GWI Technical Series: Hardware Quality for Sustainable Water & Sanitation

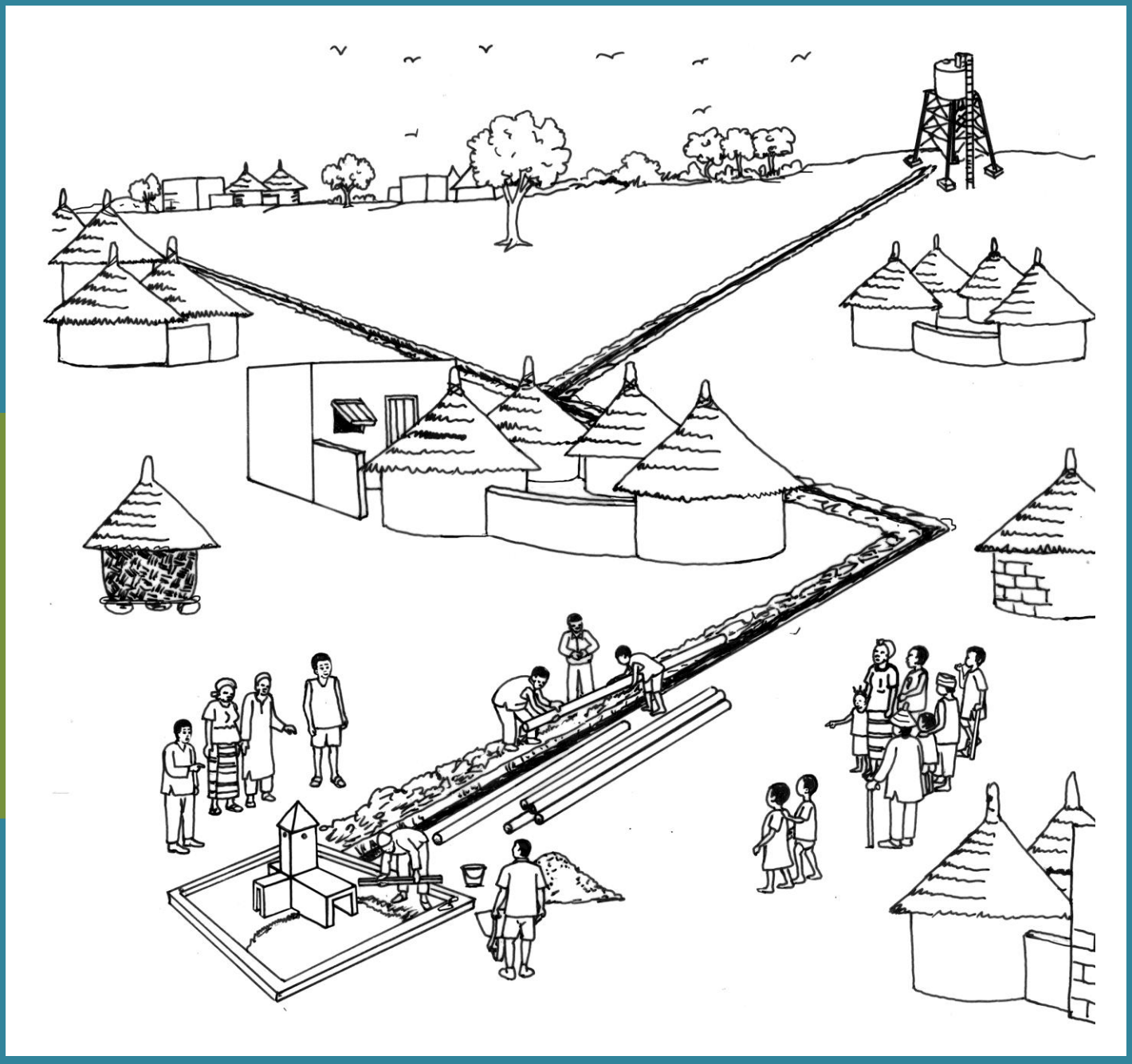
The Global Water Initiative

A Partnership Funded by the Howard G. Buffet Foundation

WEST AFRICA

Community monitoring during the construction of a gravity-fed, solar powered water supply: a training guideline

