powered village system

Where to find groundwater

Boreholes that will yield water cannot be drilled at random. Groundwater is not found in all places. A specialist (hydrologist) must find an area below the ground where water is likely to be found. This choice of location must be made after rigorous research, but gives no guarantee of drilling being successful.

For example, in sedimentary soils water can be fairly easily located, but in rocks water can only be found where the rock is fractured.

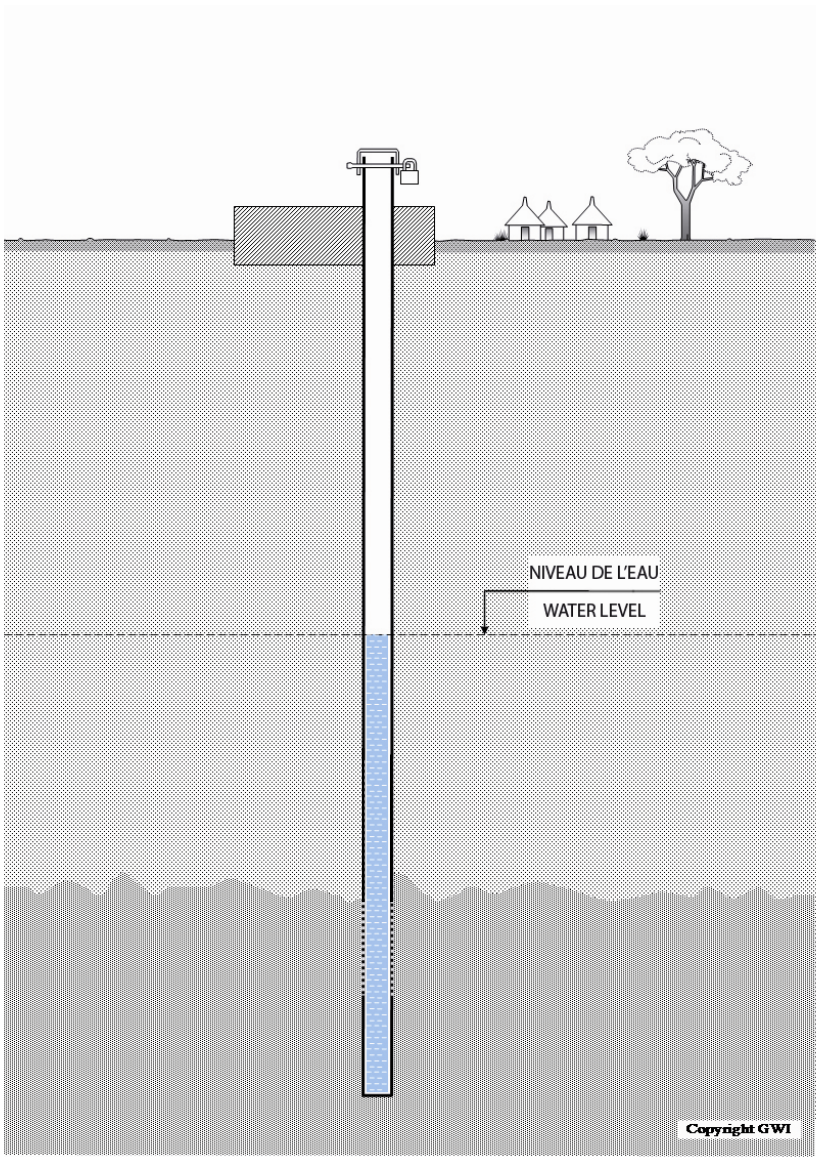

Figure 14: siting in sedimentary soils

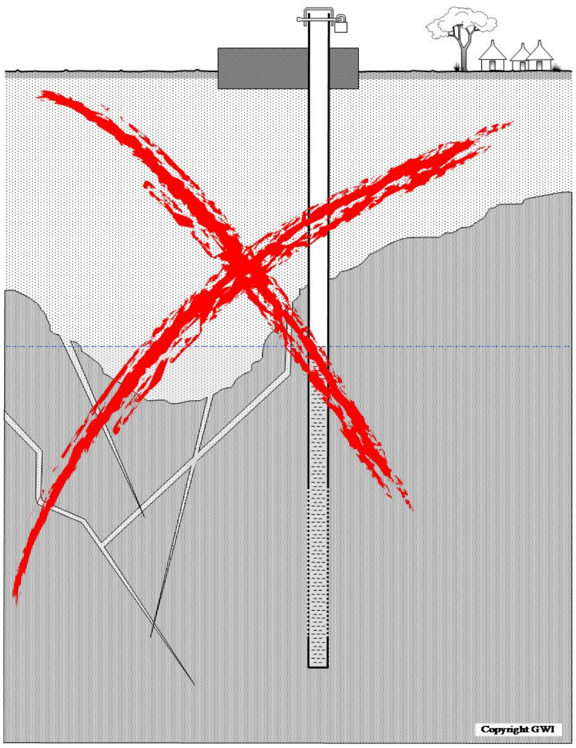

Figure 15: wrong siting in fractured rock

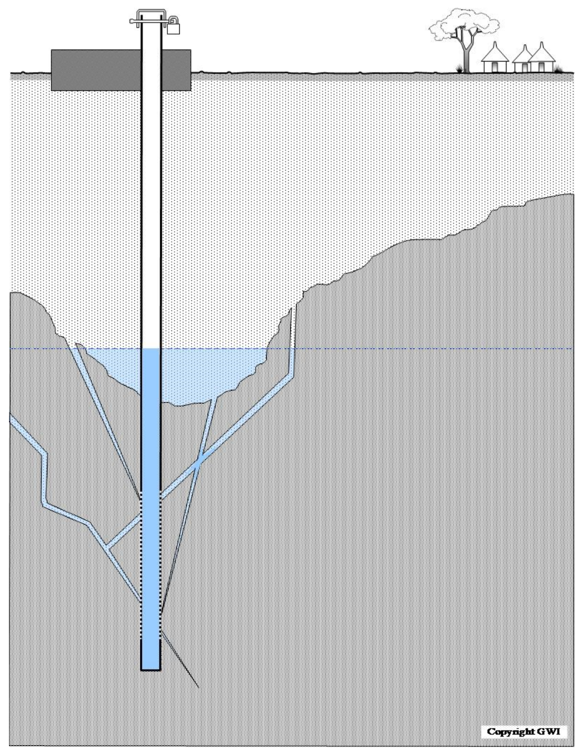

Figure 16: right siting in fractured rock

Once the borehole is drilled, the amount of water it produces (yield) is measured. The yield must be at least 5m3/hour to justify installing an electric pump and such an expensive infrastructure. Should a borehole be drilled that yields too little water for an electric pump, but enough water to meet the minimum national recommended standard (generally 1m3 / h or sometimes less depending on the country or case related to the hydrogeological conditions encountered), a hand/foot pump can be installed. If the yield is too low for either an electric or a hand/foot pump, the borehole cannot be ‘developed’ and will be sealed over or ‘capped’.

Lining the borehole

The borehole is lined with a perforated casing (a pipe with holes that allows water to enter from the sides) at the level of the water influx. The top part and the lowest part of the casing are not perforated and the bottom is closed with a cap.

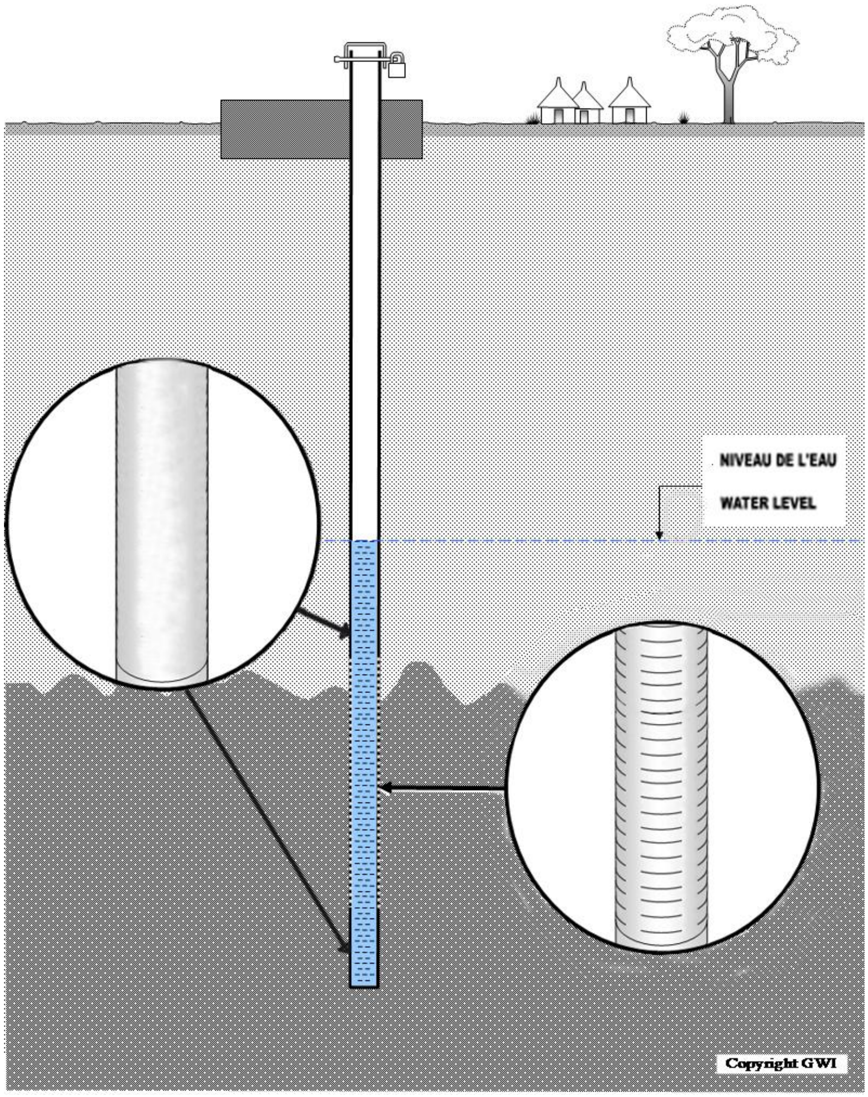

Figure 17: borehole casing and screen

The electric submersible pump

The submersible pump is placed in the water yielding part of the borehole and pumps water up to fill the water tower from where it is distributed by gravity to the water points along the distribution network.

