GLoWS

Learning about Community Water and Sanitation Assessments and Action Plans in Ethiopia

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These GLOWS modules have been developed and tested over a period of several years with the support of different organizations including RiPPLE, SNV, MetaMeta, ODI, IRC International Water and Sanitation Centre, Dutch WASH Alliance, RainFoundation, UNICEF, Addis Ababa, Hawassa and Wolaita Soddo Universities, TVETCs in Hawassa, Soddo and Dilla and Regional and Zonal Water and Health Bureaus in SSNPR.

The development of GLOWS has been a collaborative effort under guidance of Jan Teun Visscher who is also the main author of the modules. Marieke Adank, Josephine Tucker have developed the original module 4, which has been revised in 2013 by the lead author in collaboration with John Butterworth. Module 7 was initially developed as a complimentary module for the GLOWS training in the context of the work done with support of the Dutch WASH Alliance and particularly the RAIN foundation. Implementation of different GLOWS trainings was led by Desta Dimtse from RiPPLE, Fantahun Getachwe from SNV and Abebe Chukalla from MetaMeta. Comments on the modules have been obtained from staff from the different supporting organizations as well as from participants in the different GLOWS training workshops in Hawassa, Yirgalem and Chiro. As part of the process a review workshop was organized by Araya Mengistu from SNV in November 2012 in Yirgalem where staff of several of the support organizations participated which was reported upon by Jasmina van Driel from MetaMeta.

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Preface

Building government capacity at woreda level to support communities in planning, implementing and managing improved water supplies is central to the achievement of the Government of Ethiopia's Universal Action Plan (UAP). The plan is already leading to important improvements in levels of water and sanitation service provision, but additional efforts are needed to ensure further expansion and particularly to enhance sustainable performance In support of this challenge, the University of Addis Ababa, MetaMeta, SNV-Ethiopia, IRC and the Technical and Vocational Education and Training College (TVETC) in Hawassa initiated the piloting of an innovative approach to training woreda staff using guided problem based learning at the place of work which is called Guided Learning on Water and Sanitation (GLOWS)

Key to the approach is that participants in the course obtain a set of training modules as a document, complemented by a CD Rom with the same course package and additional resource materials. The self-learning modules comprise key information, specific field assignments with 'learning-by-doing' exercises and a question and answer section where participants can check their own progress.

The field assignments are developed in small groups of participants from the same or adjacent woredas and thereafter these are shared with the course moderators and resource persons through the internet, normal mail and/or face to face contact. Trainers will come to the place of work of the small groups of trainees and will go with them into the field to jointly review the main field assignments.

GLOWS has been piloted at Woreda level in SNNPR with support from RiPPLE, SNV, MetaMeta and UNICEF and in Haraghe with support from RiPPLE, MetaMeta and the Dutch WASH Alliance through the RainFoundation. In both areas the program used trainers of TVETCs and resource persons from water and health bureaus and from the support organizations.

The positive response to GLOWS shows the potential of practical, problem-based learning, which now also is being incorporated in some of the regular training in some TVETCs. GLOWS is now being expanded in SSNPR and is also envisaged to be implemented in Hararge and Afar and entails the potential for a nation-wide up-scaling.

I General introduction to the course

Waterborne and sanitation related diseases such as cholera, yellow fever, hepatitis, diarrhoea and typhoid claim the lives of hundreds of thousands of people in Ethiopia each year. In 2010 only 97 percent of the urban and 34 percent of the rural population had access to improved water supply systems (UNICEF/WHO, 2012), and many of these are facing important water quality problems. Considerable efforts are underway however to improve the situation, with the result that the number of improved systems is growing but management and maintenance of these facilities is not well developed putting their sustained functioning at risks. For urban sanitation coverage in 2010 was 69% (private and shared facilities) and for rural areas this was 25%.

Hence an urgent need exists to establish possible water pollution risks and performance problems in rural water supply and sanitation systems which can have adverse health effects on consumers and mitigate these hazards where possible. Key water and health sector staff at Woreda level from government agencies and NGOs is in a very good position to help communities to ensure that their water and sanitation systems can be improved and sustained. To help sector staff in this role a practical training course has been established. This 120 hour course is being implemented in a guided self-learning mode over a period of three months. It comprises the following course modules:

1. ***Community water supply*** which introduces the participant in the complexity of water supply in small and medium size communities and presents an overview of systems that are applied in Ethiopia
2. ***Water quality risk management*** which introduces both chemical and microbial water quality assessment including sanitary inspections and suggests approaches to explore options to manage the related risks in the water cycle at community level
3. ***Water supply improvement*** showing a number of practical improvements to overcome problems in existing system
4. ***Sustainable multiple use water services*** introducing the concept of multiple use water services (MUS) and effect of seasonal influences on water use patterns to better assess and use existing water systems and exploring possibilities for support.
5. ***Sanitation and hygiene*** focussing on the assessment of the local situation and on options to reduce the transmission of sanitation and hygiene related diseases with emphasis on improving sanitation systems
6. ***Management and finance of WASH*** which presents an assessment of management systems and management tools that are in place and addresses the issue of financing
7. ***Process facilitation*** which introduces facilitation as a very important aspect of the work of sector professionals and trainers discussing facilitation issues related to active listening, group discussions, community consultations, and conflict mediation.
8. ***Community water and sanitation action planning*** which introduces a community based approach to improving the water and sanitation situation bringing together the learning in the previous modules leading to the development of a structured plan.
9. ***Example of a comprehensive WASH assessment report***
10. ***Example of a comprehensive Community WASH Action Plan***

At the end of the course participants will be able to:

- Assess together with the Water and Health Committee (WASHCO)[1] the water supply and sanitation situation in a community, adopting a broad perspective including seasonal water fluctuations and multiple water use.
- Assist WASHCOs and communities in establishing practical water, sanitation and hygiene (WASH) improvement plans at community level and to use this information to contribute to district level planning.

[1] In SSNPR a new regulation has been adopted in which the WASHCO is replaced by a Rural Potable Water and Sanitation Association with a legal status and a defined role that includes providing potable water services, collect funds to operate and expand the system and implement hygiene and sanitation work in the environment (Regulation 102-2012). For this manual we maintain the name WASHCO as the role is similar, particularly in water supply provision (but not the legal status)

II How to go about the course

This training course has been established to help participants to acquaint themselves with water and sanitation problems that may be present in communities in their working area and to enable them to, jointly with WASHCOs and community members, find possibilities to improve upon the situation. At the end of the course they will have guided the development of two community WASH assessments and action plans including participatory situation analysis, assessment and management of relevant risks and planning and introduction of important improvements. They will also be able to reflect on how this experience can be embedded in the Woreda planning cycle.

The course follows an innovative approach of guided self-learning, where participants can access training modules, resource materials and resource persons, in different ways. The access may be through a paper based approach, CD Rom or the Internet. Participants will learn in their work environment and have face to face contact with fellow participants, course moderators and resource persons. The structure and possible timing of the course are shown below. Timing is based on an on average availability of one day per week. A shorter period can be used if participants have more time available per week or are already having considerable experience.

Course structure and timing

Module	Activities	Timing of completion
Introduction meeting	Collection of information Formation of teams of trainees Identification of trainer per team Establish contact arrangement with trainer Review Module 1	Start (two day meeting; Alternative is to visit trainees and Woreda management in the Woreda office)
Module 1	Revisit module, meet with team, visit a water supply system[1] nearby and submit assignment	End of week 1
Module 2	Review module, meet with team, review a water supply system nearby and submit assignment (as an alternative you can submit the assignment together with assignment in module 3	End of week 3
Module 3	Review module, meet with team, visit a water supply system nearby and submit assignment, possibly together with assignment of module 2	End of week 5
Module 4	Review module, meet with team, submit assignment, possibly together with assignment of module 5	End of week 7
Module 5	Review module, meet with team, submit assignment, possibly together with assignment of modules 4 and 6	End of week 9
Module 6 and 7	Review module, meet with team, submit assignment, possibly together with assignment of module 5	End of week 11
Module 8 and 9	Review modules; visit a community with your team to make a detailed assessment. Submit assessment to trainer and make appointment for trainers visit. Discuss assessment with trainer and resource person (including visit to community). Incorporate comments in the assessment	End of week 13 or 14
Module 10	Review modules 8 and 10; visit the community to make the WASH plan and visit a second community to make an assessment. Submit both assignments to trainer and make appointment for visit of trainer and resource person;	End of week 16 or 17
Final assignment	Discuss with trainer and resource person the WASH plan for first community and assessment for second community; If needed visit one of the two. Incorporate comments and make WASH plan for second community. Submit assignments	End of week 18 or 19
Group meeting	Two day meeting of trainers and trainees to reflect on course and fine tune WASH Plans where needed	Week 20 End of course
1. For the assignments in the first 7 modules you need to find a place close to where you stay as this avoids travel. Only for the complete WASH assessments and action plans you need to work in a community but also in this case it should be easy to reach		

The course includes field assignments in which participants will work in small teams. Assignments in principal can be done in the community were participants are based. It will only be necessary to go to work in a specific community when reaching the stage of making full WASH assessment and action plans (modules 9 and 10). The advantage of this approach is that as participant you are well prepared when you reach this stage and in that way participating communities can benefit from the course results and will get advice about possibilities to improve their water and sanitation situation based on what you already have been working with. This makes that the time WASHCO members spent with participants becomes a contribution to their community and supports them in their role of WASHCO.

For convenience of the participants the following schedule is being included where they can keep track of their own progress.

Format for participants to register progress

Module	Questions answered	Assignments done	Main observation received from trainer
1		1,4.1; 1.4.2 and 1.4.3	
2		2.6	
3		3.5	
4		4.5.1; 4.5.2; and 4.5.3	
5		5.6	
6		6.5	
7		7.8.1 and 7.8.2	
8	No questions	1st assessment 1st action plan 2nd assessment 2nd action plan	

Module 1 Community Water Supply

This module provides an introduction to community water supply and an overview of systems used in Ethiopia. At the end of this module the participant will:

- *Be able to explain the dynamic character of community water supply, often comprising different water sources and technologies each involving possible health risks*
- *Have an overview of the main water supply technologies that are being used in Ethiopia*
- *Have provided an overview of the water supply systems in their Woreda and made a drawing of the water supply system of their choice*

1.1 Introduction

There are few issues that have greater impact on our lives than the management of water. Water is a basic requirement for human life; we need water to stay alive and maintain basic health and sanitation. We need it to grow our food, to maintain our industry and economy and to sustain our environment.

Access to safe water is a complex issue particularly in smaller communities. It is not a straightforward engineering problem. It is about people and much less about technology. Men, women and children may have different views about their water supply and its quality, and they, knowingly or unknowingly, interfere with their water supply systems.

"Everyone living in a specific place has access to some form of water supply"

This water supply may range from a polluted river or an open well to a piped water supply with house connections and treatment. Although some of these supplies may be unacceptable to outsiders, they may be well appreciated by the local user. People create their own 'world view' and have their own perception of their situation which is shaped by history. People living all their life in a polluted environment may be so accustomed to it that they do not appreciate possible health hazards. Children seeing that mothers handle faces of babies as if they are harmless are likely to adopt this behavior as well.

In many places we see that people continue to use traditional water sources even after handpumps have been installed for example because they do not like the taste of the handpump water or because they have to walk further, wait longer or have to pay and are not much concerned with concepts such as bacteriological quality.

"Never assume that people see potential health risks the way you see them"

In 2010 according to UNICEF/WHO (2012) 660 million people in the world did not have access to improved water systems, which are systems with a higher likelihood that the water is not polluted (Table 1). Ethiopia was one of the countries with lowest coverage and particularly in rural areas where coverage was only 34% in 2004.

Table 1.1 Qualification of water supply technologies (WHO/UNICEF JMP 2000)

Technologies considered "improved"	Technologies considered not "improved"
Household connection	Unprotected well
Public standpipe	Unprotected spring
Borehole	Vendor-provided water
Protected dug well	Bottled water[1]
Protected spring	Tanker truck provision of water
Rainwater collection	

[1] Not considered 'improved' because of potential limitations in water quantity, not the quality

In Ethiopia access in rural areas is defined as the percentage of the population that can obtain 15 litres per person per day living within 1.5 km from an improved water source (Universal Access Plan). So if in a community of 5000 people only 3000 live within 1.5 km from an improved water source the access is 100*3000/5000=60%, provided the source can supply 3000*15=45000 litres per day (45 m^3/day). If in this case the improved source only has a capacity 30 m^3/day then it can serve only 30000/15=2000 people (less than live within 1.5 km). In that case access is only 100*2000/5000=40%. This approach looks at installed capacity but does not explore whether people actually use the system what we define as coverage (% of people actually using a specific system).

Figure 1.1 Collecting water from a well in Ethiopia

It is important to realize however that even improved systems may provide water that is not safe for consumers. These systems may tap polluted ground or surface water sources that that may require some form of water treatment to make it safe to drink (as will be discussed in modules 3 and 4). Adding treatment however enhances the complexity of the system because trained staff is not always available, advisory support is usually lacking and chemical supplies are not reliable. But even if the water is safe at the point of collection, it may get contaminated if it is subsequently transported and stored. Hence thinking of safe water implies looking at the total water chain from the catchment area where the water starts its journey to the point of use and disposal (Figure 1.2).

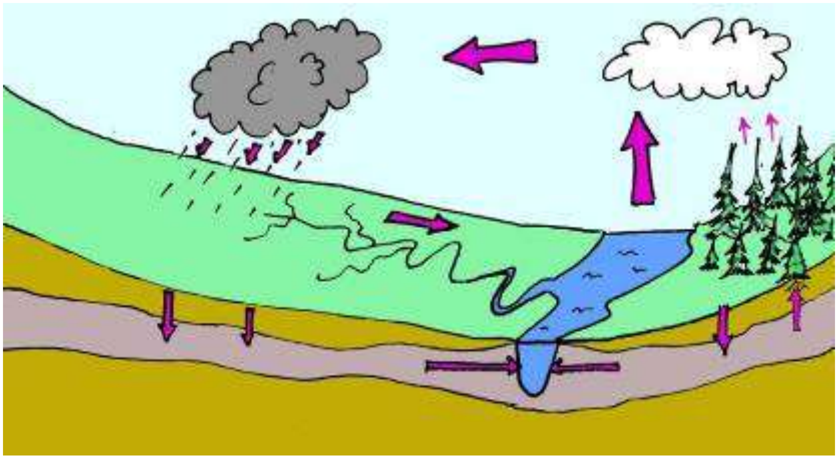

Figure 1.2 The water cycle

Different dimensions of community water supply

A community water supply system is not about technology alone. It is a much broader issue in which three dimensions can be distinguished (Figure 1.3).

- The community that uses the water
- The environment in which the community lives
- The technology that is used to transport the water and make it acceptable to use

These three dimensions are embedded in the political, legal and institutional framework of the country in which communities are situated. These dimensions are briefly described here, but more information can be found in Visscher (2006).

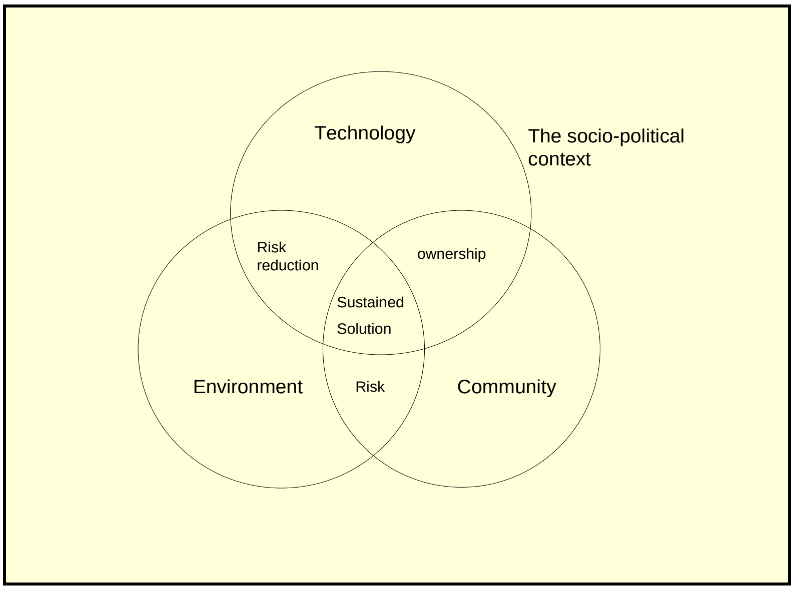

Figure 1.3 Conceptual framework for community water supply (Galvis et al., 1994)

The community comprises different groups of people usually with common and conflicting interests and ideas and different socio-economic and cultural backgrounds. The water supply system may be one such common interest, but can be a major source of conflict as well.

Long waiting lines at water points may lead to people jumping the queue leading to serious quarrels. Upstream users may leave too little water or may pollute the water for downstream users. Water vendors may be afraid to lose their income if new water systems are built etc.

Women often have interests different from those of men. Women may have to walk long distances to fetch water or may be buying it. Are they really heard when a new water supply is introduced in their community?

Figure 1.4 Ethiopia, queuing for water

The **environment** produces the water that the community can access. This dimension includes the available water resources, their pattern over the year and their level of pollution.

The interface between environment and community represents the risk the community has to overcome in relation to its water supply. This may include risk with a natural cause such as a high iron or fluoride content or climate change, but many risks are directly caused by people. People may pollute water in the catchment area by farming or cattle herding. They may construct latrines close to wells, touch water with hands that contain fecal material, etc.