Ref.: 2012-06-E



GWI Technical Series: Hardware Quality

CRS CATHOLIC RELIEF SERVICES

SAHEL CONSULTING

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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
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pump) to the community	ref.: 2012-05-E
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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

When designing and building a community water and sanitation supply, we often encounter quality-related problems even when the work is supervised by a professional. The beneficiary communities often find themselves assigned the role of ignorant & powerless observers. Community involvement in supervision of the works not only enables them to keep an eye permanently on the way works are carried out, but also contributes towards beneficiaries and future managers regarding the sustainability of that system in the long-term. Instead of just passively receiving a finished product these beneficiaries will become genuine stakeholders in the construction work. The capacity of these communities need to be built to enable them to understand the key basic engineering principles of the works and thus to play the role of assuring a quality infrastructure is built.

Training objective

This training guide aims at providing the communities with the most essential practical information on: the various stages in borehole and gravity distribution with submersible pump powered by solar energy design and construction, the main stages of the works, the critical engineering/construction points in each stage, the quality of materials to be used, and finally the expected quality of the work. It aims at preparing them to intervene in alerting the funding/facilitation body & the decentralized commune authority anytime they note gaps in compliance with the standards that were agreed at the start of the work.

Specific training objectives

The training will permit participants to:

1. Get acquainted with the various stages in the design and construction of borehole and gravity distribution with submersible pump powered by solar energy;
2. Understand how each stage of the work should be carried-out;
3. Understand the key factors that assure a quality result at each stage;
4. Know how to assess the quality of the works at each stage ;
5. Have a clearer idea on what to do in case of observing poor practice in the construction work.

Expected results

At the end of this training, participants should:

1. Know the various stages of design and construction of a borehole and mini gravity distribution with submersible pump powered by solar energy;
2. Understand how the work should be carried out at each stage ;
3. Know the factors that assure a quality product at each stage ;
4. Know how to assess the quality of works at each stage ;
5. Have a clear idea on what to do in case of poor practice in the construction work.

Training methodology

The training will be organized in several modules, each module representing one stage in the construction of a borehole and mini gravity distribution with submersible pump powered by solar energy. Modules will be presented in the chronological order in which the various stages of construction occur.

For each module the specific objectives listed below are fully discussed/understood before moving on to the next module.

The teaching of each module should include practical demonstration for illustration purpose.

In order to achieve a wider involvement of the target population and adopt the most participatory approach, participants will be constantly requested to share their knowledge on the content of the module in pre-teaching brainstorming sessions.

Training content

There are 5 main parts in the construction of a borehole and mini gravity distribution with submersible pump powered by solar energy:

A. Constructing a new borehole or identification of an old one with high discharge (at least 5m3/h) ;
B. Layout of the various equipment and infrastructures ;
C. Installation of the power generator and the submersible pump ;
D. Installation of the water tower ;
E. Installation of the mains ;

F. Construction of water distribution points.

A. / Constructing a new borehole or identification of an old one with high discharge (at least 5m3/h)

Building a new (high discharge) borehole

There are three main stages of borehole construction, and the content modules will be closely related to them:

- Geographical layout (A1);
- Practical physical layout (A2)
- Drilling (A3).

Module A1: Identification of hydro-geological investigation area

Inform village leaders and the WUA in the area predefined by the hydrogeology team for the layout of the water point;

		Remarks
How will the construction work be carried out?	Identification of the potential exploration village area for the exploration/drilling of the borehole.	
What are the determining factors at this stage?	Layout zones should be within the limits of the village land and should be identified by the relevant village authorities	Choosing land outside the village must be avoided as much as possible.
How to assess work consistency and quality? **Which actions are to be undertaken?**	Involve main village decision makers in the validation of selected zones for hydro-geological investigations. To avoid errors, field visit on selected zones is recommended.	Avoid prohibited (taboo) areas.