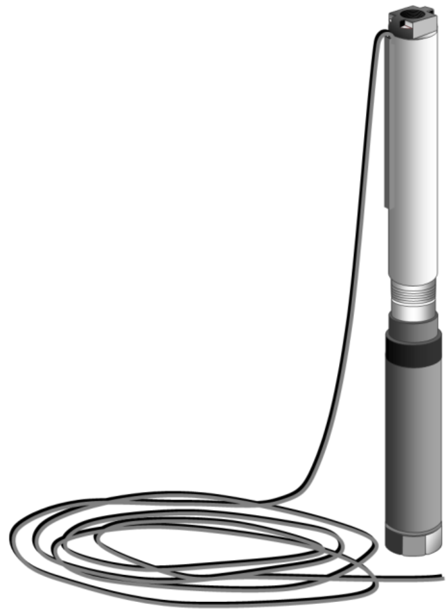

Figure 18: electric submersible pump

Source of energy

A source of energy is necessary to provide electricity to the pump. It can be powered by solar energy, a generator (diesel) or electric mains. The more powerful the pump, the more energy it requires.

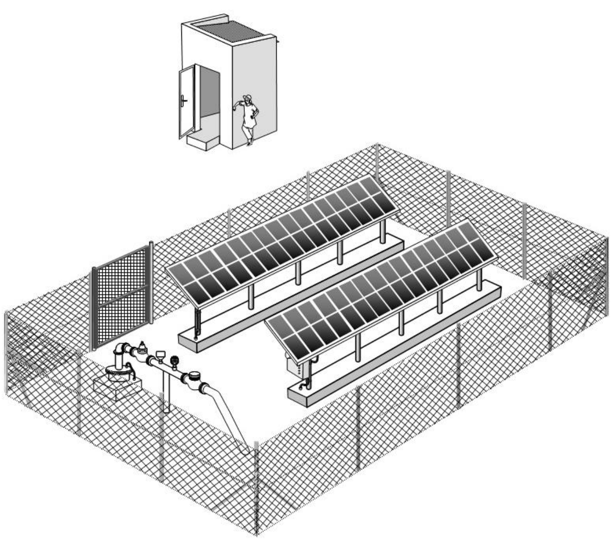

Figure 19: solar power supply to a submersible pump

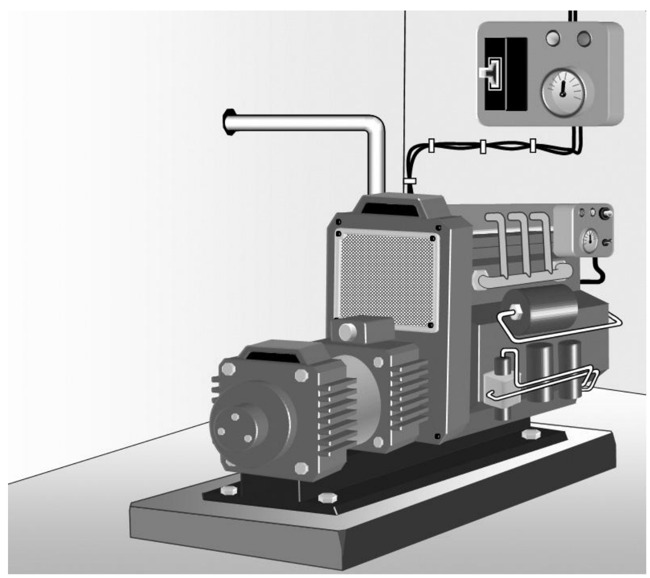

Figure 20: diesel power supply to a submersible pump

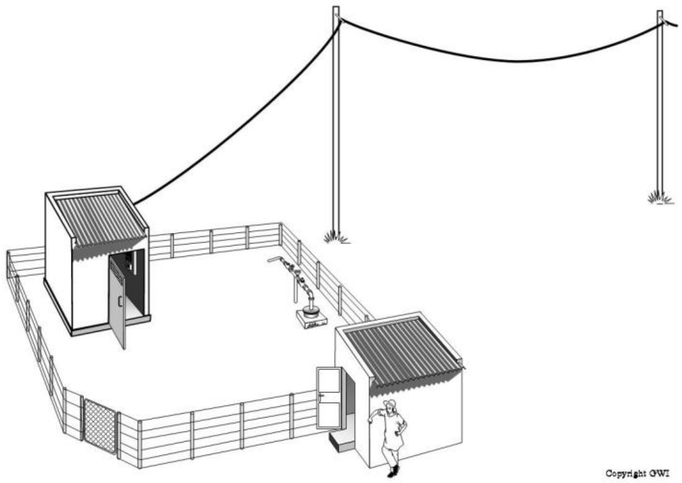

Figure 21: electric mains power to a submersible pump

The Water tower

When the system is designed, the location of the water tower will ideally be placed nearby on raised ground. Where the area is flat, a decision has to be taken whether to raise the tank on a stand or place the tank at a distance on higher grounds. It allows storage of water and gravity distribution to tap-stands.

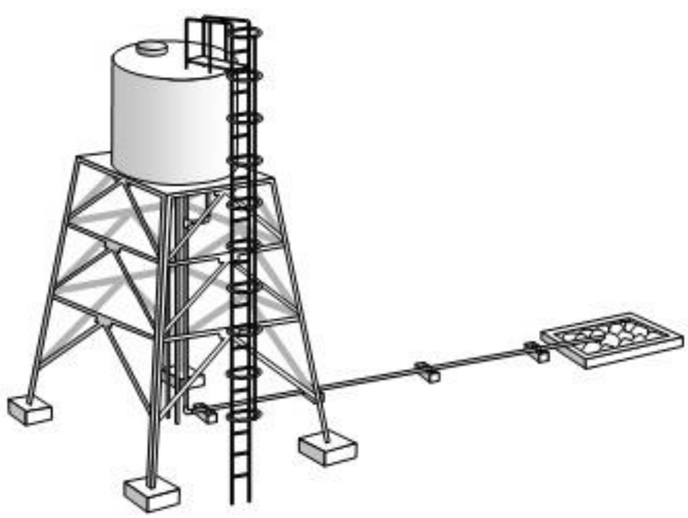

Figure 22: a water tower with its overflow and drainage system

Water supply and distribution network

The pipes are buried in a 80 cm trench running from the borehole to the water tower and then from the water tower to the water points.

Tap-stands

Tap-stands are installed in various points according to the engineering design, which has taken into account equitable distribution. There are several design options, the best of which make water fetching easier. The most common are illustrated below.