Figure 1.5 People and cattle can contaminate the water source

Technology is the combination of the water supply system and the knowledge to develop and sustain it. It involves the hardware, its management, the available external support as well as the role of the consumers and their level of adoption and ownership.

The interface between environment and technology represents the availability of knowledge and practical options to reduce the risk of drinking polluted water. Risk reduction may involve technical interventions but also issues such as change in agricultural practices and change in behaviour of users.

The interface between technology and community deals with the type of solutions the community wants; is willing and able to manage and sustain; and that match their technical, socio-economic and environmental conditions and capacities.

Figure 1.6 Collecting funds for the maintenance of community ponds;

The dynamics of water supply systems

A water supply system is not static. It changes over time because:

- The community may grow which my imply that systems need to be expanded, or it may shrink, implying that less users are available to share the cost and other burdens;
- The technology may gradually reduce in performance because of wear and tear if not properly maintained and managed. This may go unnoticed for some time and may make people to turn to other sources; Another problem may be that when a new system is built, people no longer maintain the traditional systems and then get into trouble if the new system breaks down.
- Users may adopt new habits that affect their water consumption. Introduction of new systems (water flush toilets, showers etc.) may increase water consumption whereas water saving devices may reduce consumption. Also communities may start to use water for productive use;
- The environment may change possibly affecting the availability and/or quality of the water. This may include lowering water tables because of over abstraction of water or climate change but also deterioration in water quality because of erosion, use of fertilizers and pesticides, or changes in groundwater composition.

The dynamics of a water supply system need to be recognized and taken into account to ensure long term sustainability of the system. This also stresses the need to ensure adequate monitoring to assess if the situation is changing.

Sustainable water supply

The main challenge is not to build or improve a water supply system, but to ensure that it is sustained over time. Too many systems have been built that do not operate at all. The non-functionality of rural water supply systems in Ethiopia may be as high as 35%. This is a sad situation because many people have given their best effort but to no avail.

To ensure longer term sustainability in rural water supply in Ethiopia a number of key issues need to be in place:

- Together the different water supply systems in a community need to cater for the needs of the population
- The systems need to be of sufficient quality which is not the case in quite some locations
- The community needs to be able to sustain the systems financially and technically and needs to cope with their management often only having access to limited means
- Adequate back-up needs to be available (preferably at district level) to ensure that potential problems (technical as well as organizational) can be solved within a short period of time. This includes support for capacity building to train new operators and water committee members.

1.2 Overview of water supply systems in Ethiopia

People may take the water they need from different types of water supply systems, and can only survive for a few days without it. Based on the type of source we can make a distinction between:

- Groundwater based systems,
- Surface water based systems, and
- Rainwater based systems

Important differences exist in the quality of surface water, ground water and rainwater. Rainwater is usually clean but may pick up impurities from the surface from which it is collected. Groundwater may comprise excess chemicals, but is usually free from harmful bacteria and viruses unless the water is polluted for example by nearby pit latrines or during abstraction and transport. Most surface water is contaminated with harmful bacteria and viruses and may also contain other contaminants such as herbicides, pesticides and excess chemicals. For more details see Smet and van Wijk (2002).

People may use different systems

It is often overlooked that people may use different water systems in parallel or at different times of the year and for different purposes. To help improve upon the local conditions it is therefore essential to get detailed insight in the water culture, the way in which people deal with water and the water sources and systems they use. Figure 1.7 gives an example of the water supply in a rural community.

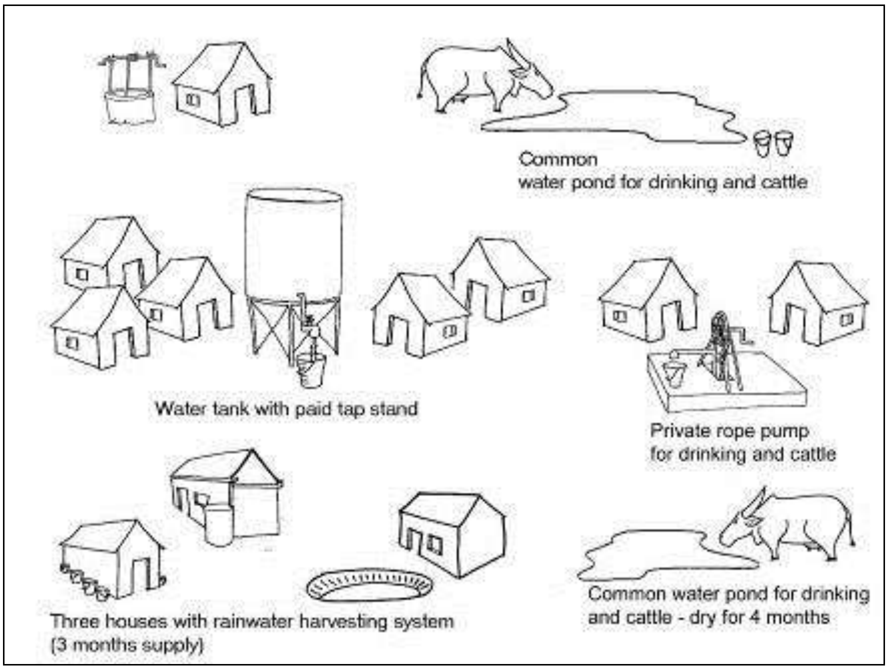

Figure 1.7 Example of a water supply system of a rural community

Table 2.1 Example description of a community water supply system

Type of source	**% of users[1,2]**	**Access**	**Type of use**	**Comment**
Tank with tapstand	60%; 40%	Public	Drinking and washing	Two periods of three hours per day; tariff. In dry season more users
Water pond 1	30%; 5%	Public	Drinking, washing, cattle, water vending	Two km distance, year round supply
Water pond 2	0%; 25%	Public	Drinking, washing and cattle	One km distance, 8 months water supply
Rope pumps	10%; 15%	Private	Drinking, washing, gardening and cattle	One pump falls dry for three months
Rainwater tank	0%; 15%	Private	Drinking	Supply for some four months

1. The percentage refers to approximate number of families using this as main household water source in the dry and wet season
2. As several sources run dry during part of the year the table has data for the dry and wet season

1.2.1 Groundwater based systems

In this group we can distinguish the following broad categories:

- Springs
- Shallow wells (unprotected or protected and with or without a lifting device)
- Deep wells with a hand or rope pump
- Deep wells with an engine driven pump and water tank
- Deep wells with distribution system (with or without treatment)

1.2.1.1 Springs

Springs can be found in different places often at slopes but sometimes also water may emerge under pressure at other places. In most cases this water will come from a confined water layer in the subsoil and therefore may be free from harmful bacteria and viruses. Spring protection (Figure 1.8) may make this water source even more valuable, but a lot of care is needed not to build up water pressure in the system you construct as this may result in the water finding another outlet leaving the spring without water.

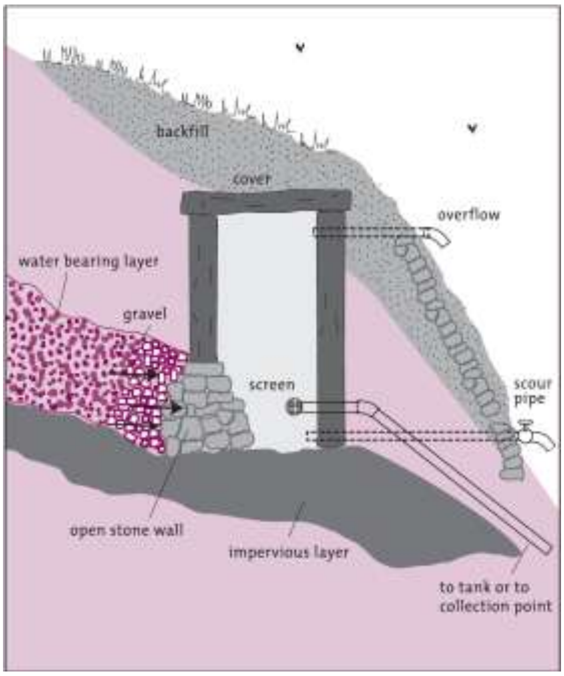

Figure 1.8 Spring capitation (WHO & IRC, 2003)

1.2.1.2 Shallow wells

Shallow wells are important water sources in rural areas and also in some urban areas. An important characteristic is that they usually tap water from a shallow aquifer which may be subject to seasonal fluctuation in water availability and to pollution from for example pit latrines. The systems may range from open dug wells to fully protected shallow boreholes.

Lined wells with a headwall (Figure 1.9) and properly sealed shallow boreholes are less prone to contamination by seepage of contaminated water around the well. Wells equipped with a rope and pulley system are less prone to pollution than wells were people use their own buckets. A pump (Figure 1.10) however is a safer solution as this minimizes the contact between the users and the water in the well. It has the disadvantage that when the pump is broken the water cannot be accessed. In dug wells a lockable manhole is therefore often included in the well cover for emergency use.

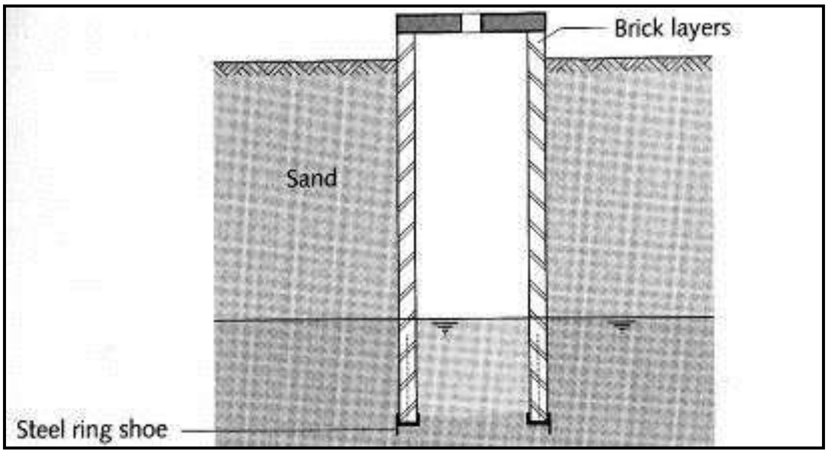

Figure 1.9 Lined dug well with brickwork (Source: IRC Small Community Water Supplies, 2002)

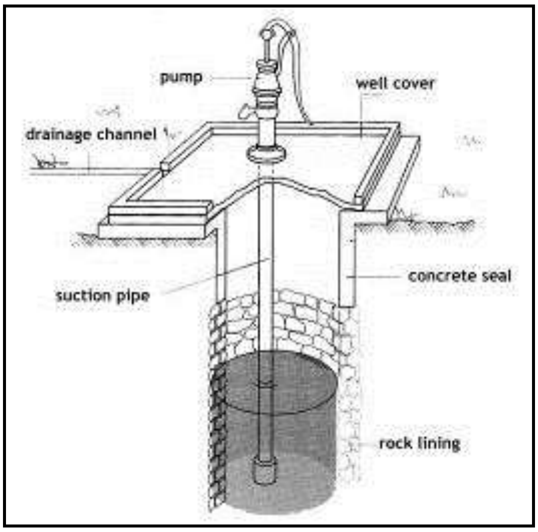

Figure 1.10 Lined well with hand pump (Source: IRC Small Community Water Supplies, 2002)

Different types of pumps can be used, but rarely this includes wind, solar, diesel or electrical pumps as the volume of water that can be abstracted from a shallow well is usually small.

1.2.1.3 Deep boreholes

An increasing number of deep boreholes are used in Ethiopia. They usually tap water from confined aquifers which is less prone to bacteriological contamination, but may contain too high concentration of chemicals such as fluoride.

Systems equipped with handpumps can be found in many places and if properly sealed can be quite safe in terms of bacteriological quality. Different types of pumps can be distinguished:

- Rope pump, in which the rope functions as a continuous chain with washers that lift the water from the well (Figure 1.11 and 1.14). A risk of contamination exist because of relatively free access to the rope, but this is relatively small if people do not touch the rope
- Suction pump, in which the cylinder is above ground. A risk of contamination exists because the pump may need to be filled with water to initiate pumping.
- Direct action pump, in which the cylinder is in the well (Figure 1.12). The plunger is directly connected to a handle at the surface. Very low risk of contamination if the pump is properly installed and maintained.
- Deep well piston pump with a handle or a wheel (Figure 1.15). It may also be animal or wind driven. The cylinder is in the well and the pump entails a very low risk of contamination if it is properly installed and maintained.

All these different types of pumps are used in Ethiopia. The trade marks include: India Mark II, Afridev, Rope pump, etc.

Unfortunately the quality of some of the locally produced pumps is very poor with a result of frequent breakdowns.

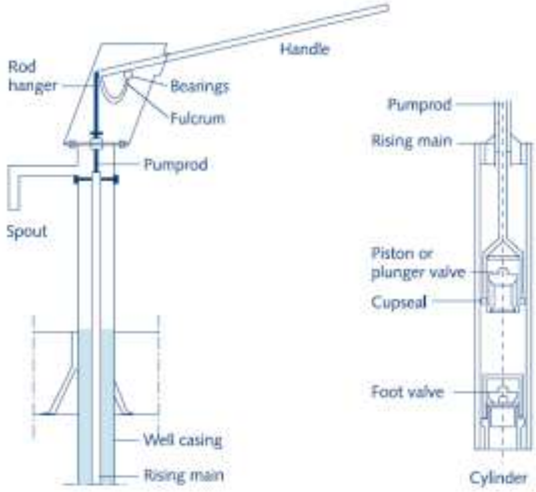

Figure 1.11 Well with rope pump **Figure 1.12** Deep well pump (source: IRC)

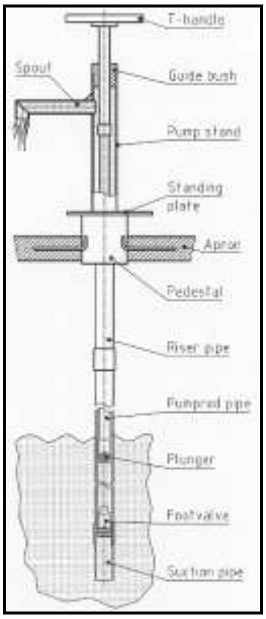

Figure 1.13
Direct action pump

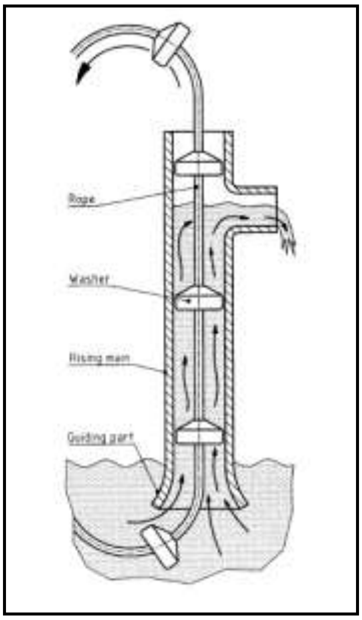

Figure 1.14
Rope pump

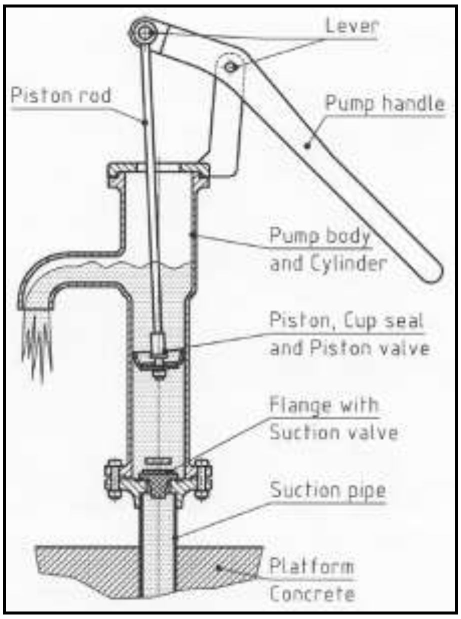

Figure 1.15
Suction pump

Figure 1.16 Different types of rope and pulley systems

Motorized systems with a storage reservoir are common in Ethiopia. The majority of the systems consist of a borehole with an electrical pump and sometimes a generator. People collect water against payment at tap stands connected to the reservoir others also include a distribution system and yard connections. In some systems water is chlorinated and some include water treatment related to the removal of Fluoride but also of Iron and Manganese. Obviously adding house connections and water treatment makes the system more complex.

Moterized systems may consist of an electrical deep well pump (Figure 1.17) which either is connected to the electricity grid or may be driven by a (diesel) generator (Figure 1.18). The pump usually pumps water into a storage tank at higher elevation or an overhead storage tank from where the water is being distributed to one or more tap stands (Figure 1.19). Different manuals are available with detailed information on this type of systems, some of which can be found in the RDRom with reference materials.