Methodology / how to run the session:

Key learning and discussion points:

- ✓ Discuss the risks/consequences related to locating a borehole on land of another village which is not part of the beneficiary community

This session will be a question/answer and experience sharing session so that participants themselves can identify potential risks related to the identification of the geographical area selected for hydro-geological investigations. Discussions could be focused on the following questions in order to encourage participants to share their ideas and experience:

Q1. Who should show the hydro geologist the limits of the village land where hydro-geological survey can be carried out?

Q2. Who should be informed about the areas selected for hydro-geological surveys, and why?

Q3. How the description of the areas selected for hydro-geological surveys should be done? Verbal description? Field visit? Other? Call for arguments in support of the various options.

At the end of the session ask participants to give a summary of best practices to be adopted for the identification of areas for the hydro-geological survey.

Session duration

About 30 minutes.

How the session is organized

In plenary.

Materials needed

None.

Module A2: Practical implementation

The purpose of this module is to address the following aspects:

- ✓ Avoiding people changing what was planned (showing an area that is different from the one initially selected by common consensus by the village);
- ✓ Avoiding selecting areas which are inappropriate or which involve some risks (close to latrines, in or next to a graveyard, sources of pollution, etc.);
- ✓ Ensuring the respect of the technical norms & criteria (distance, etc.).

Where will the borehole be built?	Determination of the precise location of the borehole.
Which are the determining factors at this stage?	Laying out the borehole on risk-free sites. Clear identification of village land boundaries within which the layout of the water should be built.
How to assess the quality of the work? **Which actions are needed?**	<u>Prior to layout</u> : - Presence of WUA before and when layout is being conducted <u>During layout</u> : - Verify that prescribed minimal distances (30m) from source of pollution have been respected; - Check water point is not in a depression or an area liable to flood; - Check water point is not located on a sacred spot where access is limited or forbidden - Check selected point is indeed located within village land boundaries. <u>After layout</u> : - Marking and protection of sites selected by layout team ; Inform public at large on sites selected for drilling.

Methodology / how to run the session:

Key learning and discussion points

- ✓ Risks related to selection of wrong location of water point (e.g.: in or next to a graveyard);
- ✓ Respect of prescribed minimal distance between water point and source of pollution;
- ✓ Drainage issues to avoid water point pollution by surface water;
- ✓ Which community member(s) should monitor the work?
- ✓ Who should be informed about selected sites?

Ask participants to explain how layout work is generally conducted in the field and then ask the following questions getting them to share their experience that justifies their opinion (and allow participants to argue and discuss throughout this session):

Q1. Who should show the work site to the layout team? And why?

Q2. If the point selected by layout team is located on sacred land, what should be done?

Q3. Which other sites should be avoided? Why?

NB: Some specific points should be mentioned (cemetery, zone liable to flood, source of pollution), otherwise, mention them and ask participants for justification.

If necessary, the facilitator should complete answers to the various questions when participant answers are incomplete or incorrect.

In the case of sources of pollution, indicate the prescribed minimal distance to be respected and possibility to eliminate some sources of pollutions (e.g.: latrines, garbage dumps, clay quarries, swamps, etc…)

Q4. Which community members should be present when layout work is being conducted, and why?

Q5. How to ensure that the point(s) selected by layout team can be easily seen/identified when the engine comes to start drilling?

Q6. What are the tasks of the community representatives who attended the layout work?

Q7. Should the whole community be informed about selected sites?

At the end of the session, ask participants to summarize the best practices that must be adopted for the practical layout stage.

Session duration

The session will last about 2 hours.

How the session is organized

In plenary.

Materials needed

None.

Preparation

Ensure you have a thorough knowledge of how various sources of pollution (latrines, garbage dumps, etc.) contaminate aquifers.