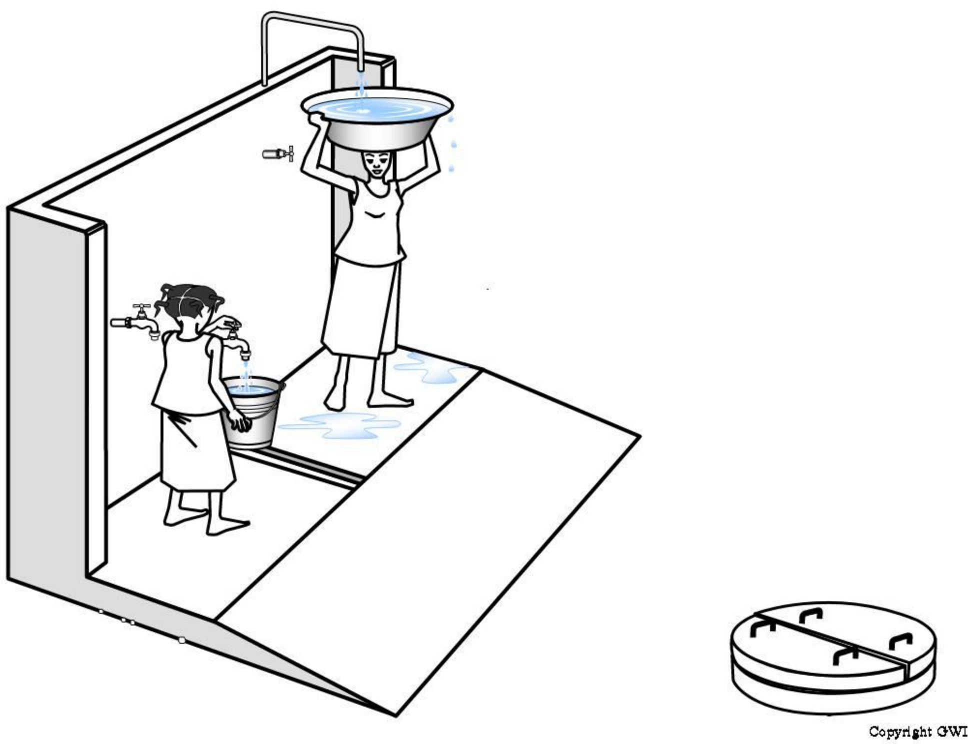

Figure 23: multiple levels taps make water fetching easier

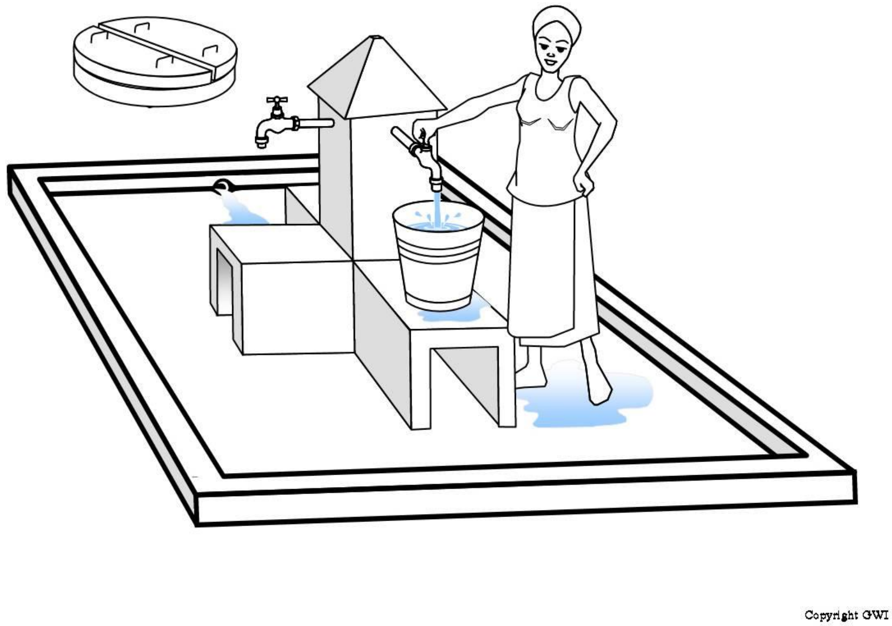

Figure 24: taps with raised bucket stands

Water Service level

Water quality

Groundwater delivered by a borehole is generally of good quality. The water comes principally from rainwater that is filtered through the various layers in the ground. However, though the water may be free of bacterial contamination, it can be unfit for human consumption because of naturally occurring chemical contaminants (i.e. arsenic). Sometimes the water can be polluted by harmful bacteria or harmful chemicals as a result to human activity. Laboratory tests for water quality (both chemical and bacteriological) must be done to see if the water is fit to be used as drinking water for humans.

Water Flow

For a borehole, the yield is the amount of water that can be taken from the borehole over a given period of time. It varies depending on the nature and the capacity of the groundwater that feeds the borehole. The maximum yield of the borehole will be determined during the pumping trial once the borehole has been fully developed.

However, the real operating yield will depend on the capacity of the pump used.

Level of service

Having several water-points dispersed in the village cuts down user water fetching time.

Costs

A borehole and gravity distribution system with a submersible pump is very expensive, not just to install but also to look after once it is in use. We expect such a water supply to last for 25 years before it needs major rehabilitation. This 25 year cost responsibility belongs to the community.

There are three types of main costs of this system:

What?	How much?	When?	Who funds?
Entire system capital expenditure. (Capital Expenditure: CapEx).	Around 40,000,000 CFA ($80,000 US) to 60,000,000 f CFA ($ 120,000 US) in Burkina Faso for small size systems.	One off at start.	External donor and community cost share.
Ongoing operation and maintenance expenditure including small repairs. (Operation and Maintenance: Expenditure. OpManEx).	Around 1,000,000 CFA ($2,000 US) to 1,500,000 CFA ($3,000 US) / year in Burkina Faso for a system using solar energy.	Ongoing from day one.	Community.
Major repairs, major parts and spares replacement. (Capital maintenance expenditure: CapManEx).		From the 5th or 7th year depending on the source of energy used.	Community, commune, and other external supports.

Capital investment

The cost for the design and construction of this system varies depending on the depth of the borehole, the type of energy used (solar, diesel, electric mains), the size of the distribution network, the water storage and the number of water points. An indication of when specific parts of the system may need replacing follows.

Item	Expected lifespan
Submersible pump	7 years
Inverter (case of solar system with a pump using AC)	10 years
Standpipes	20 years
Diesel engine or Solar panels Electric mains (electric board)	5-7 years 25 years 30 years
Water tower	25 years
Water supply and distribution network	25 years
Borehole	30 years

Operation and Maintenance

Operation costs include the water point management (watchman, water point management team, other).

This system is complex and needs looking after regularly. The following operation and maintenance is needed:

From within the community:

- A watchman for security of the overall system;
- Solar panel and borehole enclosure: washing the solar panels daily with water, checking security of the gate and fence…
- Turning the pump on and off and reporting any faults
- Overall inspection: chamber covers in place, leaks on pipeline, main valves and taps on tap-stands…
- Minor repairs on structure: village mason ;
- Water fee collection and safe keeping;
- Etc.

From outside the community:

- Repairs on water supply and distribution network: plumber;
- Major repairs - on concrete structure, mason – on diesel generator, mechanic – on electrical system, specialist electrician, etc.
- Repaint water tower (if made of metal) with protective anti-rust paint;

- Replacement of worn taps;
- Etc.

Major rehabilitation of this system can be very expensive and may largely cost more than most communities would be able to pay for without external support.

The people skills required

Good organisation is necessary for the management of the system. Key groups are the Water Users' Association (WUA), the Water-point Management Committee (WPMC), sub-contracted private operators, etc.

Water-point management includes raising funds for servicing and maintenance, organizing water-point users and accountability to community, etc.

In conclusion:

It is important to make sure that the community has understood the key aspects of this technology. After you have presented the factual information above, the following questions can help guide the conversation with the community and will allow specific questions, doubts, and points of clarification to be discussed.

Q1.	:	Is water from a borehole always clean?
Q2	:	If the system breaks, can we draw water out of the borehole with a bucket?
Q3	:	How many people at a time can draw water?
Q4	:	What are the main elements of the system?
Q5	:	What is the community responsibility to ensure operation and maintenance of the system?
Q6.	:	How much money does the community need to collect each year to maintain the system?
Q7	:	How many households would be using this system? So how much would each household have to pay each year? And how much each month?
Q8	:	What resources would you need from outside your village to keep this system alive?
Q9	:	What advantages and disadvantages do you see to this type of system for your community?

3. IMPROVED HAND-DUG WELL WITH PULLEYS

Description

This is a hand-dug well fully lined with concrete, with a frame to mount several pulleys, a superstructure to protect the well and a lid to cover the well when it is not in use.