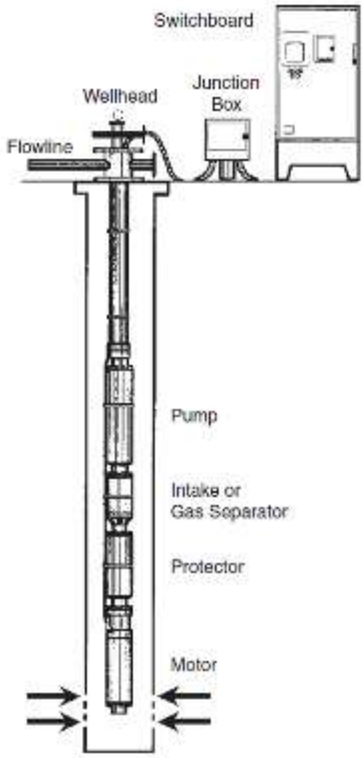

Figure 1.17 Submersible pump system
(Source Abate & Assefa, 2012)

Figure 1.18 Diesel generator

Figure 1.19 Tap stand connected to deep well

1.2.2 Surface water based systems

In this group the following type of systems exist in Ethiopia:

- Open sources (ponds, lakes, canals and rivers);
- Gravity water supply systems (with or without treatment)
- Pumped water supply systems (with or without treatment)

1.2.2.1 Open surface water sources

This type of system Figure 1.20) is still a very important water source for a large part of the population. The sources are often used for different purposes including drinking water, cattle and irrigation. Pollution levels can be considerable.

1.2.2.2 Gravity water supply systems

In hilly areas gravity water supply can be applied. Water may be captured from a spring, but more often the system uses a surface water source. In the latter case water treatment will be needed to make the water safe to drink. The number of water treatment systems in this type of supplies is still very limited in Ethiopia and therefore treatment systems will not be discussed in this module.

Figure 1.20 Water collection from an open source

1.2.2.3 Pumped water supply systems

The systems that pump water from surface water sources usually draw their water from contaminated sources. This implies that water treatment is required to make these sources safe to drink. Usually this involves some form of filtration and disinfection. As few of these systems are available in rural areas this is not discussed in this module

1.2.3 Rainwater based systems

In this group we can distinguish

- Direct collection in pots and pans
- Roof catchment systems
- Rain water ponds

Given the fact that most parts of Ethiopia receive no more than 3-4 months of rainfall per year, rainwater based systems are not likely to be the sole water supply option for a household or community(Figure 1.21). An exception may be the rain water ponds which may last longer. If rainwater is directly collected it is safe to drink unless the recipient is not clean or the water is contaminated by users. Water from roofs can be contaminated by bird or animal droppings.

Figure 1.21 Simple roof catchment and storage. Source: IRC.

1.3 Self Evaluation

This is an individual evaluation of your understanding of the information presented in this module. Answer the (multiple choice) evaluation questions and check your own answers (section 1.7). In case your answers had many mistakes it is suggested that you review the module again before doing the assignment.

Q1. Which technologies are considered improved?

A: Borehole, Protected dug well, Bottled water, Tanker truck provision
B: Household connection, public standpipe, protected dug well, rainwater collection
C: Household connection, public standpipe, vendor provided water

Q2. People with access to improved water technologies drink safe water

A: Yes
B: No
C: May not be the case

Q3. Once a water supply system is constructed we do no have to worry about whether it still meets the needs of the population.

A: Correct: Water supply systems are planned for long periods of time, 10 years or even 20 or 30 years, so they meet the demand of future populations
B: Correct: At least the first five to ten years we do not have to worry as the population will not grow that much.
C: Not correct: The population and their habits may change which may affect the water demand
D: Not correct: The people and the environment may change

Q4. A community water supply system is

A: A handpump
B: A piped water supply
C: A combination of rainwater harvesting and open wells
D: The combination of all possible water sources and technologies a community uses

Q5. Which of the following answers only includes groundwater based systems

A: Shallow wells, handpumps, ponds
B: Shallow wells, springs, dug wells, drilled wells,
C: Shallow wells, gravity piped water supply, drilled wells

Q6. Which of the following statements is correct?

A. Rainwater is always safe to drink
B. Ground water is safer than surface water
C. Groundwater may contain harmful bacteria

1.4 Assignment

In this section you will find the assignments related to this module. Preferably you first do this assignment for yourself and then you discuss with your training group and make one collective answer.

1 Make a list of the type of water supply systems and water lifting devices that are being used in the Woreda were you work. Include the English names, the trade mark and the local names of the different system and pumps.

2 Make a drawing and description (see table 2) of the water supply of (part of the community where you live. The overview should include the different types of water sources the community uses and the purpose for which they are being used.

3 Select one of the water sources and indicate what you think about the water quality and how you come to this conclusion.

Copy the collective answer of your group to questions 1, 2 and 3 and submit this to your trainer through the means of communication you have agreed upon. If you can send your response by email, you may not be able to send the drawing, but then you can send a brief description of the drawing.

1.5 References

Abate, B and Migbar Assefe, A., (eds.) (2009) Preventive Operation and Maintenance of Water Lifting Devices in the SNNPRS, a general guide line REVISED Final. Addis Ababa: SNV

Galvis G.; Visscher, J.T. and Fernandez, B. (1994). Overcoming water quality limitations with the multi-barrier concept: a case study from Colombia. In : Slow sand filtration. (pp. 47-60). Denver, CO: American Water Works Association.

UNICEF/WHO, 2007. The state of the world's children. New York: UNICEF; Geneva: WHO

WHO/UNICEF, 2012. WHO/UNICEF Joint Monitoring Programme (JMP) for water supply and sanitation. Geneva: World Health Organization and New York: UNICEF.

1.6 Further reading

If you want to explore these issues in more detail you may wish to access a number of additional titles in the internet (or on your CDrom) including:

- Van Wijk-Sijbesma, Christine. (1995). Gender in Community Water Supply, Sanitation and Water Resource Protection, a guide to methods and techniques. Delft, the Netherlands. IRC International Water and Sanitation Centre. (Occasional paper series 23). (http://www.irc.nl/content/download/2562/26426/file/op23e.pdf)
- Visscher, Jan Teun. (2006). Facilitating Community Water Supply Treatment: From technology transfer to multi stakeholder learning. Thesis Wageningen Universiteit. (http://www.irc.nl/page/29361)
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- Cardone, Rachel; Fonseca, Catarina. (2003). Financing and Cost Recovery. Delft, the Netherlands. IRC International Water and Sanitation Centre. (Thematic overview paper Series 7). (http://www.irc.nl/content/download/8160/126955/file/TOP7_CostRec_03.pdf)
- Smet, Jo; van Wijk, Christine (eds.) (2002). Small Community Water Supplies: Technology, People and Partnership. Delft, the Netherlands. IRC International Water and Sanitation Centre. (Technical paper Series 40). (http://www.irc.nl/page/1917)

1.7 Answers to self evaluation questions

Q1. Answer B. The other two answers include some technologies that are not considered as improved (Bottled water, Tanker truck provision, and Vendor-provided water)..

Q2. Answer C. The term improved water supply does not imply safe water as a considerable number of improved systems including handpumps and piped systems with house connections do not provide water of adequate quality. This may be because the source is polluted with chemical or bacteriological contaminants which is collected and supplied without treatment. In other cases treatment may fail. But also people may contaminate the water during collection, transport and storage.

Q3. Answers C and D are correct. The situation in a community and in the environment is not stable over time. Changes may occur that may reduce the water resources. Erosion may cause sources to reduce in flow or disappear. Also the community may grow thus requiring more water or shrink thus having fewer resources to maintain the system. The key message therefore is to stay alert and ensure that the system and possible changes in the community and the environment are properly monitored.

Q4. Answer D is the most generic answer. It is essential to realize that people may use different water sources in parallel or different members of the community use different sources. Hence the water supply system of the community involves all the available sources and technologies. Often the poorer sections in the community are at a disadvantage because they may use sources that entail a higher hazard or are farther away.

Q5. Answer B and depending on the local conditions answer C. Answer A includes ponds which are surface water sources. Answer C includes gravity piped systems which in many places take water from a surface water source but some take water from springs.

Q6. Answer C. Groundwater may indeed contain harmful bacteria stemming for example from nearby pit latrines. The first statement is not correct because rainwater may become contaminated during collection. In many circumstance the second statement will be correct, but there are also cases that groundwater is more polluted than surface water.

If you failed to provide several of the correct answers, then review this module again.

Module 2 Water Quality risk management

This module provides an introduction to water quality in community water supply. It discusses some key water quality parameters taking into account that water quality testing has very important limitations in many locations and therefore it concentrates more on a practical approach using sanitary surveys. At the end of this module participant will have:

- *A better understanding of key water quality aspects and related hygiene risks*
- *Explored what main risks of contamination exist in water supply systems*
- *Undertaken a sanitary survey of a water supply system of their choice.*

2.1 Introduction

Safe, adequate, accessible and reliable drinking water is essential for human health. A person needs, on average, a daily intake of water that ranges from 1.8 to more than 10 litres, depending on the conditions. Someone doing hard labour in the sun requires much more water than a person resting in the shade (Cairncross and Feachem, 1983). People need also water for other purposes including their livestock and possibly for (small plot) irrigation and (small scale) industry.

Water can cause the person to become ill, as it may contain:

- Microbiological contamination that can lead to diseases such as diarrheas and dysenteries caused by bacteria, viruses or protozoa, enteric fevers and worm infestation.
- Chemical contamination causing diseases such as fluorosis and arsenic poisoning, as now reported from several countries.

The problem is that we cannot see most chemical and/or bacteriological contamination. As a result many people judge the water just by their senses (pleasant in taste, cool, free from visual contamination, free from odor) and others just take whatever they can get or are used to. In all of these cases however this water may cause disease if it contains contaminants.

In the world as a whole, approximately 10.8 billion cases of diarrhoea each year cause 1.7 million deaths, mostly among children under the age of five (Mathers et al., 2003; WHO, 2005). A considerable number of these cases can be attributed to poor sanitary conditions. Intestinal worms which infect about 10% of the population of the developing world are also a problem. These can be controlled through better sanitation, hygiene and water supply. Intestinal parasitic infections can lead to malnutrition, anaemia, retarded growth and development, depending upon the severity of the infection.

Ensuring that people can drink water that is bacteriological and chemically safe and have sufficient water for their personal needs including to support their livestock and food production can reduce the suffering of many people

The water people obtain for drinking purposes should be free of chemical substances and micro-organisms that can result in rejection or disease among users, or in deterioration of the water supply system and domestic utensils. Clean water can be ensured by selecting water sources that are not contaminated or by removing contaminants by water treatment. Yet the provision of clean water may not be sufficient. Water from point water sources such as handpumps will be transported from the source to the point of storage at homes. This implies a considerable risk of contamination during transport and storage that depends on the "water culture" of the users.

As discussed in module 1, a household connection has a much lower risk of recontamination, but the water may be obtained from polluted sources and may not be properly treated. In many countries, service providers do not meet their legal obligation to supply safe water to the consumers. Many water supply systems both in urban and rural areas are operating intermittently and do not include adequate water treatment.

So we can conclude that water quality hazards may exist in all steps in the water chain from catchment to consumer. To assess these hazards the sanitary inspection or sanitary survey has been developed as will be explained in this module. This approach allows to establish the most important biological and chemical hazards related to the water supply and to identify control measures to reduce the risk that these hazards represent for consumers. It basically consists of a systematic assessment of the total water chain from catchment to consumer.

2.2 Key issues in water quality

Water quality is an important issue that may determine whether the water can be used for specific purposes such as drinking water, personal hygiene, cattle and/or irrigation. Drinking water must be free of substances that may create disease, and preferably with a taste, smell and temperature that is pleasant for the users. Water quality can be described in terms of its physical, chemical, and biological characteristics as will be explained in this section. The information is kept concise and primarily relates to community water supply. It also takes into account that in many locations water quality testing may not be feasible for example for lack of equipment. In case you do have such equipment than you may want to look at the more comprehensive overview that can be found in the CDRom with resource materials for this section such as the WHO guidelines for drinking water quality, volume 3: surveillance and control of community supplies, which includes also procedures for water sampling.

2.2.1 Physical aspects

The physical aspects of drinking water concern taste, odour and appearance. These aspects often determine whether consumers drink and like the water and this is also influenced by their experience and customs. Standards are available (Table 2.1) which if complied with will usually lead to consumers acceptance of the water.

Table 2.1 Ethiopian standards for the physical characteristics of drinking water

Characteristic	Maximum permissible level
Odour	Unobjectionable
Taste	Unobjectionable
Turbidity (NTU)[1]	5
Colour (TCU)[2]	15

1. **Turbidity** is the cloudiness of a fluid caused by particles (suspended solids) that are generally invisible to the naked eye, similar to smoke in air
2. The **colour** of a water sample is caused by both dissolved and particulate material in water, and is measured in **Hazen Units** (HU).

The physical aspects may also be an indication for possible risks that may be associated with the water. A bad smell for example may be caused by contact with waste or waste water. High turbidity is an indication that soil particles but also possibly other contaminants may be present in the water. Color may for example be an indication of the presence of decomposed organic materials or of high iron content.

2.2.2 Chemical water quality

There are few chemical components that produce an acute risk for users, except for situations where accidents occur in industry or through the spraying of pesticides and herbicides. In such cases, the water is often rejected by the consumers. Chemical pollution may, however, bring a chronic health risk associated with long periods of exposure, as can be seen from the incidence of arsenic or fluoride poisoning which may lead to dental fluorosis (Figure 2.2) or even more serious forms such as bone fluorosis.

Figure 2.2 Dental fluorosis a sign of long term exposure to high concentration of fluoride

Detailed guidelines are available for example from WHO and from the Government of Ethiopia concerning the maximum concentration of chemicals in drinking water. We have included a few indicators in Table 2.2, but a more elaborated list is beyond the scope of this module as it would need support from qualified laboratories. If you want to learn more on these aspects that it is suggested that you look at the resource materials that come with this module. Here the idea is to just give a brief indication of the situation focusing on some parameters that seem most relevant in your daily context.

The few existing data show that water quality across Ethiopia is highly variable. It ranges from fresh waters in many of its rivers, springs and wells to more saline waters and waters with high concentrations of fluoride especially in the Rift zone. Areas with high nitrate concentrations are found in shallow groundwater and particularly in urban areas because of leaking septic tanks (BGS, 2001). Iron and manganese may be a problem in different areas, but these are not so much a direct health problem but may cause stains in clothing and a brown or greyish color of the water and create an unpleasant taste. It may also make the water less suitable for cooking as rice may turn black. Still a health problem is associated with this because people may dislike the taste and may for example use polluted surface water instead. Finally nitrates may be a problem in some areas mainly due to pollution stemming from agriculture but also septic tanks and latrines. For healthy individuals high nitrate levels are not a problem, but it may be a risk for babies under 6 month. Another potential risk is entailed in the discharge of waste water from industry, but this often concerns complicated toxic waste and will require specialist research to detect the problems and possible solutions.

So the the main approach to cope with chemical contamination suggested in this manual is to try and find a better source, as the alternative of water treatment adds considerably to the cost and complexity of the water system.

Table 2.2 Guideline values for Ethiopia for some constituents in drinking water (MoWR)

Constituents	MoWR guideline
pH	6.5 – 8.5
F^- (mg/L)	3.0
Mn (mg/L)	0.8
Fe (mg/L)	0.4
Total coliform/100 ml	0
E. Coli	0

2.2.3 Biological water quality

The contamination of a water source with excreta from people or animals introduces a great variety of bacteria, viruses, protozoa and helminthes (parasitic worms) (Figure 2.3). Insufficient protection of water sources, or inadequate treatment, handling and storage, thus puts the community at risk of contracting infectious diseases. An important problem is that the risk of bacteriological contamination may not be perceived by the community as the pollution is often not visible. Local people may value the taste and appearance of the water, but not its bacteriological quality unless they understand the risks.

Figure 2.3 Water can be polluted by people but also animals

The problem with the microbiological quality is that you cannot see it and you cannot be sure that a water source is polluted. Another problem is that there are many bacteria and viruses but only few of them are pathogens (harmful bacteria and viruses that can cause disease). It is however impossible to just measure the pathogens as these are very divers and often present only in small numbers. So an approach has been adopted that assumes that when water has been in contact with excreta from human beings and warm blooded animals there is a considerable change that this water may not only include harmless bacteria but also some pathogens. This approach makes the situation less complex as now we just need to look at an **indicator,** a bacterium that can tell that the water has been in contact with feaces.

Indicator bacteria
The coliform organism is commonly used as indicator for the presence of water pollution. It is a very common group of bacteria that by itself is not considered to cause disease but is a good indication of potential pollution as it is for example members if this group of bacteria are present in large numbers in human excreta. Two indicators are being used: ***Total Coliform*** and the ***Termo tolerant Coliform*** (which used to be referred to as Faecal Coliforms) (WHO, 1997).

Total Coliform is measured by taking a water sample and incubating this for 48 hours at 35 ^{o}C. This test measures the presence of coliform bacteria, and therewith establishes a potential risk of contamination. Yet many of these organisms are not exclusive to human excreta, but live in the soil. Hence this indicator has important limitations.

It is therefore better to look at **Termo Tolerant Coliform (TTC),** mainly comprising Escherichia coli, a subgroup of the total coliform group that are exclusively or almost entirely exclusively present in faeces of people and warm-blooded animals" (Cairncross and Feachem, 1983). These bacteria are always excreted in large numbers by people and animals, irrespective whether they are healthy or sick". The test involves incubating a sample for 24 hours at 43.5 ^{o}C

Two general types of analyses are possible to enumerate TTC:
1. MPN - Most Probable Number
2. Membrane Filter - MF

As very few of Woreda based staff have access to equipment to carry out these tests themselves, these are not discussed here. A more feasible alternative may be to take a water sample and transport it packed in ice to a laboratory where it should reach within 6 hours to start testing. For the collection of the sample you need it to be representative for the source you want to test and you need to avoid that you pollute the sample during sampling. Another important point is to use proper sterile containers for the sample and clearly indicate the time and location of the sampling. If you do not have such containers you can use a bottle with a cap, but you will need to disinfect this bottle preferably by boiling it for 20 minutes. Further information on water sampling and testing is not included in this manual but more can be found including detailed sampling and test procedures in the resource materials.