Module A3: Drilling

This module will deal with:

- ✓ Avoiding errors in locating the borehole when drilling;
- ✓ How to ensure that the drilling and equipping of the borehole are well done (drilling equipment: casing, gravel);
- ✓ Checking the visual quality of water coming up at the end of the drilling.

How is the drilling work carried out?	Work is done with drilling machines.
Which are the key factors at this stage?	No drilling in any location other than the one identified during layout. Assuring materials of adequate quality are used for borehole equipment. Water quality at the end of drilling.
How to assess work is carried out to a consistent quality? **Actions to be undertaken?**	Prior to work launching Ensure that community official representatives are present at project launching; At borehole equipping - Check to ensure no broken casing is introduced into the borehole; - Check to ensure that screen casings have not been sawn to be used as inlet filters; - Check that gravel size and quality comply with standards At development Verify water clarity and note time taken to get clear water gushing out of the borehole.

Methodology / how the session is led:

Key learning and discussion points:

- ✓ Technical characteristics of a borehole (use visual medium);
- ✓ Quality of materials used for borehole construction;
- ✓ Process used to develop the borehole.

Ask participants to explain how drilling work is generally conducted. Then ask the following question:

1. Which community members should show the drilling company the point selected for drilling, and why? (Participants are invited to share experience that can justify their opinion)

2. Use a photo or diagram to explain the various parts that make a borehole (water inflow, water catchment with inlet filters in front of water inflow, water filtering through gravel packing, etc.)

3. Ask participants to discuss the quality of PVC casing and gravel packing & other features that will make it a high quality borehole.

Provide the participants with any additional information they may not have mentioned regarding quality materials and good borehole development, for example:

- Inlet filters should: let water flow easily in and let fine particles in during the development stage (perforations should not be too small), hold out soil materials outside the inlet filter at borehole exploitation stage (perforations should not be too large either).
- Filtering (gravel) packing should: hold bigger solid elements from the aquifer and let finer elements in, especially during development stage (cleaning of the borehole).

NB: make sure samples of good and poor quality inlet filters and gravel are available (sawn PVC casing, non-silica and non-water-worn gravel) for participants to see.

4. Ask participants to give the features of good quality water.

5. Explain the process and equipment required for the development of the borehole (cleaning of the borehole) for at least 4 hours or more (if necessary) until the water becomes clear.

6. At the end of the session, ask participants to:

a) Summarize the types of materials to be used, how to clean the borehole and what the borehole water should look like at the end of the borehole development.

b) Discuss what to do if:

- They note that the borehole is being drilled out on a different site from the selected one;
- The contractor is not using good quality materials or does not comply with best practices;
- They note that the water is not clean at the end of the borehole development.

Session duration

The session will last about 2 hours.

How the session is carried out

The session is in plenary

Materials needed

- Diagram of a borehole;
- Good quality sample of a gravel filter pack;
- Poor quality sample of gravel;
- Good quality sample of a PVC strainer;
- Sample of a hand sawn slotted PVC tube (poor strainer).

Preparation

- Knowledge of good quality gravel ;
- Good understanding of the stages of borehole development.

When using an old (high flow) borehole

In this case, there is need to ensure that there is no dispute around ownership of the borehole and it is located within the village land boundaries. The water must also be of good quality.

It is necessary to mention that the continuation of the process is linked to the water quality analysis results. This analysis is done by a laboratory. Beyond the visual aspect, the safety of the water is also related to some characteristics (physical, chemical and bacteriological). Most of the time it is cheaper to drill another borehole somewhere else than treating a poor quality water.

B / Layout of equipment and various infrastructures

This module deals with the layout of water collection points (standpipes), water tower and watchman's house:

- ✓ Avoid errors in water point (a site different from the one selected by consensus by the village);

- ✓ Avoid installing unplanned connections;
- ✓ Avoid installing the water tower on a forbidden site.

How is the work carried out?	Exact siting of the location of the various taps and of the water tower.
What are the key factors at this stage?	Layout of only the planned water points and of the water tower at the selected locations (without any later additions that were not part of the design).
How to assess the quality of the work? **Actions to be taken?**	Presence of WUA before and during the time that layout is being done.