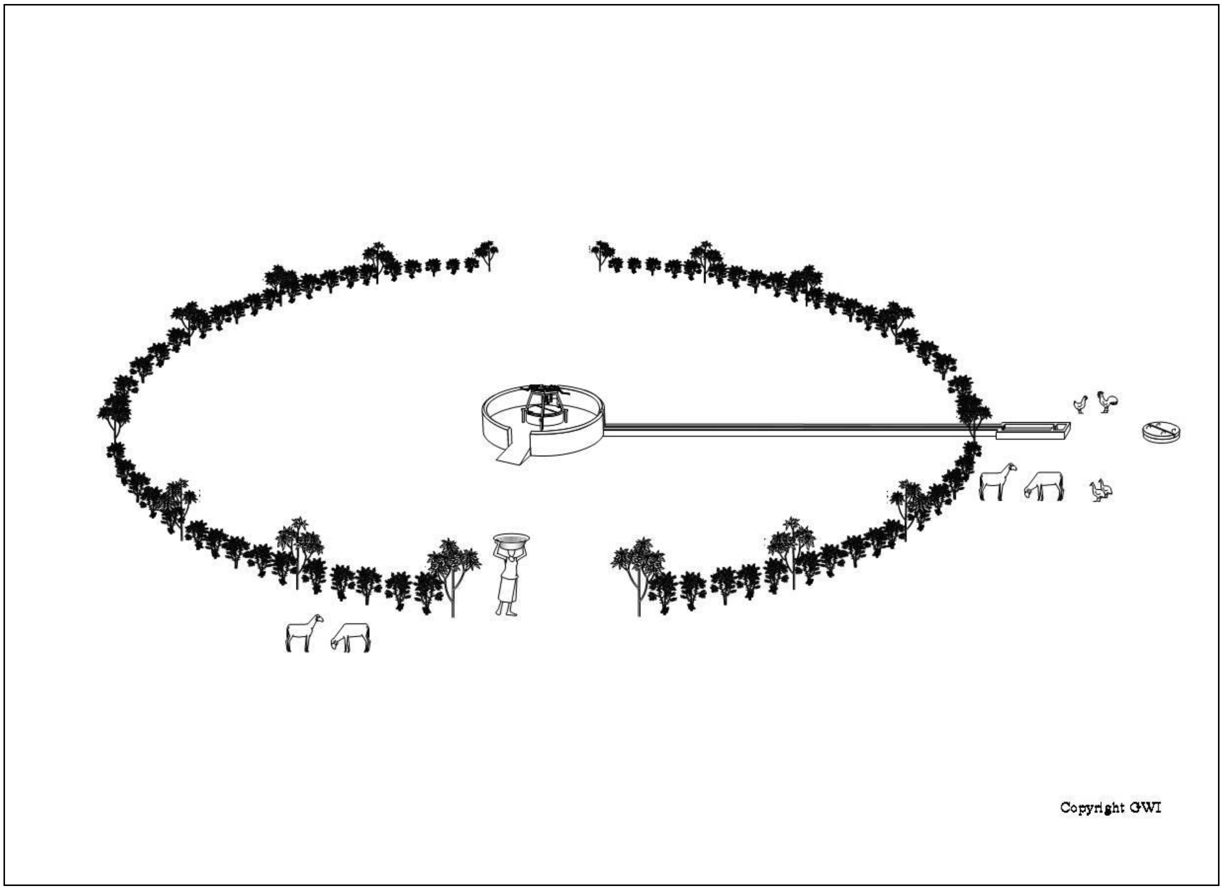

Figure 25: a hand dug well with windlasses

Lined well

A large diameter well is dug into the aquifer. It is lined to its full depth with a reinforced concrete lining.

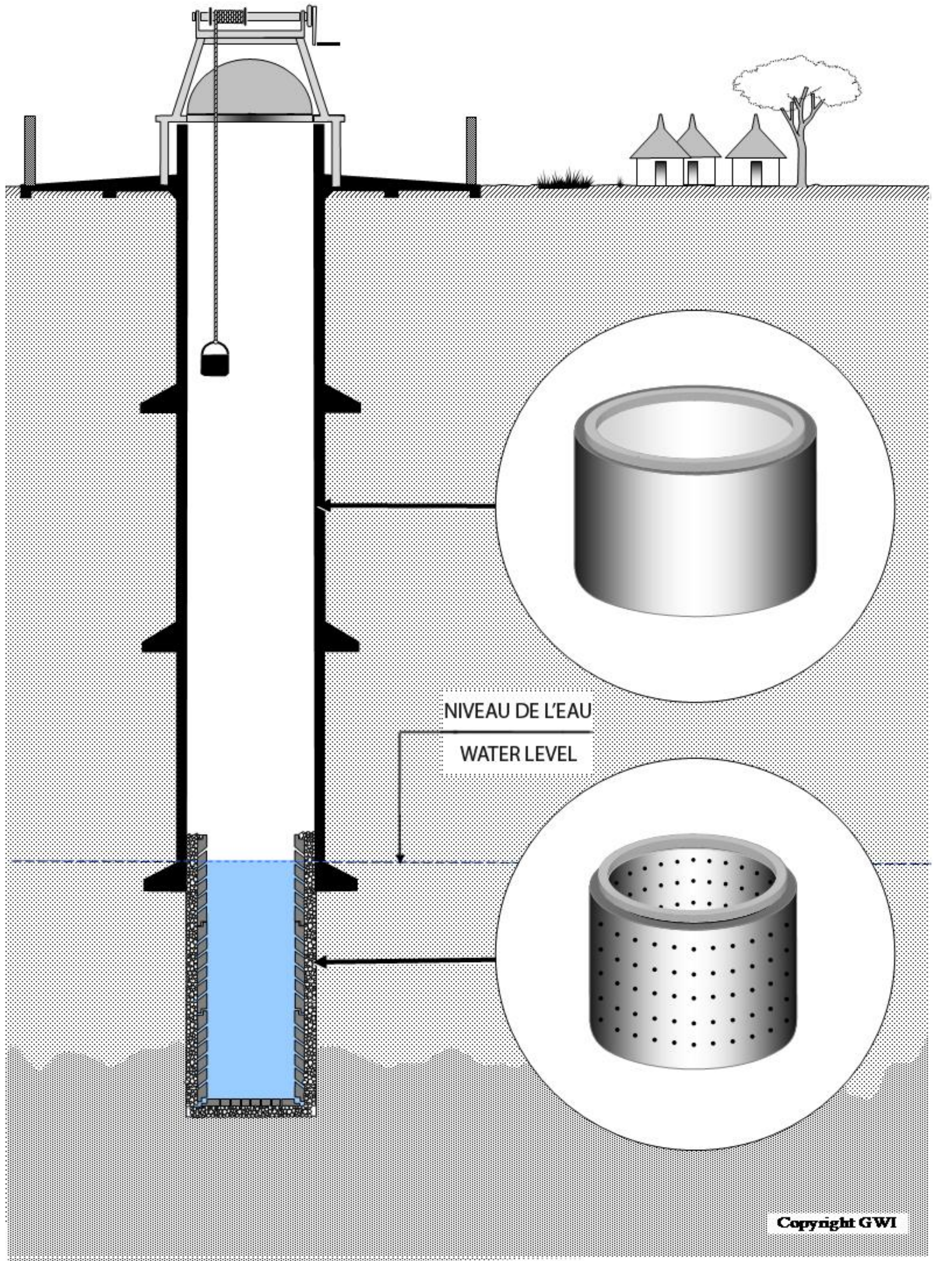

Figure 26: how water gets into the well

Two types of lining are used. In a 2-meter hand-dug well, 1.80 m diameter lining rings are used to line the hole above the water level and 1.40 m diameter perforated rings are used to line below the water level.

To hold the well lining steady, it must be anchored properly above ground and at several points inside the well shaft (usually every 10 meters).

The Superstructure

The well must be protected with:

- concrete foundations;
- a concrete apron and well head with a cover ;
- the frame on which the pulleys/windlass are mounted;
- a low wall/fence;
- a drain to carry water to the livestock trough;
- a soak-away pit.

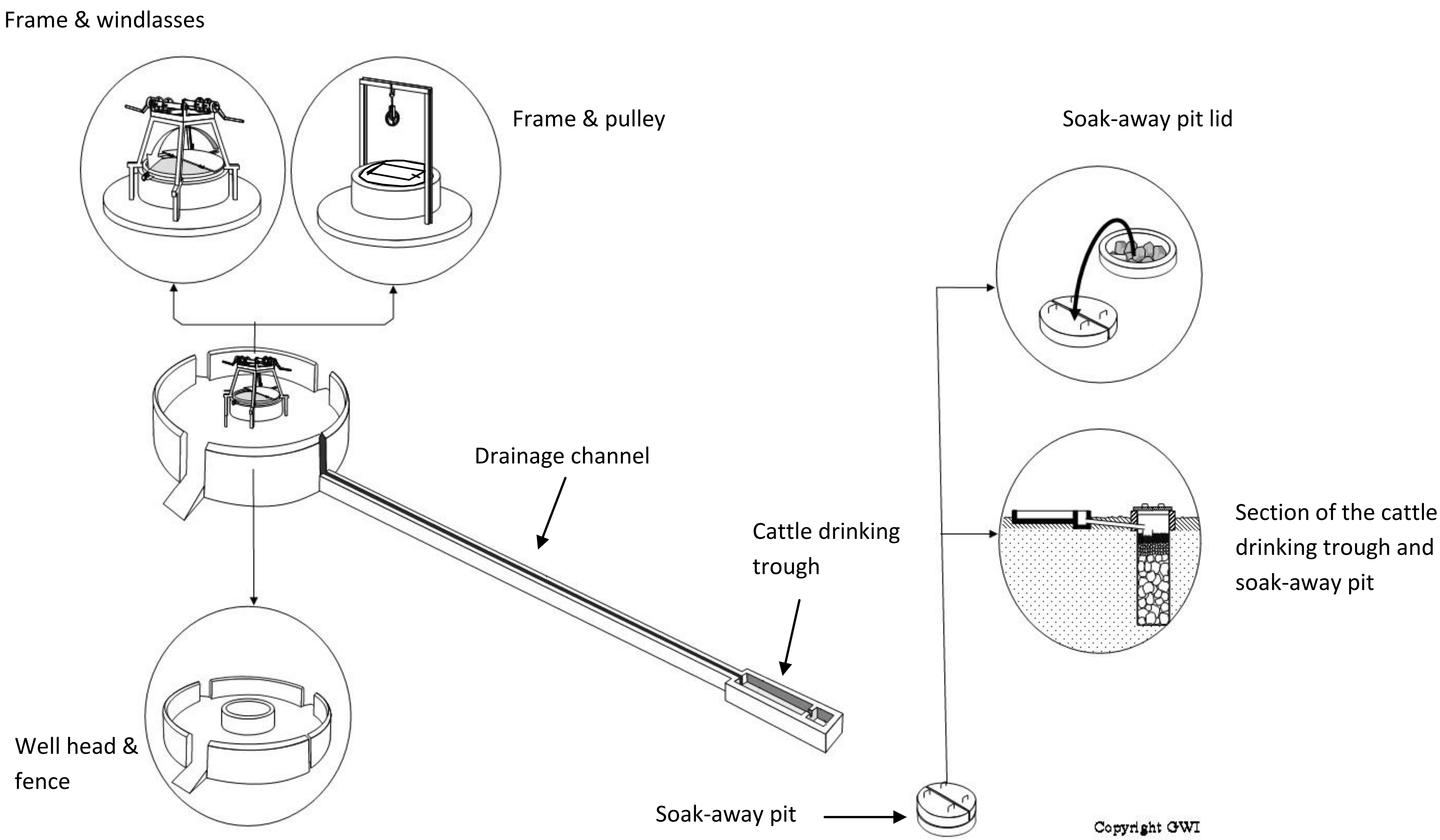

Figure 27: the superstructure design details

Getting water out of the well

A series of pulleys or windlasses mounted on a frame allow several people to fetch water at the same time.