Still it is relevant to underscore that often tests may not be needed or may have little value by themselves. If you see that water is in direct contact with excreta (for example an area with open field defecation directly draining into the water source), then it is obvious that Coliforms are very likely to be found if you would test the water. So it is better (and cheaper) only test in situations where you think that the water might be safe to drink but do not feel totally sure. Furthermore test results are only indicative as they relate to the specific moment in which the sample was taken. A sample taken just after a rainy day may give very different results from one taking in a dry period. To cope with this difficulty WHO has introduced the concept of sanitary inspections.

2.2.4 Sanitary Inspections

When visiting a water supply system, a well, a handpump, a piped supply, or a water container in a house, it is often possible to spot possible deficiencies that could lead to the pollution of the water in the system. Buckets to collect water may be left on the ground next to well, surface water may leak into a storage tank because it is cracked, and people may take water out of the container touching the water with their hands. These are all examples of possible contamination which you can spot yourself. This type of assessment is the basis for the sanitary inspection or sanitary survey, which is a technique that records visible problems, enabling fieldworkers to assess the possible risk of contamination in a specific water system.

A sanitary inspection (sanitary survey) consists of a systematic review of possible hazards that may occur in the water supply chain from catchment to consumer (catchment area, water source, water supply system and household water storage and use) (Lloyd, B. and Helmer, R. 1991). Preferably this is done by experienced sector staff, together with community members and staff from the local organization responsible for the management of the system. The main reason to include the sanitary survey in this manual is that it is the only option that is available to all Woreda based staff as it just needs common sense and no equipment. It will allow you to get an impression of the possible risk of contamination and it will allow you to pointing this risk out the WASHCO or even better by jointly visualizing the risk. At that time you can also try to get some information about possible problems with diarrhea from the WASHCOs as this is a good additional source of information. Another point is that after some training, inspections can be carried out (several times per year) by the WASHCO themselves as one element in water supply monitoring.

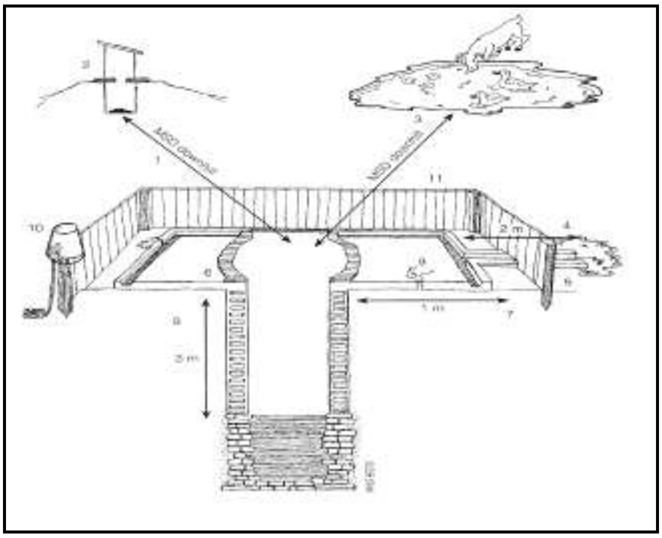
The inspection aims at identifying all the hazards that are potential and actual causes of contamination of the water. It is concerned with the physical structure of the system, its operation, and external environmental factors (WHO 1997). It involves looking at all water sources and systems in a community (water catchment area, well, handpump, water intake, transmission main, treatment system, water storage, distribution network and water use) to identify possible risks for the users (WHO 1997). It is important to note that in most of the literature sanitary inspections are often linked with water safety plans and focus primarily at piped supplies. They are equally relevant however for handpumps, wells and other water sources used in community water supply.

The main steps involved in a sanitary inspection of a community water supply include:

1. Identification of all water sources and water systems in the community and their use
2. Exploring the water chain in each of the systems from the source to the water use at household level. This implies making a brief sketch of each system looking at where the water is captured, how it is extracted (pump, well etc), how it is collected and stored.
3. Identification of the risk of contamination in each component of the chain (pollution of the source, infiltration through cracks in the well cover, contamination of water during transport etc.) by observation and discussions with users
4. Documenting this information (and as a next step exploring how to reduce risks)

Sanitary inspections will provide insight in the sources of contamination and risks involved. They are the basis to establish corrective actions in the system, the community, and community habits, to eliminate or reduce the hygiene risks.

Figure 2.4 shows an overview of the sanitary hazards in a shallow well. The possible hazards include:



- Possible sources of pollution (latrines, ponds or pools) close to the well. Harmful substances from these sources may travel underground to the well. The minimum safety distance (MSD) depends on local conditions including the type of subsoil and direction of groundwater flow.
- Problems with the well lining, headwall and cracks in the well cover
- Unhygienic handling and storage of the bucket

Figure 2.4 Potential pollution hazards in an open well with bucket (WHO, 1997)

For a piped water supply systems the situation is often more complex and you will need to look at all parts of the system (see for example Figure 2.5 in the next section). If the source is deep groundwater then it usually will be free from bacteriological contamination unless water can infiltrate directly into the well. The water storage is the easier part as you can often see the tank and this may be actually above ground. The network however is buried so you cannot see the risks. As most of the piped networks operate intermittently pipes will be without pressure for quite some time and therewith a risk of contamination occurs which is even higher if pipes pass through areas with stagnant water etc. At the collection point again pollution may occur during fetching and transport (for example by using dirty containers) and thereafter during storage and use in the homes (for example by using uncovered containers). A form can be used to help you do a systematic assessment of the type of system is shown in Table 2.3. For more information and other sources review WHO, 1997 which is included in the CDRom

Table 2.3. Assessment of the sanitary risk of a Covered dug well with a handpump (WHO, 1997)

	Community:		
	Date of visit:		
	Issue	**Risk**	
1	Is there a latrine within 10 m of the well and hand-pump?	Yes	No
2	Is the nearest latrine on higher ground than the hand-pump?		
3	Is there any other source of pollution (e.g. animal excreta, rubbish) within 10m of the hand-pump?		
4	Is the drainage poor, causing stagnant water within 2m of the cement floor of the hand-pump?		
5	Is there a faulty drainage channel? Is it broken, permitting ponding?		
6	Is the wall or fencing around the hand-pump inadequate, allowing animals in?		
7	Is the concrete floor less than 1m wide all around the hand-pump?		
8	Is there any ponding on the concrete floor around the hand-pump?		
9	Are there any cracks in the concrete floor around the hand-pump which could permit water to enter the hand-pump?		
10	Is the hand-pump loose at the point of attachment to the base so that water could enter the casing?		
11	Is the cover of the well unsanitary?		
12	Are the walls of the well inadequately sealed at any point for 3m below ground level?		

Sanitary inspections and water quality testing
Sanitary inspections and water quality analysis (2.2.5) are complementary activities. Whereas the sanitary inspection identifies potential risks, the water quality analysis establishes the level of contamination at the point and the time of sampling. The sanitary inspection is essential for the interpretation of the results of the water quality analysis and to prioritize remedial actions. The difficulty with water quality analysis is that it is just a snap shot and therefore may not at all be representative for the situation. Furthermore it may be quite difficult in many situations to find the necessary equipment and chemicals, whereas the sanitary inspection combined with users information is always feasible. On the other hand it is not sufficient to estimate water quality risks related for example with chemical substances such as Fluoride. Furthermore the regulations in Ethiopia prescribe that water supply systems need to meet certain water quality criteria which makes water quality testing a necessity, particularly when developing a new system.

Climate conditions may have an important influence on water quality. Particularly in micro-catchments these changes can be of short duration and may be difficult to detect with occasional water quality testing. The sanitary inspection can be of great help in such case. Waste water discharge often is more critical in the dry season when less water is available. First rains after a dry spell can severely enhance the microbial and chemical contamination of a water source and increase turbidity levels.

The community is an important source of information. They know about changes in water quality during and over the years in terms of turbidity, colour and taste (salinity, iron). Also they may be able to give an indication of the incidence of water borne diseases in the community. Hence their information can help to confirm the findings of a sanitary inspection. One would expect a high incidence of diarrhea if the sanitary inspection shows that there are considerable sanitary risks from the source and/or inadequate hygiene habits.

Although there are numerous contaminants that can compromise drinking-water quality, not every hazard will require the same degree of attention. The risk associated with each hazard or hazardous event may be described by identifying the likelihood of occurrence (e.g., certain, possible, rare) and evaluating the severity of consequences if the hazard occurred (e.g., insignificant, major, catastrophic). The aim should be to distinguish between important and less important hazards or hazardous events.

A semi-quantitative scoring can be used relying to a significant extent on expert opinion to make judgments on the health risk posed by hazards or hazardous events. A "cut-off" point must be determined, above which all hazards will require immediate attention. On the other hand, there is little value in expending large amounts of effort to consider very small risks.

2.2.5 Water quality parameters

Ethiopia has comprehensive water standards that are based on the WHO guidelines. But the WHO (2005) suggests that these types of standards are too complex to adhere to in rural areas and municipalities with limitations in infrastructure. WHO (1997) presents a much less prescriptive approach, which combines the use of a few water quality parameters and the implementation of sanitary inspections.

The water quality parameters in the minimum WHO approach to community water supply include:

- Turbidity
- E. coli counts (the indicator discussed in section 2.3)
- residual chlorine (if chlorine is applied)
- pH (if chlorine is applied)

Even these very few parameters are still difficult to measure on a regular basis. Hence an approach may be to sample only regularly those systems that are susceptible to pollution and or are the water source for large populations. For other schemes, the quality of water is monitored through sanitary surveys, and water quality testing is only carried out when pollution is suspected or an outbreak of water-borne disease is reported.

Another important aspect is to view the water quality in the context of local conditions. In an area where there are numerous other potential routes of disease transmission, the impact of less stringent water quality norms may be lower than in very clean environments.

2.3 Identification of water supply hazards

Managing hazards implies confronting situations that pose a level of threat to life, health, technologies or environment. Most hazards are dormant or potential, but once a hazard becomes 'active', it can cause harm. The risk involved in a hazard (and the management attention it merits) depends on the likelihood that it can become active and the seriousness of the damage it can cause.

To establish the risk involved in a hazardous event in a water supply we need to explore:

- The hazardous event
- The likelihood of its occurrence, and
- Its potential impact on water quality or quantity

Howard (2002) distinguishes three categories of factors that need to be explored:

- Hazard factors; Potential sources of feacal material or chemicals situated so that they may contaminate the water supply (e.g. the location of a pit latrine or waste dump in relation to the water source).
- Pathway factors; Potential routes by which contamination may enter the water supply (e.g. eroded backfill areas of protected springs, cracks in well covers, or leaking pipes).

- Indirect factors; Factors that represent a lack of a control measure to prevent contamination (and therefore increase the likelihood of a hazard or pathway developing). The absence of a fence, for example, will not lead directly to contamination, but may allow animals or humans to gain access to the source and create either a hazard (through defecation) or a pathway (through causing damage to the source or its immediate surroundings).

Assessing hazards and risks implies that the water supply chain needs to be reviewed very carefully while taking into account possible problems in the design, construction, operation and maintenance of all components in the water chain (catchment area, wells, pumps, pipes, storage vessels at homes etc. These may all influence the type of hazardous events that may occur and the associated risk (in particular the likelihood of occurrence).
The sanitary inspection is the main tool to assess the risks, but it is not a one off activity as risks involved in hazardous events and pathways may vary during the year and change over time. For instance in rural areas microbial contamination may peak at the start of the rainy season but then rapidly diminish as the reserve of faecal material diminishes. Man-made interventions in catchment areas may cause erosion and change of runoff patterns which may negatively affect springs in terms of quality and quantity.

The sanitary survey also needs to take into account problems caused by the technology and inadequate maintenance. This may for example result in lower production levels of pumps which may lead to longer waiting times at collection points. Users than may go to alternative (polluted) sources or buy water from vendors (forcing them to spend more on water). As such problems may be the result of poor management and financing, also these aspects need to be explored as will be discussed in more detail in the other modules in this course.

2.4 Management of the risks in the water supply chain

Managing the risk of transmission of water related disease related to drinking water supply starts with looking at all the hazards that may occur in the supply chain from collection to use (Figure 2.5). The overview of hazards and the level of occurrence will provide insight where to focus our interventions.

Some of these interventions are very feasible to implement in existing systems, but some hazards need to be or can better be addressed at the design stage. This may include, for example, choosing a protected water source with good quality water, ensuring a sanitary seal at the top of a dug or drilled well, or including a very robust treatment system.

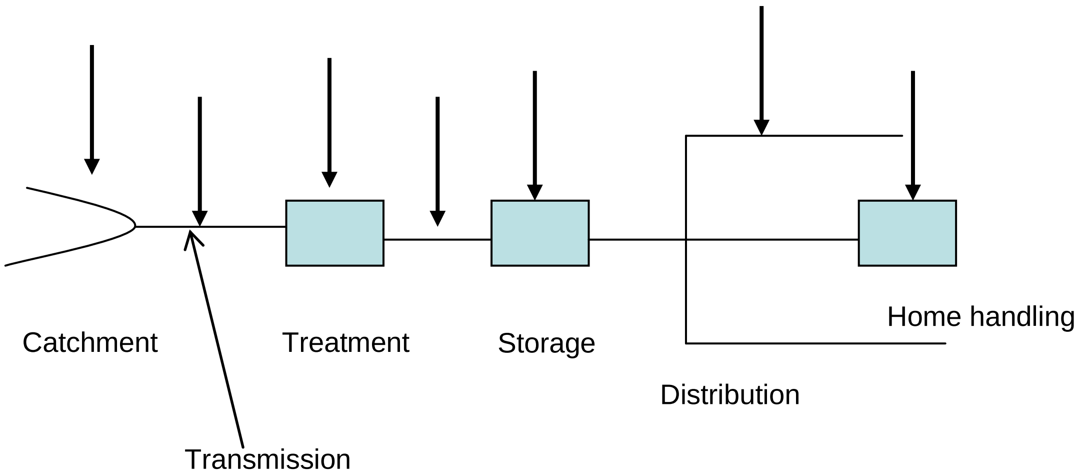


Figure 2.5 Examples of a water supply chain (arrows indicate potential risks)

2.4.1 Managing hazards related to water sources

Looking at managing hazards related to water sources implies posing a number of questions

- Where is the water coming from?
- What are the main microbial and chemical contamination hazards?

- What are the main pathways that exist for contamination to enter the source?
- Who are the main actors involved and in what way do they contribute to the risk?
- Can hazards and/or pathways be reduced or blocked?
- Is the technology in good shape and well maintained?
- Is the management properly functioning?

The answers to these questions are water source specific, but may be quite generic in similar communities in the same area. Once we know the answers it may be possible to take specific action to prevent or strongly reduce the risks. A number of possible actions for different water sources are presented in Tables 2.4 and 2.5. Additional information on some of the actions such as disinfection is presented in module 3.

Table 2.4 Action to prevent or reduce sanitary risks in existing groundwater sources

Hazard and pathway	Remedial action
Pollution of aquifer "upstream" of the water source by infiltration	Avoid or remove latrines, cattle ponds and pools close to the water collection point. The 'safe distance' needs to be assessed locally as it depends on the travel time of harmful bacteria or chemicals and the direction of flow of the ground water.
Changes in run-off patterns because of interventions in the catchment area	Regularly review catchment area to ensure adequate protection; avoid: overgrazing, deforestation, spraying with chemicals etc.
Direct infiltration of polluted water in the source	• Ensure fencing of springs to avoid erosion of the protective cover (back fill). • Review system components (spring box, well cover etc.) for possible cracks and repair them • Ensure that safe water is used for possible priming of pumps • Avoid the use of unclean buckets in protected wells • Carry out repairs in a hygienic way and if possible disinfect afterwards • Disinfect the source if pollution has occurred (which may be shown by an outbreak of diarrhea)
Wells running dry and/or salt water intrusion	Avoid possible over-pumping of groundwater as this may cause a fall in the water table. In some areas it may also result in salt water intrusion. Another option to look into is to enhance recharge of the well for example by improvements in the catchment area or by building of subsurface dams

Table 2.5 Action to prevent or reduce sanitary risks in existing surface water sources

Hazard and pathway	Remedial action
Pollution of water source "upstream" of the point of collection	Avoid or remove, waste water discharge, cattle grazing, human intervention and agricultural activities that may affect the water quality and water availability. Adequate water catchment protection is a good start to ensure good water quality, but almost always some form of treatment will be needed
Changes in run-off patterns because of interventions in the catchment area	Regularly review catchment area to ensure adequate protection; avoiding overgrazing, deforestation and inadequate land management. Construct bunds and implement other protection and corrective measures if erosion is increasing.
Direct infiltration of polluted water in the water intake and water transmission pipe	• Ensure fencing of the water intake. • Review system components (water intake and transmission pipe) for possible cracks and leakages and repair them • Close intake if water quality deteriorates (dead fish, bad smell, strange color etc.)