Methodology / how to run the session:

Key learning and discussion points

- ✓ Risks of laying out water points at locations not initially selected/not part of the original design, risk of increasing water points beyond the initial number planned;
- ✓ Consequences of locating the water tower on a forbidden site;
- ✓ What are the community member(s) who should monitor the work?

Ask participants to explain how the practical layout work is usually conducted in the field. Then ask the following question:

Q1. Who should show the team in charge of laying out the points selected for water points (taps) installation, and why? (Participants are invited to share experience that can justify their opinion)?

Q2. Who should validate the location proposed for the water tower following the topographic surveys?

Q3. Who are the community members that must be present during the layout work? And why?

Throughout the various sections of this session, let participants argue and discuss at length.

At the end of the session, ask participants to give a summary of the best practices to be adopted for the practical layout stage.

Session duration

The session will last about 45 minutes

How the session is organized

The session should be held directly in plenary.

Materials needed

None

Preparation

None

C / Installation of the power generator and the submersible pump

The purpose of this module is to allow community representatives to know what the function of the generator and the pump are, the conditions under which they function best, and which main aspects must be monitored at the time that they are being installed:

- ✓ Utility and optimal operating conditions of the solar generator and the pump;
- ✓ Quality of the foundations (concrete and layout) of the pillars supporting the solar panels and the consequences of poor quality foundations;
- ✓ Absence of any potential source of shade on the solar panels.

How is the work conducted?	The work is carried out by a specialist sub-contractor with specialist knowledge in Solar-Electricity
What are the determining factors at this stage?	Installing the solar generator correctly (on a good structure) to avoid the stands of the panels sagging, or being displaced or blown-away by the wind (their orientation to catch maximal sunlight is also very important). Eliminate any potential source of shade on the solar panels.
How to assess the quality of the work being carried out? **Actions to be taken?**	<u>Foundation dimensions are decisive (depth, width and length)</u> - Check foundations dimensions are good. <u>Quality of materials is essential</u> - Check that the sand and gravel used do not contain dirt and/or clay; - Check if the cement used comes from dry, hermetically sealed bags, is in a fine powder, and does not contain lumps ; - Check if the water used is clear and not salty. <u>Remove anything likely to cast shade on the solar panels</u> - Check that there is nothing likely to cast shade is next to/near the solar panels. <u>Making good concrete is essential</u> After the concrete has set, ensure it is watered twice a day (morning and afternoon) for at least one to two weeks.

Methodology / how to run the session:

Key learning and discussion points

- ✓ Role of foundations in keeping the solar panels stable for optimal operation;
- ✓ Good quality concrete requires good materials and strict compliance with proper mixing and curing;
- ✓ No infrastructure or obstacle should be close enough to cast shade on the panels.

This session will deal with the following aspects:

- The dimensions of foundations and the quality of concrete are very important for a good structure that provides adequate support to the solar panels;
- The quality of materials is highly important in making good quality concrete;
- Using good quality materials is not enough; mixing and curing them properly is essential

1. Ask participants what makes a robust stand. Get participants to describe the consequences that will result from a poorly made foundation for the solar panel stand.

2. Ask participants to describe the possible negative impact of shade on the functioning of the pumping system.

3. Ask participants to give the components required to make concrete. Give additional information or corrections if necessary.

4. Ask participants to mention the qualities that must be found in these various materials and explain why these qualities are required.

Ensure you supplement the missing elements in their answers.

Display good and poor quality samples of the materials for participants to see.

5. Concerning best practices, ask participants to tell the "DO"s and "DON'T"s in making concrete. Ask them to justify their answers about the mixing ratios, mixing of the materials, and the watering.

6. To test their knowledge, ask participants how one can verify whether a piece of concrete or a stand is properly made. Listen to their answers and give them the right answer in case they cannot find it.

Make a practical test.