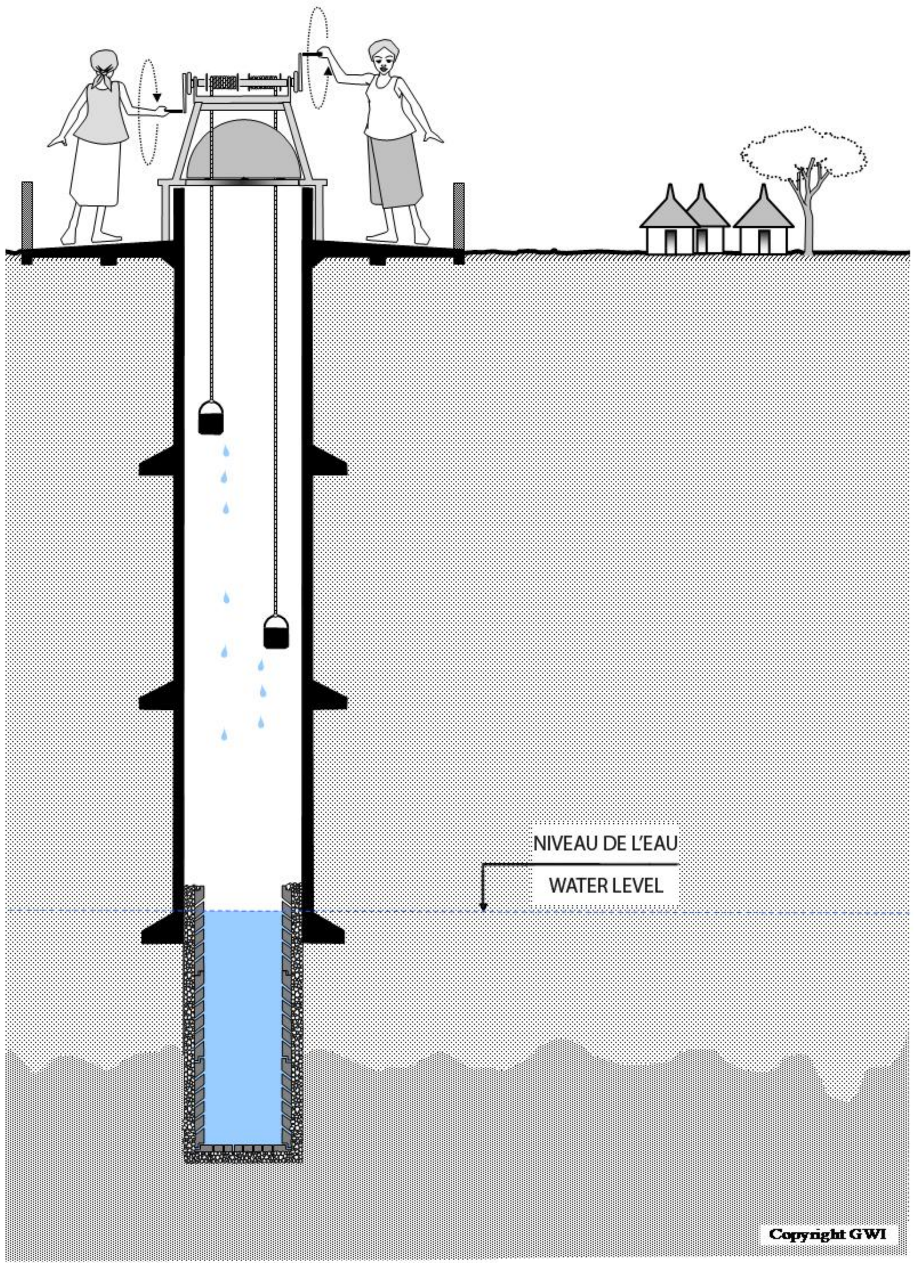

Figure 28: water drawing with windlasses

Water Service level

Water quality

Groundwater from a hand-dug well is generally of good quality. The water comes from rainwater that is filtered through the various layers in the ground. However, though the water may be free of bacterial contamination, it can be unfit for human consumption because of naturally occurring chemical contaminants (i.e. arsenic). Sometimes the water can be polluted by harmful bacteria or harmful chemicals as a result to human activity. Laboratory tests for water quality (both chemical and bacteriological) must be done to see if the water is fit to be used as drinking water for humans.

It is important to note that hand-dug wells can easily be polluted: by the rope and buckets that are used to lift the water out of well, dust and any other material that may fall into the well.

Water Flow

The yield is the amount of water that can be taken from the well over a given period of time. It varies depending on the nature and the capacity of the groundwater that feeds it. The daily capacity of the well is assessed when it is dug and varies from one well to another.

Level of service

How much water can be abstracted from the well relies both on the rate of recharge and the speed at which people can physically draw the water. This water can be used for any purpose (drinking, cooking, washing, animal watering and small vegetable gardens) but it should sometimes be treated if it is to be used for drinking purposes. However, due to the limited rate of water recharge, some types of uses will be given priority.

Costs

Improved hand-dug wells are expensive to build but are low cost once they are in use. We expect such a water supply to last for 20 years before it needs major rehabilitation. This cost responsibility belongs to the community.

There are three types of main costs:

What?	How much?	When?	Who funds?
Lined hand-dug well with pulleys or windlasses capital expenditure. (Capital Expenditure: CapEx).	About 7,500,000 CFA ($ 15,000) in Burkina Faso for a30 meters depth well	One off at start	External donor and community cost share
Ongoing operation and maintenance expenditure including small repairs. (Operation and Maintenance: Expenditure, OpManEx).	Reliable data not available. The expenditure must take account a certain actions*	Ongoing from day one.	Community,
Major repairs and spares replacement. (Capital maintenance expenditure: CapManEx).		Normally there should be no major repairs before 5 years if the structure is properly built.	Community, commune, and other external supports

**: The actions are: replacing rope, pulleys (or windlasses), maintenance and repairs of the water lifting frame, minor repairs on the concrete rings or on the superstructure, periodic de-watering and disinfection of the well, major repairs on the superstructure, the concrete rings (porous and not porous), gravel packing, periodic technical visits of the well.*

Operation and Maintenance

A well maintained improved hand-dug well with pulleys or windlasses will need to have key parts replaced as they wear. This replacement cost is built into the "ongoing operation and maintenance expenditure" above.

Major rehabilitation can be expensive and may cost more than most communities would be able to pay for without external support.

The people skills required

Good organisation is necessary for the management of the well: Key groups are the Water Users' Association (WUA), the Water-point Management Committee (WPMC), etc.

Insuring proper operation and maintenance of the well requires the following tasks to be carried out:

From within the Community:

- Fund raising according to a specific budget (a transparent and accountable system);
- Preventative maintenance of the water lifting equipment
- Small masonry repairs
- Organisation of water point users and information.
- Monitoring.

From outside the community:

- Periodic de-watering and sanitization of the well
- Regular pump maintenance / spare replacement / repairs (area mechanic);
- Supply of spare parts;
- Major repairs on superstructure, concrete lining and gravel packing;
- Deepening the well in case of a marked drop in the water table;
- Technical assistance to monitor, troubleshoot, and train.

In conclusion:

It is important to make sure that the community has understood the key aspects of this technology. After you have presented the factual information above, the following questions can help guide the conversation with the community and will allow specific questions, doubts, and points of clarification to be discussed.

Q1.	:	Is water from a well always clean?
Q2	:	If the pulleys/windlasses break down, can we draw water out of the well with a bucket?
Q3	:	How many people at a time can draw water?
Q4	:	What are the main elements of an improved well?
Q5	:	What is the community responsibility to ensure operation and maintenance of an improved well?

Q6.	:	How much money does the community need to collect each year to maintain an improved well?
Q7	:	How many households would be using this improved well? So how much would each household have to pay each year? And how much each month?
Q8	:	What resources would you need from outside your village to keep this improved well alive?
Q9	:	What advantages and disadvantages do you see to an improved well for your community?