2.4.2 Managing hazards related to water treatment

Although few rural water supply systems in Ethiopia involve water treatment still some issues are mentioned here that need to be looked at if water treatment or disinfection is included. Key questions that need to be posed include:

- Are the treatment processes adequate to produce a water that is attractive and low in sanitary risk;
- What are the main hazards that need to be addressed in terms of microbial and chemical contamination during the treatment process?

- What are the main pathways that exist for (re)contamination of the water during treatment and storage?
- Who are the main actors involved and in what way do they contribute to the risk?
- Can hazards and/or pathways be reduced or blocked

The answers to these questions are specific for each water treatment system, but may be quite generic in similar communities in the same area. Once we know the answers it may be possible to take specific action to prevent or strongly reduce the risks. A number of possible actions for different water sources are presented in Table 2.6. Additional information on some of the actions such as disinfection is presented in module 3.

Table 2.6 Action to prevent or reduce sanitary risks in water treatment and related storage

Hazard and pathway	Remedial action
Inefficiency of water treatment processes	• Monitor the treatment processes and take action when required indicator levels are not met • Ensure adequate operation and maintenance • Explore if the operator occasionally by-passes the water treatment system, explore why and try to solve the problem
Problems with overdosing chemicals in treatment	• Over dosing of chemicals such as alum sulphate or chlorine may not represent a direct health hazard, but it can be dangerous as people may reject the water and use polluted sources instead. Monitor as feasible and take immediate action if problems are encountered or users complain.
Ineffectiveness of disinfection process	• Monitor chlorine level at strategic locations. Review functioning of the equipment and chlorine dose if indicator levels are not met
Direct infiltration of polluted water in treated water or in the central storage tank	• Review system components (tanks, pipes, boxes and valves) for possible cracks or other damages and repair them • Ensure that safe water is used for possible priming of pumps and cleaning • Avoid the use of unclean equipment, boots etc. in O&M • Carry out repairs in a hygienic way and if possible disinfect afterwards • Disinfect the clean water pipes and storage tank if pollution has occurred (which may be shown by an outbreak of diarrhea)

2.4.3 Managing hazards related to water transport and distribution

In water transport and distribution we can distinguish three main situations:

- **A piped water supply system**, which is a convenient system that may entail some hazards primarily related to the intrusion of polluted (ground) water through leaks into the system or cross connections with pipes that contain polluted water
- **Manual transport by users** often in open containers with a considerable risk of contamination by hands and dirt.
- **Mechanized transport by water vendors** which in most countries is not well controlled. Risk involved may be considerable because of poor handling of the water, but also water may be collected from polluted sources

For each situation the main questions are the same

- Is the water of good quality when it enters the distribution system;
- What are the main hazards that need to be addressed in terms of microbial and chemical contamination during distribution?
- What are the main pathways that exist for (re)contamination of the water during distribution?
- Who are the main actors involved and in what way do they contribute to the risk?
- Can hazards and/or pathways be reduced or blocked

The answers to these questions will depend on the type of distribution and local conditions, but may be quite generic in similar communities in the same area. Once we know the answers it may be possible to take specific action to prevent or strongly reduce the risks. A number of possible actions for different water distribution options are presented in Tables 2.7 and 2.8. Additional information on some of the actions such as disinfection is presented in module 3.

Table 2.7 Action to prevent or reduce sanitary risks in piped water distribution

Hazard and pathway	Remedial action
Water pressure is not maintained during 24 hours	• Maintain continuous pressure on the pipes to avoid infiltration by improving efficient water use (leakage control and reduced consumption) to improve water pressure conditions • If 24 hours supply is not feasible test water quality at taps in strategic locations particularly after periods of low or no water pressure • Ensure water treatment at home
Pipes are buried and pass through water logged areas or close to waste drains	• Improve drainage and/or reinstall the pipes in areas that pose a risk • Test water quality at taps in strategic locations • Ensure water treatment at home if needed
Water is contaminated because of repairs of the distribution system	• Carry out repairs in a hygienic way and if possible disinfect afterwards • Inform users that the water supply will be interrupted for a given period (to allow them to store water) and tell them that they will need to treat the water at home (boiling) during the first day after the repair of the system.

Table 2.8 Action to prevent or reduce sanitary risks in water transport

Hazard and pathway	Remedial action
The water may be polluted at the point of collection; water vendors for example may collect water from polluted sources	• Explore where the water is being obtained • Test the water if possible • Encourage that water is only collected from 'safe water sources' • Inform the users that the water is polluted • Encourage water treatment at home
Water is contaminated by users during transport	• Explore how people handle the water • Introduce safer containers with less risk of pollution • Inform the users about the risks and show better ways of handling the water • Inform about water treatment at home for weaker family members
Water is contaminated by vendors during transport	• Explore how vendors handle the water and if feasible test the water • Introduce safer ways of handling the water to reduce the risk of pollution • Explore possibilities of disinfection of the water by vendors • Inform the users about the quality if the water of vendors • Inform about water treatment at home for weaker family members

2.4.4 Managing hazards related to water storage

Water storage is yet another aspect where water may be contaminated either because pollution can infiltrate in the storage tanks or containers or because the water is withdrawn in an unhygienic way.
Key questions that need to be posed include:

- What are the main hazards that need to be addressed in terms of microbial and chemical contamination during household storage?
- What are the main pathways that exist for (re)contamination of the water during storage?
- Who are the main actors involved and in what way do they contribute to the risk?
- Can hazards and/or pathways be reduced or blocked

The answers to these questions are specific for each type of storage. Once we know the answers it may be possible to advise the users about specific action they can take to prevent or strongly reduce the risks. A number of possible actions are presented in Table 2.9. Additional information on some of the actions such as disinfection is presented in module 3.

Table 2.9 Action to prevent or reduce sanitary risks in household water storage

Hazard and pathway	Remedial action
The water may be polluted prior to the storage	• Explore whether the water comes from a safe source and if the risk of recontamination in water transport is low (test if possible) • Encourage use of water with lower risk either by using water from safer sources and safer water transport or by water treatment at home
The storage container may be polluted before the water is stored	• Explore maintenance of the water container and encourage cleaning preferably with a disinfectant.
Pollution may enter the water in the storage because the storage is not properly closed or water is taken out in an unhygienic way	• Ensure that the water storage container can be properly closed to avoid that pollution (dust, flies, rodents) may enter • Encourage users to keep storage containers closed • Encourage users to draw water from the container either with a clean ladle but even better if the container has a tap.

2.4.5 Managing hazards related to household water treatment

In many situations it will not be feasible for people to obtain water with a low risk of contamination. This implies that many households still will need to ensure that they have access to safe water. Some are in the advantageous position that they can afford to buy bottled water, but this is often very expensive. For many other people the only feasible option then becomes to treat the water at home by boiling or by using other treatment processes to reduce the health risk involved.

Management of household water treatment may involve however a number of risks which will need to be reviewed. The main issue in household water treatment is about its effectives. This needs to be explored by looking at a number of generic questions:

- Is the treatment effective for the type of pollution that needs to be controlled
- Is the treatment process properly handled by users
- Is it necessary and affordable to apply treatment throughout the year
- Is water properly stored after treatment

These questions will generate insight in the local situation and possible remedial actions can be identified that needs to be shared with users. As actions may be quite divers, we have not included a table but refer to the information presented in module 3.

2.5 Self evaluation

This is an individual evaluation of your understanding of the information presented in this module. Answer the (multiple choice) evaluation questions and check your own answers (see section 2.9). In case your answers had many mistakes it is suggested that you review the module again before doing the assignment.

Q1. Is cold crystal clear water safe to drink?

A: Yes
B: No
C: May not be the case

Q2. Indicate which of the following statement is correct. (Several statements may be correct)

A: The physical characteristics of water include Odour, Taste and Smell
B: The physical characteristics of water include Odour, Taste, Smell, Turbidity and Colour
C: Important chemical contaminants in some Ethiopian water sources include fluoride and nitrates
D: Bacteriological contamination of water supplies is an important problem in Ethiopia

Q3. A sanitary inspection

A: Consists of a systematic review of all the hazards that are potential and actual causes of contamination of the supply.
B: Consists of a systematic review of all potential and actual causes of contamination in combination with water quality testing
C: Is carried out only once when the best water source is being identified for a community

Q4. A good sanitary survey only needs to be carried out once to clearly identify the risks involved in hazardous events and related pathways.

A: Yes
B: No

Q5. An experienced researcher may carry out a sanitary survey without asking information from the local community and water users.

A: Yes
B: No

Q6. Indicate which of the following statement is correct. (Several statements may be correct)

A: Changes in run-of patterns in a catchment area may imply changes in the sanitary risks
B: Low water pressure in pipes are an important hazard and may lead to transmission of water related diseases
C: Users may contaminate safe water during transport and storage
D: Water treatment at home is needed in a considerable number of communities in Ethiopia

2.6 Assignment

Make a brief report (2-3 pages) (including a drawing with all key components and their dimensions) and a sanitary inspection of a simple water supply system such as a rainwater tank, a handpump, a well or a spring. Include a brief description of all the water quality hazards you observe. Add if feasible some key data about the water quality if you have data available or have access to test equipment or people who have this type of equipment. (If you have to travel to the community then look at assignment 3.5 as well as you may combine the field work for the two assignments)

2.7 References

BGS, (2001). Groundwater Quality: Ethiopia, London: British Geological Survey

Cairncross, S. and Feachem, R.G. (1983). Environmental health engineering in the tropics: an introductory text. Chichester: John Wiley & Sons.

Howard, G. (2002). Urban water supply surveillance - a reference manual. WEDC/DFID, Loughborough University, UK.

Lloyd, B. and Helmer, R. (1991). Surveillance of drinking water quality in rural areas. Harlow: Longman.

WHO, 1997. Guidelines for drinking water quality. Volume 3 Surveillance and control of community supplies. Geneva: WHO. http://www.who.int/water_sanitation_health/dwq/gdwq2v1/en/index2.html

WHO (2005). Children's environmental health (CEH). Geneva: World Health Organization.

2.8 Further reading

If you want to explore these issues in more detail you may wish to access a number of additional titles in the internet (or on your cdRom) including:

- WHO, 1997. Guidelines for drinking water quality. Volume 3 Surveillance and control of community supplies. Geneva: WHO. (http://www.who.int/water_sanitation_health/dwq/gdwq2v1/en/index2.html)

- WHO (2008) *Guidelines for drinking-water quality: Training materials.* Geneva: WHO http://www.who.int/water_sanitation_health/dwq/dwqtraining/en/index.html

- Water Safety Plans, managing drinking water quality from catchment to consumer (2005) by Davidson, A., Howard, G., Stevens, M., Callan, P., Fewtrell, L., Deere, D. and Bartram, J., WHO. http://www.who.int/water_sanitation_health/dwq/wsp170805.pdf

2.9 Answers to self evaluation questions

Q1. Answer C. The cold clear water may not be safe as chemical and bacteriological pollution may not be visible. So it will depend on the water source, possible hazards in the water supply system and in the handling and storage at home.

Q2. All answers need to be marked as they are all correct

Q3. Answer A. The sanitary inspection looks at the potential and actual causes of contamination of the supply and is complementary to water quality testing. It is not carried out once but on a regular basis as a monitoring tool.

Q4. Answer B. A sanitary survey is not a one off activity as risks involved in hazardous events and pathways may vary during the year and may change over time. Important differences may exist for example between the wet and the dry season. Also situations may change over time. Water tables may be falling because of over-pumping and water catchment areas may change because of overgrazing of cattle or deforestation. People may invade the area etc.

Q5. Answer B. Communication with the users and people living in the catchment area is an important part of a sanitary survey. They know about activities that take place in the area, which may be related to specific seasons. They know if the water sometimes becomes turbid. They know if they receive water intermittently or at low pressure etc.

Q6. All answers need to be marked as they are all correct

If you failed to provide several of the correct answers, then review this module again.

Module 3 Water supply improvements

This module introduces technical improvement options to overcome problems in water supply systems. Course participants will have their own experience and may know other solutions. Still the options presented here may encourage them to improve upon the solutions they know and if they have very interesting experience than they are requested to inform their trainer as it may be worthwhile to include the option in future trainings and/or on the resource web site.

At the end of this module the participant will have:

- *An overview of different options to improve water supply systems together with community based organizations and community members*
- *Identified possible remedial actions in a water supply system of their choice (see 2.6).*

3.1 Introduction

Water supply systems operated and maintained by WASHCOs with no specialist skills and limited (financial) resources, amounts of time, formal training and back-up support may have different types of problems. The water supply systems may be old and already incorporate many problems and operators may have very few tools and equipment to identify and rectify faults. In theory they may have support from external bodies (usually an arm of local or national Government or an NGO) to provide support for problems beyond their capacity but in practice this is often not existing or is not timely and effective.

An important way to support these WASHCOs is to help them develop a water and sanitation action plan to establish measures to improve the performance of the community water supply and sanitation situation. Part of this plan will concern the implementation of practical technical improvements looking at all steps from catchment to consumer. We can distinguish between different categories of problems including:

- Inadequate preventive and corrective maintenance
- Problems as a result of mistakes in the design and/or construction
- Water quality problems
- Water quantity problems

The key issue to problem solving is to get a good understanding of the problems together with the community who often are part of the problem and the solution.

So the first step in any location is to carefully review the different water systems that are in use and explore their conditions. The steps involved include:

- Physical inspection of the system(s) to review the technical conditions. This includes making a sketch and an assessment of the performance (see box 3.1)
- Discussion with the operator to explore the operation and maintenance routines. You can learn a lot from these discussions and you are likely to find for example that monitoring is not part of the routine and that breakdown maintenance is common, with the big disadvantage that this cannot be planned and so repair may take more time.
- Assessment of potential causes of breakdown and repair experience
- Assessment of the technical capacity at local level (and supervision of operators)
- Exploration of difficulties with sparepart supply
- Possible risk of pollution (sanitary inspection)

Box 3.1 Some tips to explore performance of systems

- In dug wells the main issue is often the variation in water level between seasons. If water tables fall over the years it is good to explore if other users draw water (irrigation)
- In case of handpumps it is essential to check the yield and ask if this varies (has reduced) as this may be an indication of wear in the cup seals; Furthermore it is necessary to count the strokes when pumping starts after a period of rest. If it takes several strokes the foot valve may have problems.
- In pumped systems the operator may have a logbook with production figures and fuel or electricity consumption. If not you may be able to get some insight by measuring the time it takes to fill the reservoirs. Also you may be able to explore how much water they sell and how much they pump to get insight in the water that is being lost. You may also be able to get insight in the performance of piped systems by asking about pressure problems particularly in the tail ends.

It is important to take an action oriented approach from the beginning. The review of the systems will show a number of problems which sometimes may be very serious. It does not seem fair to just leave the community and write a report instead of already exploring possible 'emergency' improvements the WASHCO or community members can make. In high risk systems for example it can be considered to suggest as a minimum that water needs to be boiled, chlorinated or treated by solar disinfection at household level at least for children and elderly people. Or a safe source (a deep well handpump for example) may be identified and the community may prioritize this for drinking water supply leaving the other water sources for other uses.

3.2 Water quality improvement techniques

Water treatment may be needed to as much as possible reduce the potential risk involved in ground water or surface water supply. The level of treatment should maintain harmony with aspects such as: the type of risk existing in the water source and water supply system and the socio-economic conditions in the community. Five issues are essential to take into account.

- **Select and protect the best water source you can find**. Water catchment and water source protection is in fact the first step in water treatment as this will allow you to prevent harmful materials entering the water. This may include measures such as banning construction of latrines close to wells etc. Source selection may also be an option to avoid fluoride problems. It is well known that fluoride levels may vary considerably in water sources even if they are close to each other. Prioritizing the 'safest' source for drinking water then may be a feasible option to reduce the problem.
- **Make sure that possible treatment works.** If no experience exists with a specific treatment system first try it out or have it tried out carefully before you depend on it. Particularly explore the assurance that possible chemicals and spareparts are readily available.
- **Disinfection** requires that the water is already of reasonable quality and does not contain a lot of pathogenic micro-organisms or substances such as organic matter that can interfere with the disinfection process. The essence is to ensure that the water quality is sufficiently good (either by selecting a good water source or providing water treatment) that only a small and rather constant dose of disinfectant is needed to make the water safe to drink.
- **Avoid recontamination of the water**. Unfortunately recontamination of water after treatment is rather common either trough leaking pipes or inadequate collection transport and storage of the water.
- **Household water treatment** In many situations water treatment may not be included in the water supply, or water is being re-contaminated in the water chain prior to its use. In such situations household water treatment needs to be explored as the quickest option. Yet this puts an important challenge to individual households as household water treatment may add a number of routine activities to the daily chores.

3.2.1 Physical Disinfection

Disinfection means the destruction, or at least the complete inactivation, of harmful micro-organisms present in the water. At family level the two principal physical disinfection methods used are boiling of the water and solar disinfection. Ultraviolet radiation is gaining acceptance for community water supply because of the reliability of the components and the declining costs.

Boiling is highly effective as it destroys pathogenic micro-organisms such as viruses, bacteria, cercariae, cysts and helminthes ova. It is recommended to filter the water through a cloth when cloudy and to boil for one minute or a bit longer at high altitude where boiling temperature is lower. On the down side it may be expensive as it involves considerable fuel consumption. Also consumers may not like the taste of boiled water and it takes a long time for the water to cool. Shaking the water when it has cooled down may improve the taste. Particularly for vulnerable groups such as babies, and young children water boiling may prevent a lot of problems.