7. At the end of the session:

a) Ensure that participants make a summary of the main points on the use of good foundations for the solar-panel supporting stand, on the quality of materials to be used and on the best practices in making concrete.

b) Discuss with them about what they can do in case
   - They notice that the dimensions of the stand are inadequate ;

- They notice that the work team are not using good materials or are using wrong mixing ratios to do the concrete;
- The concrete is not properly watered (morning and afternoon over the required period) ;
- They notice that some obstacle next to the solar panels is casting shade on them.

Session duration

The session will last about 1h30 minutes

How the session is organized

The session should be held in plenary.

Materials needed

- Samples of good quality sand and gravel;
- Samples of poor quality sand and gravel;
- Samples of badly mixed concrete materials;
- Samples of well cured concrete;
- Samples of poorly cured concrete.

Preparation

Good knowledge of the consequences of poor quality materials and bad practices for making cinder blocks and concrete. Good understanding of how the structure of the stand works and the role of foundations in supporting the stand carrying the heavy weight of the solar panels. Knowledge on the minimal sizes for the foundations of the stands.

D / Installing the water tower

This module will teach community representatives the key aspects in the installation of the water tower and the need for them to monitor this installation and to understand the role of the water tower and the plans for its protection:

- ✓ Role of the water tower;
- ✓ Quality of foundations (concrete and layout).

Who carries out the work?	The work is carried out by a contractor
What are the determining factors at this stage?	Dig out the soil and lay foundations at the recommended depth with good quality concrete A metal water tower must be painted (with several layers) for protection against corrosion
How to assess the quality of the work? **Actions to be taken?**	<u>The correct dimensions of the foundations are vital (depth, width and length)</u> - Check adequacy of the dimensions of the foundations. <u>The quality of the materials used is vital</u> - Check that the sand and gravel used do not contain dirt or clay; - Check if the cement used comes from dry, hermetically sealed bags, is in a fine powder, and does not contain lumps; - Check if the water used is clear and not salty. <u>Making concrete adequately is essential</u> - After the concrete has set, ensure it is watered twice a day (morning and afternoon) for at least one to two weeks. <u>Metal water tower must be well protected against corrosion</u> Check if water towers are painted: number of layers, quality of layer application.

Methodology / how to run the session:

Key learning and discussion points

- ✓ The role of the foundations in maintaining the water tower steady;
- ✓ Good quality concrete requires good materials and compliance with specific regulations regarding mixing and curing the concrete ;
- ✓ How to protect the water tower against deterioration (case of metal water towers);
- ✓ The role played by the water tower in the whole system.

This session will focus on the following:

- The dimensions of the foundations (which depend on the total charge to support and the soil characteristics) and the quality of the concrete are very important for the quality of the structure of the water tower;
- The quality of materials is decisive to ensure good quality concrete;
- Having good quality materials is not enough, it is essential to use them properly (mixing and curing);
- The water tower plays many roles in the water supply system: giving pressure to the network, allowing the pump to rest and not work continuously or while the standpipes are operating, storing water to allow for maximum draw-off times.

1. Ask participants to tell what makes a water tower stand robust. Get participants to tell the consequences of making poor foundations for the water tower.

2. Ask participants to give the components required for making concrete. Supplement or correct their answers.

3. Ask participants to list the qualities they expect to see in these materials and justify their answers.

Supplement their answer with the missing elements.

Display samples of good and poor quality materials for participants to see.

4. Concerning best practices, ask participants to tell the « DO »s and « DON'T »s when making concrete and to justify their answers on the ratios of materials when mixing concrete, and curing it correctly.

5. Ask participants how one can verify whether a piece of concrete or a stand is properly made. Listen to their answers and give them the right answer in case they cannot find it.

Make a practical test.