4. IMPROVED HAND-DUG WELL WITH HAND/FOOT PUMP

Description

This is a hand-dug well fully lined with concrete, equipped with a hand/foot pump. Most hand/foot pumps can pump to the depth of 45 to 60 meters. If the water level is lower than this it is unlikely that such a pump is the right solution. A cement superstructure is built to protect both the well and the pump from damage and pollution.

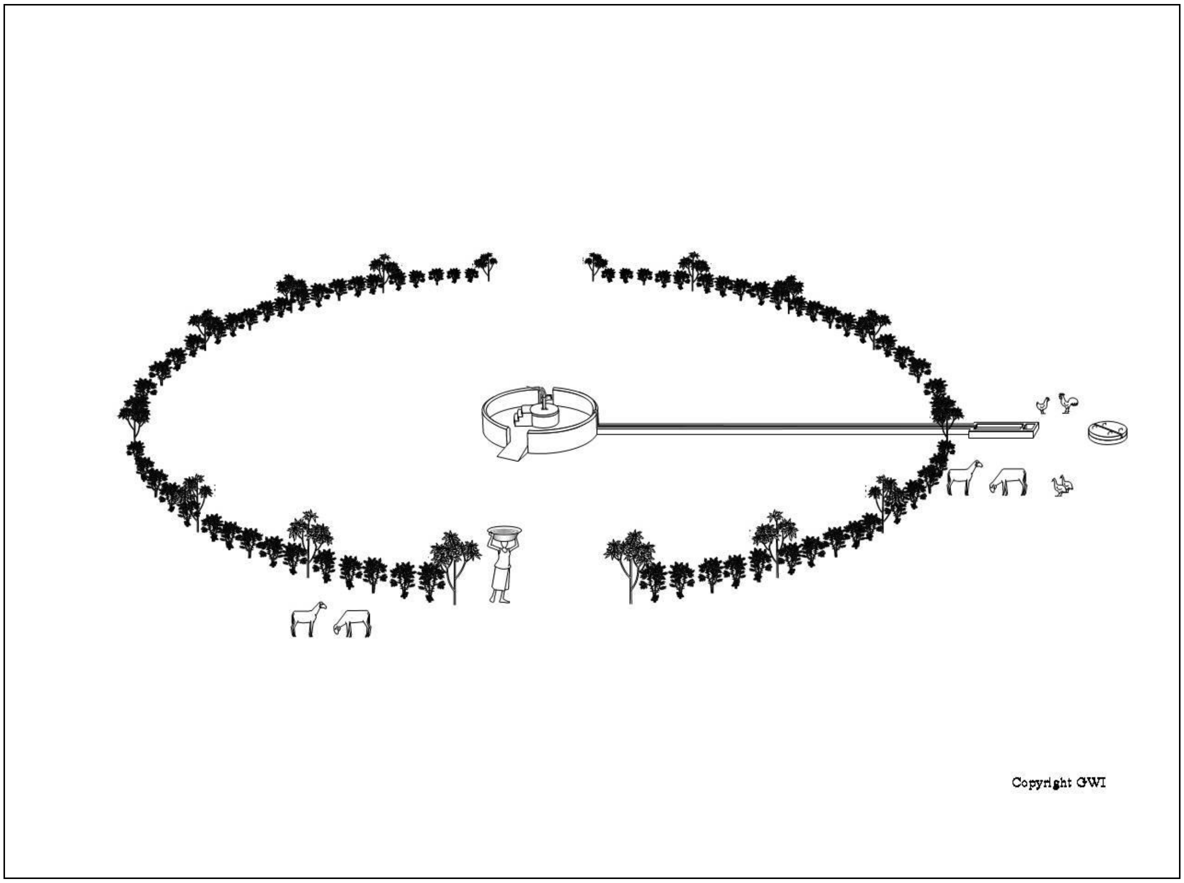

Figure 29: hand dug well with hand pump

Lined well

A large diameter well is dug into the aquifer. It is lined to its full depth with a reinforced concrete lining.

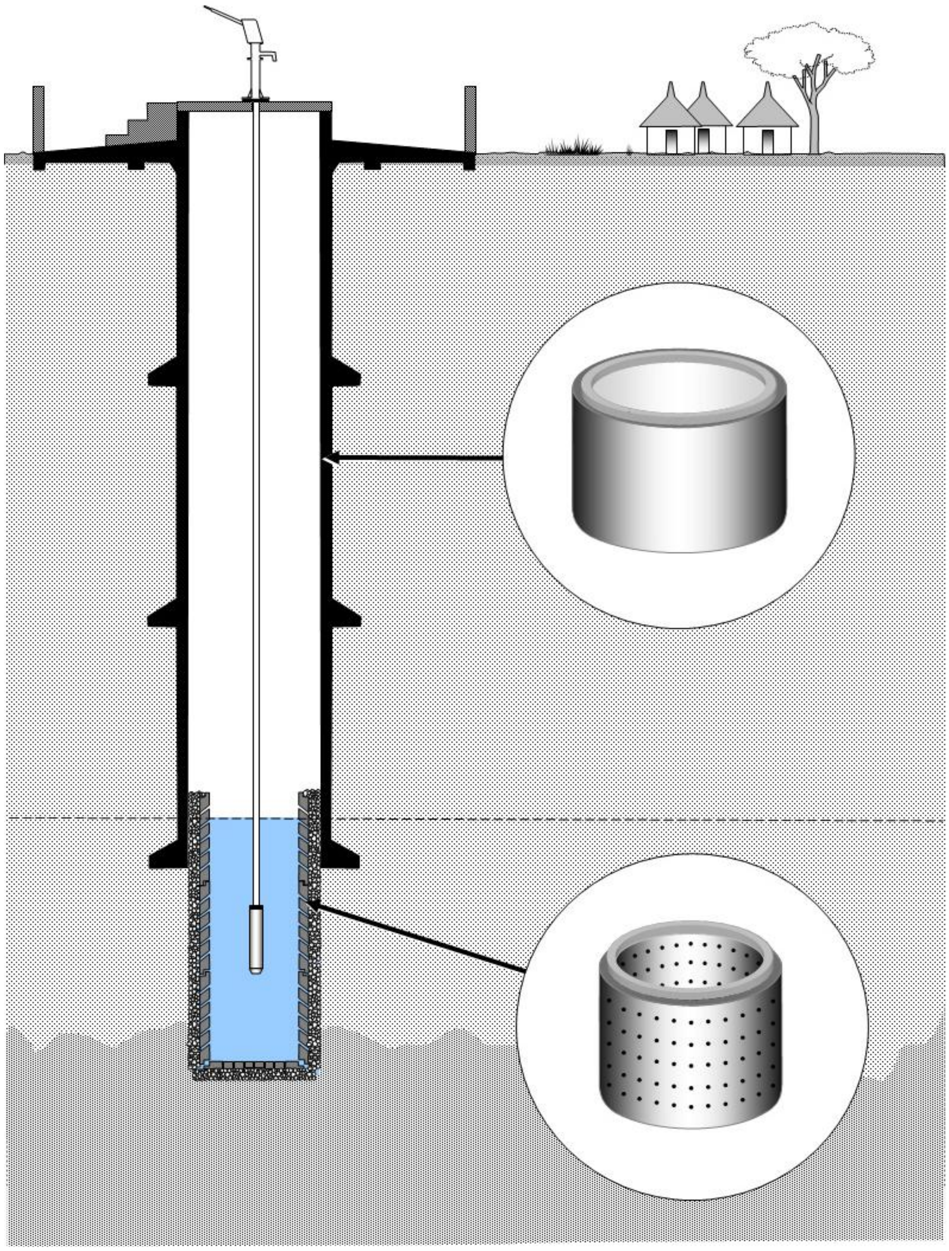

Figure 30: how water gets into the well

Two types of lining are used. In a 2-meter hand-dug well, 1.80 m diameter lining rings are used to line the hole above the water level and 1.40 m diameter perforated rings are used to line below the water level.

To hold the well lining steady, it must be anchored properly above ground and at several points inside the well shaft (usually every 10 meters).

The Superstructure

The well must be protected with:

- concrete foundations;
- a concrete apron and well head with a reinforced concrete slab on which the pump is mounted.
- a low wall/fence
- a drain to carry water to the livestock trough and soak-away pit.