Solar disinfection (SODIS) (Figure 3.1) works on the principle of combination of UV disinfection and heating. Exposing water to sunlight will destroy most germs that cause disease. This is even more effective at higher temperature. To also effectively inactivate amoeba species the water temperature needs to rise above 50°C for at least an hour. One easy method of treating the water is to expose plastic or glass bottles of water to the sun. The recommended time of exposure is six hours on a sunny day. The amount of time the bottle is exposed to the sun will need to be doubled (two days instead of one) when the water is cloudy. The exposure time should also be increased if there is not sunny weather (rainy season). For greater effectiveness place the bottle on a corrugated-iron roof which will help to increase the temperature.

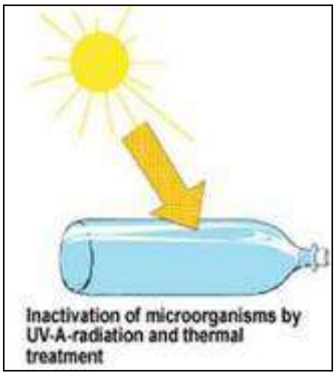


Figure 3.1 Solar disinfection SODIS (Source: www.sodis.ch)

3.2.2 Chemical disinfection

Several chemicals, acting as strong oxidants, can destroy micro-organisms including for example chlorine, ozone and iodine. Here we will focus on water disinfection by chlorination, which is widely used because of its effectiveness, availability and the ability to produce a good persistent residue that can be easily measured and monitored in networks and after delivery to users.

Chlorination of drinking water is carried out in practice through the bubbling of chlorine gas through the water or by dissolving chlorine compounds in the water. At household level the approach is to add a tablet or some chlorine solution to a container of water. Different chlorine compounds are available in the market such as Aquatab, Water Guard, Bishangari, and Pure and come with a description of use on the package.

Chlorine is also used to disinfect wells. Different methods are being used including hanging a container with chlorine compounds in the well. These components will gradually dissolve over time and therewith create a longer term effect. Another method that is applied is the provision of a single dose of powdered or liquid chlorine, after for example a repair or an indication of contamination. An important point here is that it is very important to do a sanitary survey as this may show that there is a continuous risk of contamination because water is drawn with dirty containers. Then chlorination is not of much use until the situation is improved. In case of protected well where the survey indicated a low risk you would want to seek confirmation by bacteriological testing before deciding to chlorinate.

It is essential that the water that is being chlorinated is very low in turbidity and organic content. This is important as the chlorine may react with these impurities thus becoming less effective in killing bacteria and viruses as these may protect themselves by hiding in flocculate material. In case of turbid water this first need to be treated by filtration for example to obtain good results.

3.3.3 Filtration

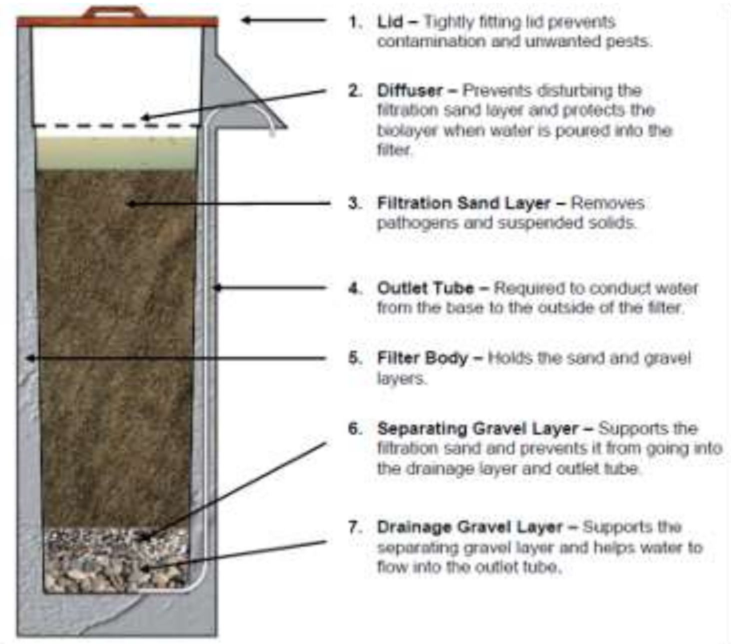
One option to improve the transparency of water and partly remove impurities is plain sedimentation. By adding chemicals this process can be further improved. Filtration however gives much better results.

Rapid sand filtration

One of the techniques widely used in water supply systems is rapid sand filtration (RSF). It is important to mention however that this technology is less suitable for rural water supply as it requires chemicals and a higher level of maintenance. Another point is that RSF systems are only removing part of the micro-organisms, still leaving a considerable risk of transmission of water borne diseases unless the water is properly disinfected after filtration.

Slow sand filtration

Slow Sand Filtration (SSF) is a very effective treatment. It was one of the first treatment systems that was applied in large water supply systems and is used in many places around the world. In an SSF water slowly passes through a box with sand. After some days a biological film is formed at the surface which comprises a lot of useful micro-organism that contribute to oxidizing organic matter and to the removal of disease causing organisms. The essence of the process is that the water flow is maintained as this provides the oxygen and nutrients the micro-organism in the filter need to do their work.



SSF is also used at household level where they are also called Biological Sand Filters (BSF) (Figure 3.2). Maintenance is easy and comprises of removing the top of the sand layer where most materials have been retained and putting the filter back to work. Also the tube may need to be cleaned. These BSFs do reduce turbidity and remove pathogens but have a limitation in that often the water flow is not continuous which implies that the removal efficiency for harmful organism is not guaranteed. So still some chlorine dosing, solar disinfection or boiling of the water is needed particularly before giving it to young children.

Figure 3.2 Biological Sand Filter

Cloth Filtration

Another technique used at household level is cloth filtration. By pouring water through a piece of fine, clean cotton cloth part of the suspended solids and pathogens are removed. This contributes to improving the water quality but is not ensuring the complete removal of the contamination and therefore some chlorine dosing, solar disinfection or boiling of the water is needed. An important advantage is that chlorine and solar disinfection will be more effective as the water is cleaner. The cloth can be washed between uses to maintain the flow that can be used in the straining.

Ceramic filter candles

Ceramic Filter Candles (Figure 3.3) are porous candles which are put in a container with water but also can operate under pressure. Different filter candles are being produced throughout the world, some using the latest techniques to provide a hollow porous ceramic which is fired at a temperature of over 1000°C. The most effective candles have an inner silver coating that kills bacteria that still may pass the candle. This coating however gradually dissolves and therefore the candle needs to be replaced (often after one year in normal use). The most advanced candles use a variety of specialist media to improve taste, odour and appearance as well as combat chemical and organic pollutants.

Figure 3.3 Modern filter candles

Locally made filter candles may also be available but may be less effective as they may have small (invisible) cracks which may enable some bacteria and viruses to pass through the filter. Hence a risk still remains that the water is not safe unless the silver coating is working and therefore, particularly in the case of locally made filters, still extra measures may be needed for babies and small children.

3.2.4 Fluoride removal

In this course fluoride removal techniques are not discussed as they apply only for specific areas in Ethiopia. It is important however to realize that all fluoride removal techniques are rather difficult to sustain. On the other hand not all sources even within the same communities in fluoride infested areas have similar levels of fluoride. Therefore the first option is to try and select the water sources with lowest fluoride content and reserve these for drinking and cooking water, keeping those with high fluoride for other household chores. An alternative may be to install a treatment system on one of the water collection points and sell water for drinking and cooking separately (and a higher price to meet cost) from the water that is not defluoridated. For those who face fluoride problems in their area we refer you to the study by Haimanot (2005).

3.3 Technical improvements

Technical problems may exist in water supply systems because of design and construction mistakes which as much as possible should be traced back to the source (designer or contractor). Too often such mistakes are the result of insufficient review of the design. Also inadequate supervision of construction is a main issue as it may allow contractors to use poor quality materials or to put for example less cement and iron rods in the concrete. The problem is that this may very much reduce the life time and the performance of systems and enhance the suffering of the users.

Other problems may arise from poor preventive maintenance and repairs particularly in older systems but also from an increasing number of users. In this section we will present a few experiences with this type of problems which sometimes can be overcome quite quickly at low cost whereas in other cases larger external interventions are needed.

3.3.1 Physical improvements in tanks, wells and springs

In this section a number of suggestions are presented of possible solutions for problems that seem to be quite common.

- **Cracks in storage tanks and wells** often can be repaired quite quickly and even by local masons. It can help to reduce leakage and may reduce the risk of infiltration of contamination. If cracks in tanks are considerable you will need to check for structural problems. Sometimes a quick way to repair is to put chicken mesh wire with a cement coating of some three centimeters on the inside wall and floor.

- **Leaking overhead tanks** of other materials also need repairs as continuous leakage is costing a lot of resources in pumped systems. A way to calculate the leakage is to fill the tank, close the tap, and measure the fall of the water level over say a period of one to a few hours.

- **Wells running dry** may be caused by falling water tables. An option may be to deepen the well to chase the water table. Yet this needs a lot of care and first and foremost the cause of the problem needs to be assessed. If it results from over pumping for example for irrigation than this may need to be controlled also because irrigation is often very inefficient. Another problem is that deepening sometimes leads to connection with another aquifer which sometimes may be of lesser quality. Alternative options may also need to be explored including the construction of a new (possibly hand drilled) well.

- **Contamination of open wells** may be reduced by installing a head wall, a cover and a pump. Yet in areas with a high percentage of broken pumps it is essential to keep a manhole (with a lock) as an emergency water supply when the pump breaks down.

- **Springs may have important risks,** which may relate to infiltration of polluted water, inadequate protection of the structure or reduced flow because of changes in the catchment area. Different options may exist to improve the spring including repairing cracks and spill ways. Enhancing protection of the area, but also exploring whether measures can be taken in the catchment area that will help to increase water infiltration and reduction of run-off. A very important point to take into account is that the intervention should not lead to disappearance of the water. It is always essential to avoid blocking the free flow of water as closing the outlet of the spring will lead to building up pressure in the collecting structure. This may result in the eye of the spring finding another outlet and your structure will become useless.

3.3.2 Improvements in distribution networks

Pressure problems and leakages in distribution networks may be extensive. Often pressure problems may be directly associated with leakages or with lack of control valves to properly distribute the water. There are several options to try to find the leakages even with simple means, but in case of major differences in pressure it will be needed to seek expert advice. When reaching an area you may explore the following:

- **Checking the water loss** (making a water balance) by comparing production and consumption. This involves assessing the water production per day by taking data from the bulk water meter. If no bulk water meter exists but a water tower you may get this information by asking for the pumping hours and by pumping for 10 or 15 minutes into the tower with all outlet valves closed to obtain the pump production per hour). The total then needs to be compared with the volume that is received by the users (either from the water meters or the sales). The difference is the non-revenue water (leakage but maybe also caused by illegal connections or by inaccurate water meters.).

- **Reducing water loss** is a challenging task as leakages may not be visible. Still a visual inspection of the network and taps can be useful including being alert on possible leaking taps, wet spots in the ground or differences in vegetation. Still this will not help you enough to find the leakages. A better option is to close all outlet taps and 'to listen to flowing water' by putting a metal stick through the ground to touch the pipes. This device you can call a 'local listening device' because when you put your ear to the metal bar you will hear water flow if there is considerable leakage. You follow the pipe downstream and repeat the listening and this may help you to detect leakages.

- **Exploring possible meter problems.** This can be done by comparing the payment by different water users or different stand posts. Differences may show up which can be the result of differences in water use (number of users etc.) but also may indicate meter problems. Than the households with 'strange' data (high or low) can be checked. If you then find low consumption data but a large family or many users than you need to check the meter for example by tapping a few hundred or even 1000 liters of water and see what the meter indicates. You may ask one or more water vendors to help collect this water as they will be able to sell it.

- **Low pressure at taps** may be an important problem that may be caused by leakage but also by many people with open taps at the same time, distribution systems with too small pipes or inadequate pressure distribution for lack of control valves. For standposts this may lead to long waiting lines. One option to tackle this problem is to install storage tanks at the tap points where water can accumulate during periods with low consumption. One added advantage is that the number of taps connected to this tanks can be increased thus allowing more people to get water at the same time. Another advantage is that when a risk of (re)contamination in the piped systems has been identified then it could be considered to put a disinfection device in these tanks.

- **Very high pressure at taps** may also be a problem as it will increase leakage. This problem is quite common in gravity piped systems and may require the installation of pressure break chambers or pipe-reductors.

- **Very different levels of discharge in different taps** is quite common in many systems and is often caused by faulty or absent water regulation valves or by important leakages in some parts of the system. If this is the case the WASHCO most likely will need to seek support from the Regional Water Bureau to make a detailed analysis of the system to identify the most suitable solutions.

3.3.3 Improvement in pumps

Problems with pumps are common in many places as a result of design and construction failures, falling water tables but mostly because of poor monitoring and maintenance. Particularly lack of preventive maintenance is an issue. This concerns regular maintenance of the equipment and timely replacement of spare parts to avoid that systems wear out and break down and may require costly repairs that may take considerable time with water users having to revert to other water sources.

You will need to explore the situation in detail with the operator and the WASHCO to understand the problems asking among others about age of the system, performance, repairs, availability of fast moving spares etc. It is clearly an issue of finding out what the problems are and not of telling them what to do. It is quite likely that operators have received some kind of training for example from NGOs when systems were installed and most likely they did receive instructions for preventive maintenance. So just telling them to do it does not seem to work. The crucial question is why they do not do it and what would it take to change the situation. So you may find that the pump has a lot of play and then the question is whether this is a technical problem or whether people do not use the pump properly. Or you may find animals near the pump and so the question is why do they not maintain the fence etc. They may repair the fence because you tell them to do that but if they do not see the need themselves this will not be sustained in future.

In this section we will indicate a few common problems with different types of pumps and some suggestions for improvements. It is not the scope of this manual to give detailed information on these improvements or on operation and maintenance and repairs. More information is available on specific systems in the resource materials including for example the manual: Preventive Operation and Maintenance of Water Lifting Devices in the SNNPRS (Abate, B and Migbar Assefe, A., (eds.) 2009) developed with support of SNV. That manual addresses one of the key problems being lack of preventive maintenance giving detailed schedules about the different tasks to perform including monitoring. We will get back to the issue of preventive maintenance in module 6 where the issue of management is being addressed. There we will suggest that the first entry point for preventive maintenance is the WASHCO and they will have to supervise the operator and among others review his report on operation and maintenance.

The approach here is to give you some ideas about problems and possible solutions that you could pursue further.

- **Problems with handpumps** often relate to poor preventive maintenance as in many cases break down maintenance is applied waiting till the pump is broken before seeking repair. When exploring the situation with the WASHCO and the operator a visit to the pump will allow you to understand some of the problems at hand and to see how they go about them. In Table 3.1 an example is included taken from Abate and Migbar Assafe (2009) which shows a number of problems that are common in handpumps. You can take advantage from this list when visiting a pump to explore what is wrong. A quick way to find out about pump performance is to assess the number of strokes it takes to make the water flow after a period of rest as if this takes several strokes the seal in the foot valve is likely in need of replacement. Another issue is too explore is to ask users whether production has reduced (e.g. does it take them longer to fill their containers), as this may be an indication of problems in the seals in the cylinder or of a falling water table.

- Other problems related to handpumps that may be relatively easy to repair include, replacing bolts, filling of cracks in the apron, ensuring an adequate fencing to keep animals out and which also can help to keep the area around the pump (within the fence) clean. Also ensuring proper drainage may be a necessity in many places. Remember this type of repairs will only be sustained when the WASHCO understands the problem and the need to take care of it.

  Whereas you may even advice on a possible solution this is not the main point to tackle. You will need to make an analysis of the problem to find out why it is happening and then put the problem in the WASH assessment. The cause may for example be lack of preventive maintenance. Then you will need to identify with the WASHCO what action is needed to overcome the problem. This may for example be to include an action to jointly work out a simple monitoring system for the pump together with the WASHCO and the operator.

Table 3.1 Trouble shooting for Indian mark II and Extra Deep Handpumps

Fault	**Cause**	**Remedy**
Pump handle works easily but no flow of water	Worn out cylinder leather cup washer	Overhaul the cylinder and replace the leather cup washer
	Valve seat worn out	Replace valve seat
	Connecting rod joint disconnected	Pull out the pump and join the connecting rod where ever necessary
	Pump cylinder cracked	Replace cylinder assembly
	Water level gone down below the cylinder assembly	Add more pipes and rods
Delayed flow or small flow	Leakage in cylinder check valve or upper valve	Overhaul cylinder Replace rubber seats
	Leather cup washer worn out	Overhaul the cylinder and replace leather cup washers
	Damaged rising main	Replace the damaged pipe or disconnect the affected rising main
Folding of chain during return stroke	Leather cup washer getting jammed inside the cylinder	Overhaul the cylinder and replace the leather cup washer
	Improper erection	Adjust the length of the last connecting rod suitably
Noise during operation	Stand assembly flange not leveled properly	Level the flange
	Bent connecting rod	Change the defective rod
	Hexagonal coupler welded offset	Change the defective rod
Shaky handle	Loose handle axle nut	Tighten handle axle nut
	Worn out ball bearing	Replace ball bearing
	Spacer damaged or short in length	Replace spacer
	Bearings loose in the bearing house	Replace the handle assembly

Source: Abate, B and Migbar Assefe, A., (eds.) (2009)

- **Problems with rope pumps** may also be common and in a number of cases these are the result of the poor quality of materials that are being used as well as construction problems. So the first step is to check the pumps to assess whether repair is realistic or whether it is better to find a more sturdy rope pump. If you have doubts it is important to seek technical advice from outside.