6. At the end of the session:

c) Ensure that participants make a summary of the main points on the use of good foundations for a stand support, on the quality of materials and the best practices in making concrete.

d) Discuss with them about what they can do in case
   - They notice that the dimensions of the foundations are inadequate ;
   - They notice that the contractor's team are not using good materials or are using wrong ratios when mixing concrete;
   - The concrete is not properly cured (watered morning and afternoon over the required period) ;
   - They notice that the paint application on water towers is faulty (type of paint, number of layers, and quality of application).

Session duration

The session will last about 1h

How the session is organized

The session should be held in plenary.

Materials needed

- Samples of good quality sand and gravel;
- Samples of poor quality sand and gravel;
- Samples of badly mixed concrete materials;
- Samples of badly cured concrete;
- Samples of well cured concrete.

Preparation

Good knowledge of the consequences of poor quality materials and bad practices for concrete. Good understanding of how the structure of a stand works and the role that foundations play in the strength of the stand. Good knowledge of the role water towers play in storing water and providing height for gravity water supply systems.

E / Layout of mains

The purpose of this module is to enable community representatives to understand how the water mains must be laid out and the importance of each aspect of the mains layout work so that they can ensure good supervision:

- ✓ Depth at which mains should be laid;
- ✓ Installation of special parts like bends, valves, etc.;
- ✓ Installation of the mains on a bed of sand;
- ✓ Check that the system is tight, has no leaks.

Who does the work?	The work is carried out by a contractor with plumbing knowledge
Which are the determining factors at this stage?	Laying the pipes at the recommended depth (trenches of at least 0.80 m deep) in order to protect them from weathering and overloads and other risks (e.g.: plows and other farming implements) At turning points where pipes change direction, abutment must be placed to avoid pipes uncoupling under the pressure of water). Avoid using hand-made parts instead of correctly manufactured parts like bends (heating and hand-bending a UPVC pipe is not adequate) No leakage should be found in the laid pipes and the whole system of pipes should be tested before the trenches where pipes are laid are back-filled.
How to assess the quality of the work? **Actions to be taken?**	<u>Storage of pipes on the construction site</u> - Pipes (in PVC or HDPE) should be stored under the shade to avoid sunrays degrading them <u>The depth at which pipes are laid is important</u> - Check if the pipes are laid at the appropriate depth. <u>Pipes laid on a bed of sand</u> - Check if the pipes are laid on a loose (sand) bed that is at least 10 cm thick. <u>Abutment help avoid uncoupling and leaks</u>

	- Check if abutments are placed at turning points where pipes change direction. <u>No use of non-genuine parts (e.g.: heated pipes to make bends)</u> - Check that bends are not hand-crafted from heated pipes and used in the mains network. <u>No leakage should be found on laid pipes</u> A test to verify appropriate laying of pipe and absence of leakage should be conducted.

Methodology / how to run the session:

Key learning and discussion points:

- ✓ Compliance with the a minimal depth at which pipes should be buried ;
- ✓ PVC or HDPE pipes must be constantly stored under the shade prior to their laying ;
- ✓ Good quality materials must be used for the sand-bed. To be efficient, the sand bed should be of the prescribed thickness;
- ✓ Materials used for back-filling of trenches must be loose;
- ✓ After laying pipes, water tightness and leakage control tests must be made before back-filling in the trenches;
- ✓ At turning points, pipes should be held steady (with abutment);
- ✓ Special parts (e.g.: bends) should not be hand-crafted (pipes heated to force them into a given shape).

1. The modules will be taught using a participatory approach, banking on participants' knowledge and reasoning, etc.

2. Make various samples available: good special parts, hand-crafted special parts, etc. photographs and pictures can be used to show some aspects (e.g.: abutment, etc.).

3. Discuss with them about what they can do in case they note that:

- The trenches do not comply with the prescribed depth;
- Abutments are not placed at pipe turning points;
- Sand-bed is not used, or is of poor quality, or the materials used for backfilling in the trenches are loose;
- The PVC or HDPE pipes are stored under the sun before being laid;
- The company laying the mains has not carried out a leakage test.

Session duration

The session will last about 1h30 minutes

How the session is organized

The session should be held in plenary.