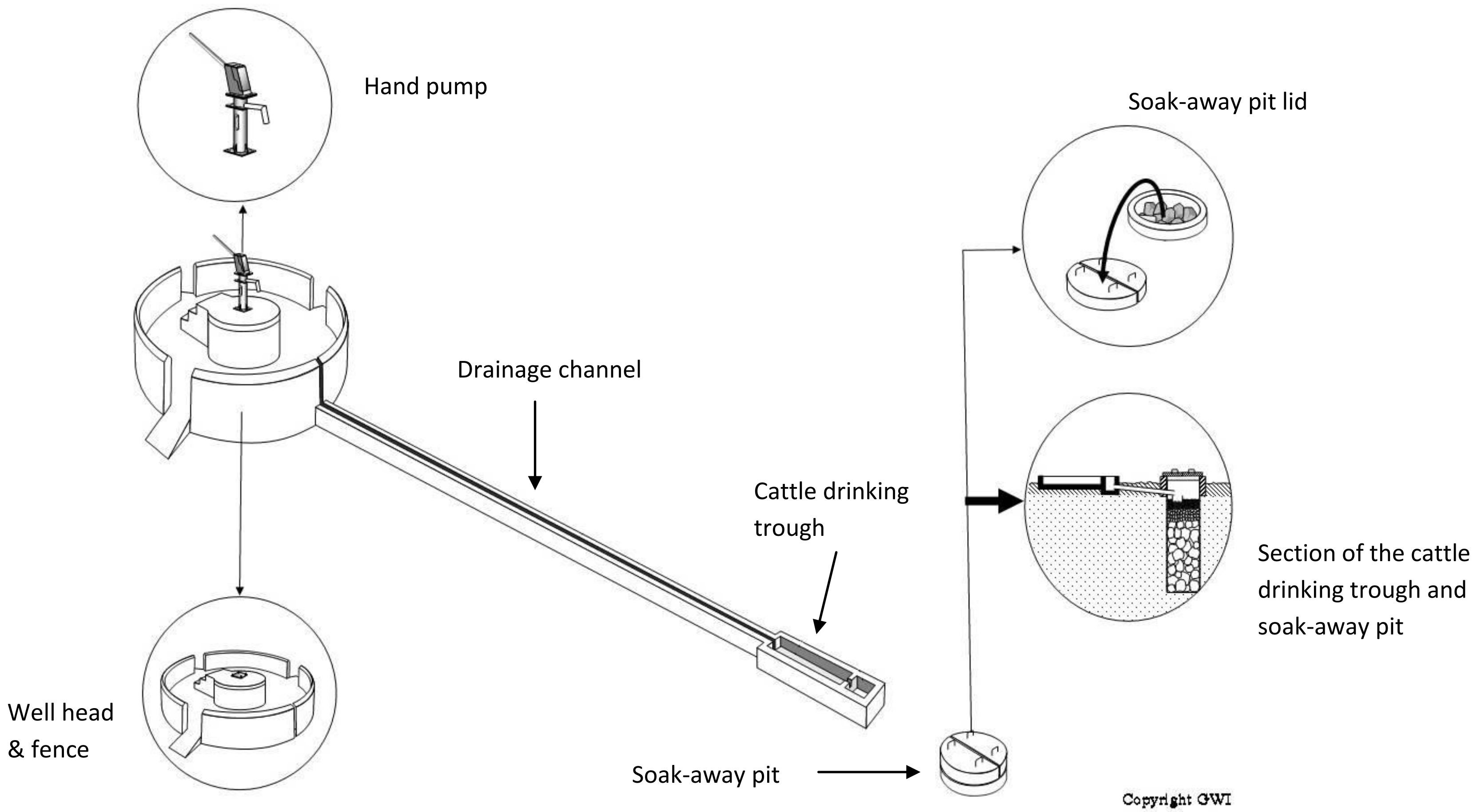

Figure 31: the superstructure design details

Selecting the hand/foot-pump

A pumping system such as a manual/foot pump allows users to draw water from the well. There are many types of pumps. The most common in West Africa are:

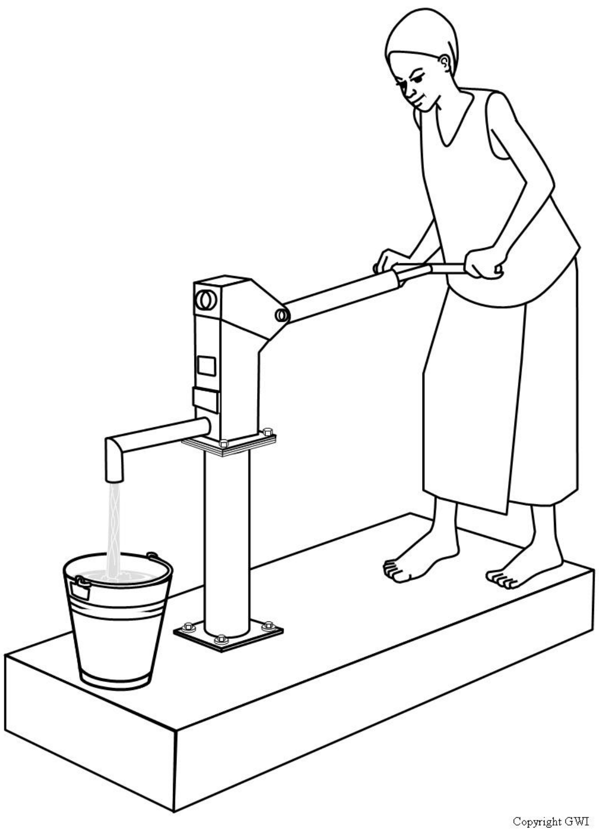

Figure 33: Afridev pump

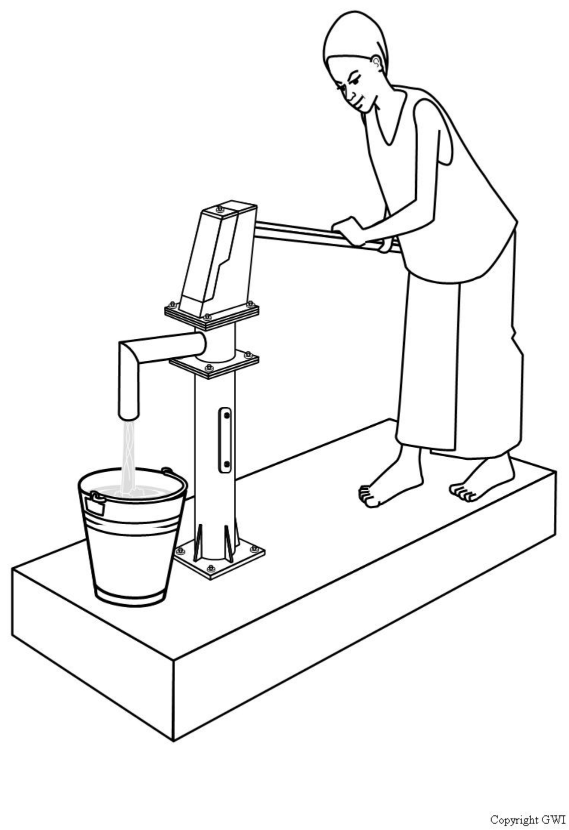

Figure 34: India Mark II pump

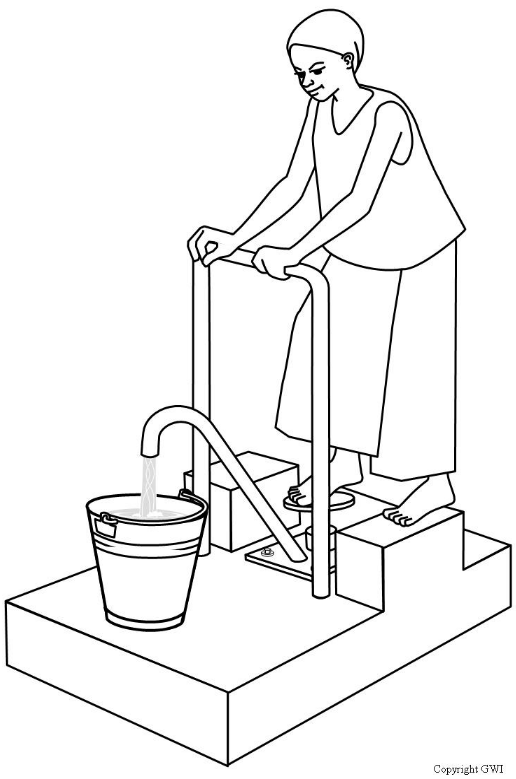

Figure 35: Vergnet pump

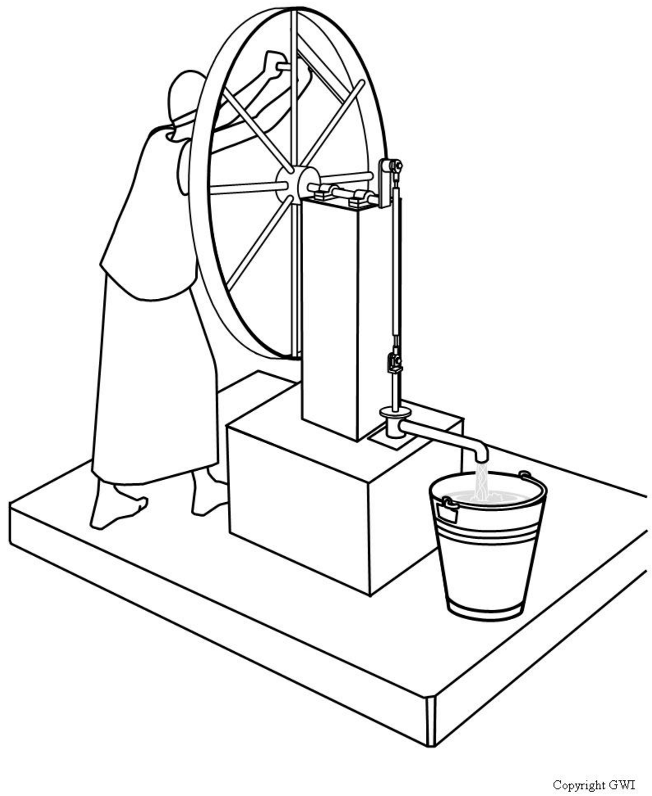

Figure 36: Volonta pump

Water Service level

Water quality

Groundwater from a hand-dug well is generally of good quality. The water comes from rainwater that is filtered through the various layers in the ground. However, though the water may be free of bacterial contamination, it can be unfit for human consumption because of naturally occurring chemical contaminants (i.e. arsenic). Sometimes the water can be polluted by harmful bacteria or harmful chemicals as a result to human activity. Laboratory tests for water quality (both chemical and bacteriological) must be done to see if the water is fit to be used as drinking water for humans.