  In the fact finding it is important to explore about pump performance. Is the pump for example being maintained on a regular basis? Are users satisfied with production or do they feel that the pump is producing less water than before? Is the well environment clean and what are people thinking about this? Such problems may be easily solved, but this often will require more than just telling that it is necessary. It may need quite some work to ensure that solutions are understood and engrained in an improved management system.

Another very common problem is that a considerable number of rope pumps have been constructed to support agriculture. Often these pumps are built a little but below the surface to allow rain water runoff to drain into the well. This of course is creating a considerable risk of contamination that needs to be remedied if pumps are used for drinking water supply preferably by increasing the height of the walls of the well.

- **Problems with electrical pumps** may be quite varied and may particularly relate to fluctuation in current which may cause burning of pumps. This was for example one of the main problems identified in implementing GLOWS in Haraghe. Another very common problem is that performance of the pump may have been dropping because of wear and tear over the years. Lower production may also be caused by lowering water tables. These problems often go in a way undetected because performance of the system is not monitored and registered. So no data are available to compare.

  Many of the pumps are not connected to the electricity network but to a (diesel) generator. This implies that the operator also has to provide for preventive maintenance of the generator and to ensure that the pump environment is clean and safe. One thing to check is the electrical switch board and particularly the safety fuses as these need to work properly to prevent the pump from burning.

  So the main point is to carefully check the whole system together with the operator and the WASHCO to identify important problems and if possible discuss possible solutions. This however may be more difficult than for handpumps and so it may well require a visit of a pump specialist to establish the cause of the problem and the best solution. Hence in such case an action can be included in the action plan in that the WASHCO needs to contact the Water Bureau or possibly private sector to seek specialist support for problem shooting.

  The electrical part including the switchboard is a crucial part of the system and may have different types of problems including exposed cables that entail a risk of electrocution but also safety fuses that are by-passed, as they switched off the pumps frequently and so the operator gets tired of switching the safety switch back all the time. Checking with the operator gives you a good idea of what is going on and what should be improved. It is great if you can get access to data on electricity consumption (and particularly changes in consumption) in combination with water production data as this may give you an important indication of potential problems.

  Also in this case you may benefit for your analysis from the trouble shooting model made by Abate and Migbar Assafe (2009) shown in Table 3.2 which gives you an number of key points to check and to find out what is wrong as well as some possible solutions. Also other manuals are available and some are included in the CDRom with resource materials that may give you some further ideas on possible problems and solutions which perhaps can be included in the improvement plan. It is however important to take into account that interventions in electrical deepwell pumps often need a specialized organization with heavy equipment for example to lift the pump from the well.

  Many electrical pumps are not connected to the electricity but to a diesel generator. This implies that maintenance of this generator also has to be taken care off. Also in this case it would be great if you can get data on fuel consumption in combination with water production information, as a possible indication of difficulties, which may include the use of part of the fuel for other purposes. A brief checklist is indicated in Table 3.3 with points to check when looking at generators.

  Remember it is not the idea that you immediately take these actions. The WASHCO is the organization responsible for the water supply system. You are there to help them to find out about problems and possible solutions and to assist them to make a plan how these solutions can be implemented. Actions may therefore include for the WASHCO to seek specialist support.

Table 3.2 Trouble shooting for electric deep well pumps

Fault	**Cause**	**Remedy**
Electric pump fails to start	switch is set to OFF position	Turn to the ON position
	The motor is not powered	-Check whether motor receives power (fuses burned out, circuit protecting relay activated, defect level gauge or pump cable) - Dry running protection activated due too low water level in borehole
	The motor starter overload tripped out or is defect	Reset the motor starter overload, if it trips out again check voltage. Replace if starter defect
The fuses burnout on start up	Fuse of inadequate size	Replace with proper fuses for the engine
	Insufficient electrical insulation	check insulation resistance, repair or replace
	Damaged power cable / connection	Repair or replace the cable or connection
The overload relay activates after a few seconds or minutes of service	Voltage too low or full voltage is not reaching all the motor phases	Check voltage and contact electricity supplier Check the condition of the electrical equipment -Check the terminal strip is well tightened -check the power supply voltage
	Power draw unbalance between the phases	Check unbalance (see instruction manual) -send pump to authorized service center
	Abnormal power draw	-check that star or delta connections are correct
	Wrong relay setting	check that the setting amperage is correct
	The rotor is jammed or pump fails to turn freely since parts are rubbing	send pump to authorized service center
	Pump fails to turn freely owing to a high concentration of sand	Reduce the flow rate and if needed clean the pump and inspect borehole (clean if needed)
	Electric panel temperature high	Check if relay is set to the ambient temperature Protect electric control panel from sun / heat
The electric pump delivers at poor or no flow rate	Air intake or pump operating in cavitation conditions	Increase installation depth
	Too low water level in the borehole	Check water level; lower pump if feasible but also explore cause for water level reduction
	Motor turns in wrong direction	Inverse two of the three phases
	Check if valve and or non-return valve are partly blocked or disfunct	Disconnect pump and check and if needed send to authorized service center
	Closed sluice valve	Adjust the sluice valve
	Riser pipe or discharge pipe partly blocked by impurities	Check for impurities and clean
	Worn electric pump	send to authorized service center
	Pump head is not sufficient	Replace pump
The electric pump is noisy and vibrates	Plant installed incorrectly drawing water with air	Increase the suction mouth head
	Worn shaft and the guide bearing	send to authorized service center
Frequent start and stop	The differential of the pressure switch between the start and the stop pressures is too small	Increase the differential. But stop pressure must not exceed operating pressure of pressure tank, and start pressure should be high enough to ensure sufficient water supply.
	Water level electrode or level switches in reservoirs not installed correctly / working properly	Check and if needed adjust intervals of electrodes/level switch to ensure suitable time between cutting –in and -out of the pump (installation manual) . If intervals between stop/start cannot be changed pump capacity may be reduced by throttling discharge valve
	The diaphragm tank has a problem	Check diaphragm, adjust pressure (see manual) or replace diaphragm pressure tank

Source: Abate, B and Migbar Assefe, A., (eds.) (2009)

Table 3.3.Checklist for identifying improvement options for generators

Check point	Observation
General impression	If environment and system are dirty it is likely that maintenance is a problem; Particularly check training level, motivation and supervision of the operator
General condition of engine	Check engine oil level, radiator water level (if water cooled), battery water level and possible loose bolts; these are indicators for a possible lack of preventive maintenance
Check possible changes in fuel consumption over time against pump production	May give an indication of problems with the generator or the pump
Check voltage and frequency	Possible fluctuation in voltage and frequency may be very damaging for the pump and the WASHCO will need to plan a review by an expert as soon as possible
Check vibration	This may be caused by engine problems and will need the WASHCO to plan a review by an expert as soon as possible
Check color of the smoke	If diverts from normal encourage WASHCO to seek expert advice
These points are based on:………………………	

3.3.4 Improvement of household storage and treatment

The household is often a weak link in the water chain as they may easily pollute the water during transport, storage and use. Hence the first action to take is to review the water habits and the risks involved. Is water transported and stored in close containers? Is it withdrawn from these containers in a hygienic way? You may then suggest improvements based on the risks you see and perhaps you can use more careful users to help others. This type of problems need to be discussed with the health extension worker (HEW) and may lead for example to implement a small campaign to improve water handling and household water storage as an action point in the plan.

If the water from the source that is not safe or it is not possible to avoid recontamination then it may be an option to introduce solar disinfection or the use of chlorine or at least advice families to boil water for younger children as has been discussed in module 2. Also this action may be more in line with the work of the HEW and this implies that either the WASHCO takes up an action in the improvement plan to contact the HEW to request the implementation of specific activities (possibly working together) or the HEW as well as Kebele management are involved in the discussions you are having with the WASHCO and in that case the HEW and the Kebele management can agree to take this action forward.

3.4 Self evaluation

This is an individual evaluation of your understanding of the information presented in this module. Answer the (multiple choice) evaluation questions and check your own answers. In case your answers had many mistakes it is suggested that you review the module again before doing the assignment.

Q1. An experienced water professional can assess the prevailing problems in a water supply system without asking information from the water users.

A: Yes
B: No

Q2. Important water leakages may occur and can be detected by (indicate which answer is correct (multiple answers possible):

1. Observing and repairing leaking taps;
2. Visual inspection of the area where the network is installed;
3. Making a water balance
4. Making a detailed inspection including the use of a 'local listening device'

Q3. Indicate which of the following statement is correct. (Several statements may be correct)

A: Low water production in a handpump may be caused by worn out washers
B: If water appears only after several strokes of the handle than the pump may have a leaking foot valve or a leaking pipe or cylinder
C: When the water appears only after several strokes than it is very likely that the water table has lowered

Q4. In a water supply system it is important to (several answers possible**):**

1. Prevent contamination of source waters even if you have water treatment;
2. Treat the water to reduce or remove contamination that could be present to the extent necessary to meet the water quality targets;
3. Prevent re-contamination during distribution, storage and handling of drinking-water

A: Answers 1 and 3 are correct
B: Answer 2 is correct
C: All three answers are correct

Q5. Household water treatment is not needed in systems with chlorination

A: This is indeed not needed
B: This is still very much needed
C: This still may be needed

3.5 Assignment

Take your assignment of module 2.6 and explore possible remedial actions that can be taking to reduce or avoid the hazards that you have identified in the system that you have reviewed.

3.6 References and Further reading

Abate, B and Migbar Assefe, A., (eds.) (2009) Preventive Operation and Maintenance of Water Lifting Devices in the SNNPRS, a general guide line REVISED Final. Addis Ababa: SNV

Bolt E., Fonseca C. (2001) *Keep It Working: a field manual to support community management of rural water supply.* IRC Technical Paper Series 36; IRC, the Netherlands http://www.irc.nl/content/download/2602/27266/file/TP36_KeepItWorking.pdf

Brikke, F. and Bredero, M. (2003) Linking technology choice with operation and maintenance in the context of community water supply and sanitation. Geneva: WHO and Delft: IRC http://www.who.int/water_sanitation_health/hygiene/om/wsh9241562153.pdf

NWP, Practica, Partners for Water, IRC, SIMAVI, Agromisa, NCDO, Aqua for All (2006). *Smart Water Solutions* http://www.irc.nl/page/28654

Stevenson, M. (2008) Monitoring Effective Use of Household Water Treatment and Safe Storage Technologies in Ethiopia and Ghana. Massachusetts: MIT

Visscher J.T. (2006) *Facilitating Community Water Supply, from technology transfer to multi stakeholder learning.* IRC, International Water and Sanitation Centre, the Netherlands http://www.irc.nl/content/download/25104/278851/file/TP46_FacilitatingCWS.pdf

WHO, 2008 Household Water Treatment and Safe Storage. Geneva: WHO http://www.who.int/household_water/en/index.html

Worm, J. (ed) (2007). Smart Water Harvesting Solutions. Examples of innovative, low-cost technologies for rain, fog, runoff water and groundwater. The Hague Netherlands: NWP

3.7 Answers to self evaluation questions

Q1. Answer B is correct. Communication with the operator, the WASHCO, the users and people living in the catchment area and supply area is an important part of a sanitary survey. They know about activities that take place in the area, which may be related to specific seasons. They know if the water sometimes becomes turbid. They know if they receive water intermittently or at low pressure etc. If you did not provide the correct answer, then also review Module 2.

Q2. All answers need to be marked. All four options can contribute to the reduction of water loss. The water balance will give you insight in the level of the water loss, the visual inspection may show some problem areas, the listening device will help you to find mayor leakages and dripping taps in fact may produce considerable leakage. Just as an experience put a bucket under a dripping tap and come back an hour later. If you did not mark all answers than better review module 3 again.

Q3. Answers A and B are correct: In fact most problems in handpumps occur because of normal wear and tear of cup seals and washers. Leaking pipes and cracked cylinders are less common, but indeed may occur. Answer C is not correct. A falling water table may cause a reduction in pump flow or the flow may stop entirely if the water level drops below the cylinder. It does however not cause a 'delayed' flow.

Q4. Answer C. All three answers are correct

Q5. Answer C. Even if the water supply system includes disinfection at the source this may not be fully effective to the point of use. So you will need to explore if a risk of recontamination exists. This risk may result from infiltration of impurities in for example pipes which may be common in systems that operate intermittently, but also from water carrying and home storage.

If you failed to provide several of the correct answers, then review this module again.

Module 4 Sustainable multiple use water services

This module introduces the concept of multiple use water services (MUS) and the effect of seasonal influences on water use patterns to better assess and use existing water systems and exploring possibilities for district support to be included in the community water and sanitation action plan. It is a fully revised and updated version of module 4 of the first GLOWS training package and this revision was supported by the Dutch Partners for Water programme. *At the end of this module the participant will:*

- *Be able to explain the implications of multiple water use including seasonal influences and its relationship with livelihood zone(s) and wealth groups in a community*
- *Be able to assist Water, Sanitation and Health Committees (WASHCOs) and farmers in planning, designing and improving practical applications of MU*
- *Have developed an assessment of MUS in a location of his or her choice*

4.1 Introduction

People in rural areas may have access to different water sources and use water for a variety of uses. These include domestic uses, like drinking, cooking, washing and cleaning. They also may use it for watering animals, gardening, irrigation, processing of agricultural products and small-scale industrial activities, like beer brewing and brick making. These different uses of water bring different benefits (Table 1). Domestic water use will mainly lead to an improved health situation with respect to water, sanitation and hygiene related disease, while productive use of water can result in direct economic benefits (income generation) and improved diet and greater food security (Moriarty et al 2004). The health and wellbeing of the population requires water and food security as well as financial resources to among others support the sustained functioning of water systems.

Table 1. Multiple sources, multiple uses and multiple benefits at user level

Multiple sources	Multiple uses	Multiple benefits
• Springs • Water ponds • Wells • Streams • Rain water	• Drinking, Cooking • Washing • Livestock • Gardening/Irrigation	• Health benefits • Time saving • Nutrition • Income

An important problem exist however in that in many communities available water sources and services vary in quantity, quality, accessibility and reliability over the year which may be due to natural causes but also because of project interventions. Different ministries but also NGOs often have their own sector specific targets, approaches, solutions, and sector specific financial resources which results in projects that are built to cater for a specific need (e.g. drinking water or irrigation). As a result an important mismatch between water supply and demand may exist in communities leading for example to long waiting queues at water points particularly in the dry season lines but also to drinking polluted water drawn, for example, from irrigation systems. This clearly calls for coordinated action and collaboration between different actors in which the multiple water demand of communities are addressed in an integrated way instead of adopting water services that only focus either on water supply for domestic use, or on water for livestock or water for irrigation.

In this context it is promising that the successful approach to promote family wells for self-supply in agriculture, which has led to the construction of thousands of wells, is increasingly seen by the water sector as an option to also improve upon domestic water supply. This seems very feasible by putting stronger emphasis on water quality and possibly the introduction of household water treatment. Such an approach is a good example of how to buy into the potential merits of MUS, which obviously can very much benefit from further interaction between sectors (Butterworth et al., 2011).

Why multiple use services?

If people's multiple water needs are taken as a starting point, multiple use water services can be provided which will result in multiple benefits, rather than providing services that only bring one specific set of benefits, either health and time saving benefits from domestic water use, or economic benefits from productive uses. In terms of livelihood improvements, MUS concurrently improves health, food security, and income, and reduces women's and girls' drudgery, especially among the poor in rural and peri-urban areas where their multi-faceted, agriculture-based livelihoods depend in multiple ways on access to water (Butterworth et all., 2011). Furthermore, it is important to realize that providing for MUS may have a positive impact on sustainability of water systems. If water systems are designed for one specific use but used for multiple uses, the resulting extra pressure on services may cause conflict and premature system failure and breakdown. Taking the multiple uses into account in the design and management of the system will help prevent that. Adopting multiple water services can also positively impact the willingness of the users to operate and maintain the system, since it caters for their needs. People might also be more willing to pay for water they can use for different uses, including productive uses.

Key features of multiple use services:

- They take people's water needs as starting point
- The start comprises an assessment of the actual situation
- A long term 'service delivery' approach is used, rather than just building systems
- Water supply and needs are matched in a reasonable way whilst looking at fair use

Woreda level staff should be able to help the Kebele leaders and WASHCO to make equitable decisions to meet the demand within the available and future water system options, building on and strengthening existing hard and software, where appropriate. In this it is important to give priority to drinking water supply, whilst also looking at food security. Woreda staff needs to be aware of the heterogeneity of communities and their multiple water needs and need to deal with this in a transparent and equitable way (Van Koppen, et al., 2009).

In the next section several options will be explored that can provide entry points to better cater for MUS. In section 3 main issues to be explored at community level to assess the local situation and the need for MUS. This is complemented by a short description of tools that can be useful for the assessment in section 4 followed by a section which provides suggestions for taking action. In section 6 and 7 questions for self-evaluation and some exercises, references and suggestions for further reading are indicated in section 7 and the answers to the questions are indicated in section 8

4.2 Different entry points to enhance multiple use services

Different types of systems provide different levels of potential for multiple water uses, may require different organizational arrangements, and may benefit from programs supported by different organizations. In general we can differentiate between the following options:

- Household based systems (e.g. Family wells and rainwater harvesting systems)
- Communal water supply systems with single or multiple access points
- Irrigation systems

For each of these options cases of multiple water use exist in Ethiopia.