Materials needed

- Samples of pipes, genuine special parts and non-genuine special parts;
- Samples of PVC and of HDPE pipes made 'brittle' in the sunshine so are easy to crack/leak;
- Display heaps of poor quality materials that should not be used for filling in after laying pipes.

Preparation

Good knowledge of the effects of sunrays and overload on PVC and on HDPE pipes, good understanding of water flow and using gravity to get water from the storage tank to the water delivery points, why putting in more than the planned connections reduces water pressure so much that water will not come out of the taps at the distal end of the pipe network, understanding forces applying at pipe turning points, knowledge and understanding of how pressure test is conducted on laid pipes, etc.

F / Construction of water distribution points

The purpose of this module is to enable community representatives to assess the quality of the construction work of water points (standpipes):

- ✓ Quality of aggregates;
- ✓ Making concrete and rendering.

Who carries out the work?	The work is done by a contractor with plumbing/water engineering knowledge
Which are the determining factors at this stage?	Building robust water points.
How to assess the quality of the work? **Actions to be taken?**	<u>The quality of the materials used is decisive</u> - Check that the sand and gravel used do not contain dirt or clay; - Check if the cement used comes from dry, hermetically sealed bags, is in a fine powder, and does not contain lumps - Check if the water used is clear and not salty. <u>Making good concrete and render is vital</u> - Check for compliance with instructions on adequate proportions of materials used to make concrete and adequate mixing; - Check if the concrete is cured by watering in the morning and in the afternoon after setting for at least one to two weeks; Check if all rendered surfaces are watered after setting in the morning and in the evening for at least one to two weeks.

Methodology / how to run the session:

Key learning and discussion points:

✓ Good quality concrete requires good materials and compliance with specific criteria regarding mixing and curing.

This session will deal with the following messages:

- Poor quality materials cannot be used to produce good concrete;
- Using good quality materials is not enough; using them properly is essential (compliance with correct ratios and good mixing of materials).

1. Ask participants to give the components required for making concrete. Supplement or correct their answers if necessary.

2. Ask participants to mention the quality they expect to see in these various materials and justify their answers.

Please supplement answers with missing aspects.

Display samples of good quality and poor quality material for participants to see.

3. Concerning best practices, ask participants to tell the «DO»s and «DON'T»s when making concrete and to justify their answers on location of production, mix ratios (proportions of sand and gravel), materials mixing, and curing.

4. At the end of the session:

e) Make sure participants give a summary of the quality of materials and best practices in making concrete.

f) Discuss with them about what they can do in case:

- They note that the workers do not used good quality materials and/or do not use appropriate ratios in mixing the materials ;
- They note that the concrete or the mortar (rendering) are not adequately watered (in the morning and the evening during the required period).

Session duration

The session will last about 30 minutes.

How the session is organized

The session should be held in plenary.

Materials needed

- Samples of good quality sand and gravel;
- Samples of poor quality sand and gravel;
- Samples of badly mixed concrete materials;
- Samples of badly cured concrete;
- Samples of well cured concrete

Preparation

Good knowledge of the consequences of using poor quality material and wrong practices in making cinder blocks and concrete. Good knowledge of the correct ratios in making concrete.

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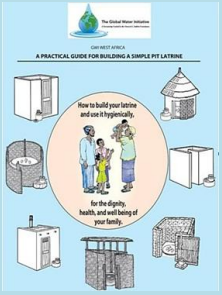

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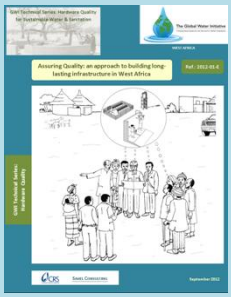

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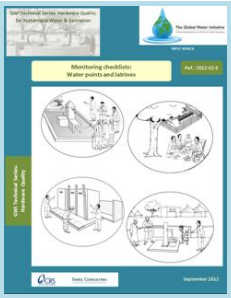

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These documents are also available in French.

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