Water Flow

The yield is the amount of water that can be taken from the well over a given period of time. It varies depending on the nature and the capacity of the groundwater that feeds it. The daily capacity of the well is assessed when it is dug and varies from one well to another.

Level of service

With a hand/foot pump, water drawing is time-consuming. Water-point users need to pump one at a time.

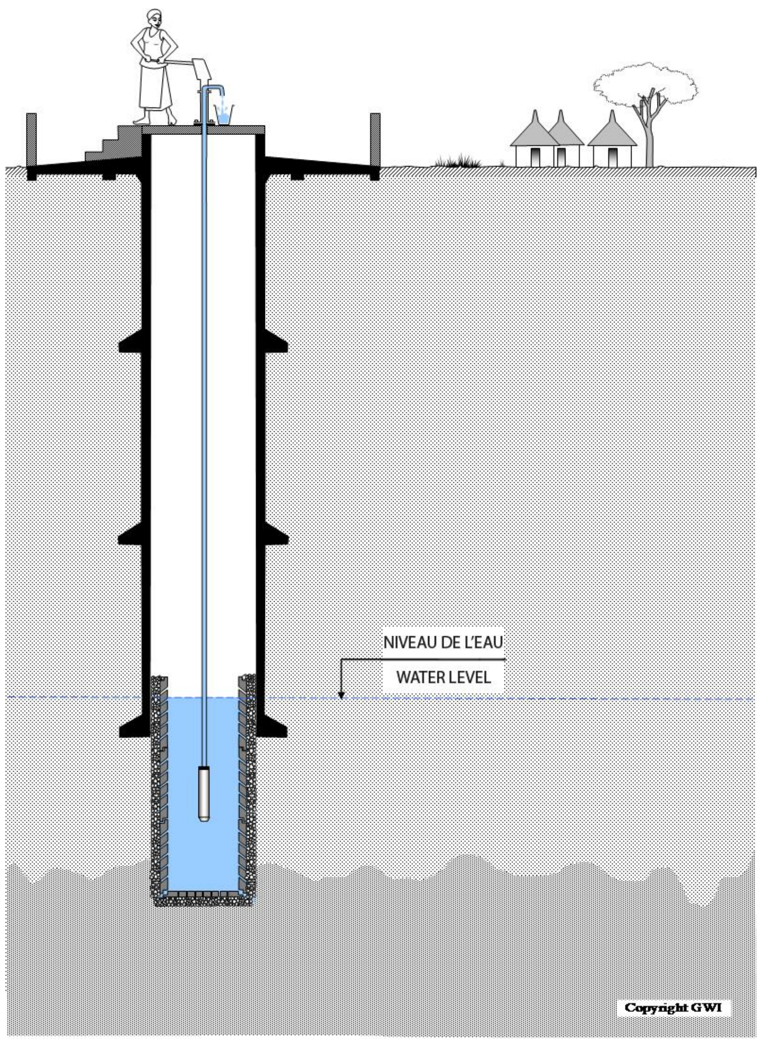

Figure 37: water drawing

These pumps are designed for domestic water (drinking, cooking, and washing, and personal hygiene). Occasionally a few animals or small vegetable gardens may also be watered.

Costs

Lined wells with hand pumps are expensive not just to build but also to look after once they are in use. We expect such a water supply to last for 15 years before it needs major rehabilitation. This 15 year cost responsibility belongs to the community.

There are three types of main costs of the well and hand/foot pump supply:

<table>
<tr><th>What?</th><th>How much?</th><th>When?</th><th>Who funds?</th></tr>
<tr><td>Lined hand-dug well with hand/foot pump capital expenditure.
(Capital Expenditure: CapEx).</td><td>About 8,500,000 CFA ($ 17,000) in Burkina Faso for a 30 meters depth well</td><td>One off at start</td><td>External donor and community cost share</td></tr>
<tr><td>Ongoing operation and maintenance expenditure including small repairs.
(Operation and Maintenance: Expenditure, OpManEx).</td><td rowspan="2">About 140,000 CFA ($280 US) / year in Burkina Faso for an India Mark II pump +the costs for the maintenance of the well (*)</td><td>Ongoing from day one.</td><td>Community,</td></tr>
<tr><td>Major repairs and spares replacement.
(Capital maintenance expenditure: CapManEx).</td><td>From the 5th to 7th year.</td><td>Community and commune</td></tr>
</table>

(*)*: the maintenance of the well includes: minor repairs on the concrete rings or on the superstructure, periodic de-watering and disinfection of the well, major repairs on the superstructure, the concrete rings (porous and not porous), gravel packing, periodic technical visits of the well.*

Operation and Maintenance

A well maintained hand-dug well with pump will still need to have key parts replaced as they wear. This replacement cost is built into the “ongoing operation and maintenance expenditure” above.

Major rehabilitation can be expensive and may cost more than most communities would be able to pay for without external support.

The people skills required

Good organisation is necessary for the management of the well: Key groups are the Water Users' Association (WUA), the Water-point Management Committee (WPMC), etc.

Insuring proper operation and maintenance of the well and hand/foot pump requires the following tasks to be carried out:

From within the Community:

- Fund raising according to a specific budget (a transparent and accountable system);
- Preventative maintenance of a) the pump - day to day maintenance carried out (village pump caretakers) and b) the superstructure (village mason)
- Small masonry repairs
- Organisation of water point users and information.
- Monitoring.

From outside the community:

- Periodic de-watering and sanitization of the well
- Regular pump maintenance / spare replacement / repairs (area mechanic);
- Supply of spare parts;
- Major repairs on superstructure, well concrete lining and gravel packing;
- Deepening the well in case of a marked drop in the water table
- Technical assistance to monitor, troubleshoot, and train.

In conclusion:

It is important to make sure that the community has understood the key aspects of this technology. After you have presented the factual information above, the following questions can help guide the conversation with the community and will allow specific questions, doubts, and points of clarification to be discussed.

Q1.	:	Is water from a well with a hand/foot pump always clean?
Q2	:	If the pump breaks, can we draw water out of the well with a bucket?
Q3	:	How many people at a time can draw water?

Q4	:	What are the main elements of this system?
Q5	:	What is the community responsibility to ensure operation and maintenance of this system?
Q6.	:	How much money does the community need to collect each year to maintain this system?
Q7	:	How many households would be using this pump? So how much would each household have to pay each year? And how much each month?
Q8	:	What resources would you need from outside your village to keep this pump alive?
Q9	:	What advantages and disadvantages do you see to a well with hand/foot pump for your community?

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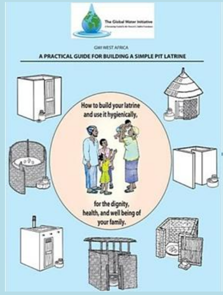
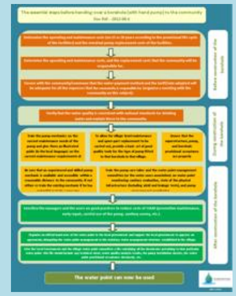
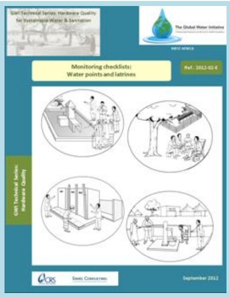
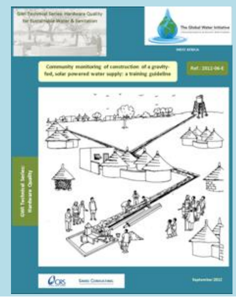
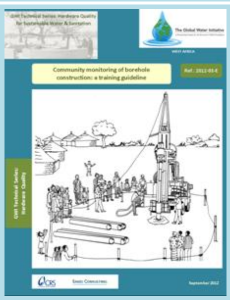
A practical guide for building a simple pit latrine. ref.: 2011-01-E		Contracting for water point construction: Provisional and final acceptance forms. ref.: 2012-04-E	
Assuring Quality: an approach to building long-lasting infrastructure in West Africa. ref.: 2012-01-E		The essential steps before handing-over a borehole (with hand pump) to the community. ref.: 2012-05-E	
Monitoring checklists: water points and latrines. ref.: 2012-02-E		Community monitoring during the construction of a gravity-fed, solar powered water supply: a training guideline. ref.: 2012-06-E	
Community monitoring of borehole construction: a training guideline. ref.: 2012-03-E		Making the right choice: comparing your rural water technology options. ref.: 2012-07-E	

These documents are also available in French.

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