4.2.1 Household based systems

Most household based systems are family wells (often involving household-led financing) but can also include household level rainwater harvesting technologies (roof top harvesting systems and small catchments with ponds). Both the Ministry of Water, Irrigation and Energy (MoWIE) through its Self-supply acceleration programme, and the Ministry of Agriculture (MoA) under the household irrigation strategy are widely promoting groundwater development through family investment. Family wells, or shallow wells, can be used for domestic water use, and for watering animals, but are also being widely promoted (with a rope pump, treadle pump or petrol/diesel pump) for household irrigation. Households often build these wells themselves (with help of a local well builder), close to their house or to their land that requires irrigation. Sutton et al., (2012) indicate that on average, 'family' wells in Oromio and Southern Nations Nationalities and People's Region (SSNPR) are shared by some 70 people and water from mechanised wells is shared with over 120 people. The use of the wells is dynamic in that users will also take water from other sources for example river water for washing cloths as to avoid lifting the water and sometimes also water from pumps for drinking. Family-owned wells are very important for food security as they are far more commonly used for irrigation and livestock than communal water points. This situation has a lot to do with the difficulty to transport larger quantities of water over large distances (Sutton, et al., 2011).

The ministry of agriculture is strongly promoting the development of family wells under their responsibility for household irrigation (<5 ha) and small-scale (5-200 ha). This is a very ambitious program that has the intention of 'one family, one well' in suitable areas. This programme is supported by the agriculture extension workers at Woreda level.

A key concern with many of these wells is the risk of bacteriological contamination related to inadequate protection and poor pump installation and these problems may be identified by a sanitary survey. Hence in many cases the main intervention to enhance the safe multiple use of such wells is to introduce proper protection measures and improve pump installation and water handling. This may be quite feasible as many examples exist of shallow wells with rope pumps that deliver good quality water free from bacteriological contamination. An important advantage is that such wells are often used by a small user group thus reducing the risk of a large outbreak of diarrheal disease. Still in case the risk is estimated to be relatively high and for example diarrhoea episodes are frequent, it may be necessary to introduce simple household water treatment by filtration and or solar disinfection, or the use of household chlorination. This is also a good example of the need for collaboration among different actors. The agriculture extension workers can team up with the Woreda staff working on drinking water supply and the HEWs to introduce water quality improvements that make wells meant for irrigation also suitable for domestic water supply. This is a win-win situation as it will contribute to increasing access to good quality water which is a goal of MoWIE and will help farmers to become more healthy which may increase their productivity.

Rainwater harvesting also has potential for multiple use, but more often as a supplementary source. An interesting option that may exist is to distinguish between high quality rainwater that can be used for drinking and cooking (some 5 litres of water per person per day) and needs good quality storage and low quality rainwater that does not need to be of the same quality and does not require (costly) good quality storage. This issue is being addressed in more detail in another GLOWS training module on rooftop (rainwater) harvesting

The potential for multiple uses of household water supplies can be improved by improvements in the water lifting potential, for example by equipping the shallow well with a simple pump, like a rope pump. When more water can be easily extracted from the source, this water can be used to irrigate more land, water more livestock etc. A recent development is the introduction of manually drilled wells initially aiming at providing water for irrigation but increasingly also being adopted for drinking water supply. Interestingly this is one of the more affordable solutions for farmers to use ground water for irrigation and now also for multiple water use. Typically wells are 5 to 15 cm in diameter with a depth of up to 30m and a cost of some 3750 to 5000 Birr (Mekonta & Boelee, 2013a). Different examples exist of the use of these wells equipped with rope or treadle pumps that make an important impact on their owners. Wells may be used for drinking water, cattle and small scale irrigation. Well users may carry the water in buckets to their animals to reduce the risk of contamination by the cattle if it would come close to the well. When used for small scale irrigation farmers may get a considerable benefit as shown by different examples presented by Mekonta and Boelee (2013a) from selling tomatoes, green peppers, onions etc. Yet with growing numbers of this type of self-supply options coming available in different areas the rate of return on investment may diminish depending on the availability of local markets where products can be sold.

Still household based systems seem to be one of the most promising options for providing water for different uses, including drinking, watering livestock and watering plants. To enhance this potential self-supply would need support in four main areas: technology options and advice, strengthening the private sector, supporting financial systems and enabling government policies (Butterworth et al., 2011). This implies that households need to get access to low cost credit facilities. Support is also required in the form of advice about the risks involved in terms of water quality and how to overcome these, but also in terms of the potential risks involved in not having sufficient a market for their products. A related issue is that these kinds of improvements can benefit a lot by strengthening the private sector. Already different private sector actors are involved in well construction and provision of pumps and spare parts, but the quality of their interventions can be improved considerably.

4.2.2 Communal point source systems

This type of systems include hand dug wells and boreholes with hand pumps, boreholes with electrical pumps or protected springs with one public tap stand or a small distribution network with several public tap stands and sometimes also house connections. Communal point source systems generally have limited scope for multiple use services unless they are specifically designed for this purpose. Often the number of users is quite extensive resulting in long queues at tap stands and even rationing of water, with inadequate supplies for domestic use let alone productive uses.

Still boreholes with handpump and piped systems with scattered public standpipes can offer an opportunity for some productive use. This may include provision of cattle troughs but also some small scale irrigation (close to the point of discharge). The question arises however about the equity of the benefits from these productive uses. When people pay enough for the water used for the cattle to meet the production cost then at least they do not benefit more than other community members with fewer or no livestock. For small scale irrigation it is likely that only community members with land close to the water point can benefit for example from spill water. This still may be a fair deal if in return they undertake the maintenance of the facilities or participate in the WASHCO. In fact such an arrangement may enhance the sustainability of the system as it may make the maintenance and the participation in the WASHCO more attractive.

The equity issue of different groups within the community: man and women, different livelihood groups (e.g. livestock keepers and crop farmers) and different wealth groups not benefitting equally from water systems seems to be overlooked and no guidance seems to be available how to deal with this type of 'hidden conflict'. It can be argued that it would be fair that those benefitting more would also contribute more to the running cost of systems and in fact this may be very important for their long term sustainability. Hence a set of rules need to be established in case of multiple use of communal systems that sets out the terms and conditions for the users. Such types of arrangements may be expected to require external support from Woreda level or regional level, also depending on the organizations involved in system development.

In Ethiopia, gravity spring systems in mountainous areas often supply water for both domestic, as well as for other uses, like watering animals and irrigating small plots. Often, these springs are developed to supply either water for domestic use, or for irrigation. However, in reality people will use the water for both. Run-off water will be used for irrigation and watering animals, in case of a water supply system. In case of an irrigation system, people will often fetch water from the storage reservoir or the irrigation channels (Figure 4.1). These multiple water uses can easily be facilitated by add-ons to the single use infrastructure, for example by adding a public tap stands for domestic water use to an irrigation reservoir, or by adding small scale irrigation infrastructure (small lined canals) to guide the run-off water from a spring water supply system (Box 4.1). The main problem however is that the water may be contaminated hence just putting an add-on is often not sufficient. Measures may be needed to improve the water quality either at the source or at the household level.

An example of an interesting multiple use case is the Avola spring in Senkegna, Yilma Densa (Mekonta & Boelee, 2013b). This spring was developed under the Commuity Managed Project (CMP) approach and comprises one water point with four faucets, one laundry basin with four compartments, two shower rooms, one cattle trough and a storage reservoir. The surrounding land also contributes to sustaining the system as it has been turned into a protected (non-grazing) area which is now producing hay that is harvested by the community. Income of the system includes user contributions of 4 Birr per family per year, income from selling hay and income from taking a shower (1 Birr per use). Over the last six years the system has generated a considerable profit and the WASHCO has some 15000 Birr in its account. This example however also raises equity issues. Six families living downstream of the spring are now benefitting from the surplus water which they use for irrigation free of charge. Furthermore the income is used to pay for the guard and the maintenance but it is not clear what will be done with the surplus. In fact the system was built with a grant of the Government of Finland of some 35000 Birr and a community contribution of 10000 Birr. It would seem that in this case a loan could have been provided which could have been paid back in say ten years particularly if also some revenues would be obtained from the six families that use the water for irrigation. Grants than could be used to help other communities where conditions are less favourable and which rely for example on systems using power supply where they may have to pay even 0.5 Birr per 20 litres of water.

Box 4.1: Technological add-ons to facilitate multiple use of water: the case of Ido Jalala and Ifa Daba

In Ido Jalala, a community in Gorogutu Woreda, East Hararghe zone, Oromya Region, the Ethiopian NGO HCS capped a spring and installed a water point to improve the quality and the easiness in which the water can be collected and used for domestic use. Initially, the spring had been used for domestic water, as well as irrigation. Therefore, HCS decided to add an irrigation component to the system, with a separate night storage reservoir (to avoid the risk of blocking the flow of the spring) and lined canals, to improve the efficiency of water use.

In Ifa Daba, in the same woreda, HSC capped a spring and diverted the water into an irrigation reservoir, from which lined irrigation canals divert water to irrigated plots. However, people collected water from the irrigation reservoir for domestic water as well. Collecting this water was not easy and quite time consuming (see picture). Therefore, HSC decided to add a water tap from which people could collect water for domestic use.

Figure 4.1 Woman collecting water from the irrigation reservoir in Ifa Daba

It is important to note that CMP is a nationally recognized priority approach for rural communal water supplies which in theory ought to facilitate MUS because it is based on decentralized decision-making of communities. In practice however this potential is not realized as typically wells with a handpump are provided for 50 families leaving little space for other than domestic water supply (Butterworth et al., 2011). Hence further analysis is needed to explore if a stronger emphasis on MUS can be adopted for example by installing two handpumps on one well provided that water resource conditions allows abstraction of more water.

Communal distribution systems are piped systems with household connections and/or tap stands, bringing water closer to people. These systems supply water to taps closer to people's homes. Theoretically this may offer a good opportunity for multiple uses and to be complemented with 'add-ons', like drip irrigation to water home gardens in an efficient way, using domestic water from the piped network. The difficulty with most of these systems is that they are designed for domestic water use based on the prevailing level of 15 l/p/d, leaving no scope for other uses, except for people re-using the water at home. In fact several systems in Ethiopia suffer from the addition of house connections over time often by local technicians who have no clue on the requirements of water systems in terms of pressure distribution. A case in Afar shows that the addition of house connections led to a dramatic drop in water pressure at tap stands resulting in increasing waiting lines and in the end in the total collapse of the system. Hence any intervention in the distribution network needs to be assessed beforehand and it is also necessary to look at such interventions including the introduction of house connections from an equity perspective as usually the better off will be able to afford such a connection whereas the poorer sections in the community then may have to wait longer to collect their water from a tap stand.

4.2.3 Multiple systems for multiple uses

Providing multiple use water services which respond to people's water needs does not mean that all uses of water have to be addressed through one single system. There may be multiple systems providing services for different uses. This raises an important point for reflection in that under a MUS approach it can be considered to split the domestic water supply in water for drinking and cooking (washing vegetables etc.), in general some 5 liters per person per day and other water use (for personal hygiene, washing cloths etc.). The five liters need to be of very good quality but is a smaller volume that can be taken for example from a safe water point or produced through household (or even communal) water treatment.

Rainwater harvesting for example can be split in a part that is collected for drinking and cooking (some 5 l/p/d) which needs to be of good quality and requires a good roof and good quality water storage, and a part for washing, watering cattle or irrigation which can be of lower quality and can be kept for example in lined water ponds. If conditions are favourable also other rainwater harvesting techniques can be considered such as rock catchments but also sand dams as explained in more detail in some of the other GLOWS training modules.

In terms of using multiple water sources roof top water harvesting can also be of great help in areas where groundwater for example has a high fluoride concentration. Roof top collection and storage then can cater for the water required for drinking and cooking whereas groundwater can be used for example for washing and bathing.

4.3 Planning for multiple uses of water

In order to ensure that communities have access to water services for their multiple uses, all year round, it is important to first understand what these uses are, and what water sources and infrastructure are available to meet them, and to understand the barriers people face in accessing these resources. This can be done through a participatory assessment of the situation looking at the water sources and their use throughout the year.

Water Resources

There are 3 types of water resources and for each some key questions may be relevant:

- Ground water (where are the sources located, in which months is water available, what is the quality of this water, can water storage be improved, and what options for additional wells exist)
- Surface water (where are the sources of surface water, in which months are they available, what is the quality of the water, and can subsurface storage be improved)
- Rainwater (what are the rainy periods, what is the intensity and how strong is their fluctuation, can rainwater harvesting be improved through rooftop or catchment harvesting or enhanced infiltration and subsurface storage)

There can be seasonal variations in the availability and quality of water resources, for example:

- Water tables drop during the dry season; this may even happen during the wet season as a result of over abstraction and/or climate change
- Seasonal ponds and pools appear when it rains and disappear in the dry season.
- Rivers may be seasonal and dry up (or partly dry up) during the dry season. With the reduction in discharge often comes an increase in level of contamination as less water is available for dilution
- Boreholes may break down in the dry season because other sources of water have disappeared and they are therefore over-used.

These variations are part of normal seasonal cycles and are seen in a normal year, but they are often intensified by droughts. They may also be the consequence of changes in the catchment area which may lead to reduced water infiltration resulting in lower water availability or even totally drying up of water sources. Deforestation, overgrazing and the use of inappropriate agriculture techniques (e.g. not applying contour ploughing) may lead to erosion, changes in run-off patterns (increased peak flows), and reduced infiltration resulting in lower availability of groundwater. Hence water resources problems need to be analysed in order to find their cause(s) and to be able to introduce appropriate mitigation measures. In addition it is also needed to look at the possible effect of mitigation measures. For example banning cattle from a certain catchment area implies that farmers need other grazing grounds or fodder will be needed possibly from the same catchment area or from elsewhere.

Infrastructure

A variety of systems is being used to abstract water from these different sources (Box 4.2). For drinking water supply systems include rope pumps, handpumps (Afridev and India Mark 2) and electrical pumps with a generator; for small scale irrigation systems can be found such as rope pumps, treadle pumps, petrol/diesel pumps, as well as electrical pumps. Important variations exist between states in the presence of some of these systems. IMWI (2011) indicates for example that over 14000 treadle pumps were installed in Amhara whereas in Oromia they found only some 160. Such differences may have complications as with fewer pumps installed also the expertise with that particular pump may expected to be lower and spare parts may be more difficult to obtain.

Box 4.2. Water supply systems

Ground water based:

- Springs (confined or unconfined)
- Dug and manually drilled wells (unprotected or protected, with or without a lifting device)
- Boreholes with a hand or rope pump
- Boreholes with an engine driven pump and water tank
- Boreholes with distribution system (with or without treatment)

Surface water based:

- Open sources (ponds, lakes, canals and rivers) ;
- Gravity water supply systems (with or without treatment)
- Pumped water supply systems (with or without treatment)

Rainwater based:

- Direct collection in pots and pans
- Roof catchment systems
- Rain water ponds

When regarding multiple use water services, a considerable number of shallow wells constructed under the agricultural programme usually can also provide for the quantity of water needed for drinking water supply. An important problem however is that the quality of the installations entails considerable risks of contamination. Hence the first check to be made is whether the system and pump installation can be improved to reduce this risk. If the latter cannot be achieved at short notice than at least users need to be informed about options for household water treatment. For existing communal systems the situation is often more complex in that their design perhaps may include water for animals (cattle troughs), but rarely will include water for fodder production or other types of small scale irrigation. Also it may not be easy to include the latter in new systems as this will increase the cost which often is subsidized and comes with specific design criteria which may not allow building a larger system to, for example, enable (drip) irrigation. A related problem is that subsidized systems in theory should contribute to enhancing equity, but in practice it may be expected that some can benefit more from the systems than others.

Demand

Water demands of communities are likely to include:

Domestic use:

- Drinking and cooking
- Personal hygiene and sanitation
- Washing clothes and utensils

Productive use:

- Growing crops (hence it is important to understand the type of crops that are used and the area of land that is irrigated in the community)
- Livestock (hence it is necessary to have an indication of the types and approximate numbers of livestock community members keeps).
- Other activities such as beer brewing or brick-making (hence it is also necessary to find out how much water is used for such other purposes).

The minimum volume of water for **domestic use** in Ethiopia is defined as 15 litres per person per day within a distance of 1.5 km. This includes

- 5 litres per person in a household per day for drinking and cooking needs
- 6 litres per person per day for hygiene and sanitation needs plus
- 4 litres per person per day for laundry.

These minimum requirements are used by the Ministry of Water Resources in Ethiopia but are also in line with those indicated in the SPHERE manual (although the latter suggest a maximum distance of 500 meters and also indicates a maximum waiting time of 30 minutes (http://www.spherehandbook.org/en/water-supply-standard-1-access-and-water-quantity/)

The volume of water needed for **productive uses,** will depend on the number and types of crops, livestock and other activities and may also vary between seasons (Table 4.2).

Table 4.2. Daily Water Requirements for Livestock Across Seasons (Lpcd)

Daily Water Requirements – Livestock (voluntary intake)	**Wet seasons (23 - 27^{o}C)**	**Cool dry seasons (15 – 21^o C)**	**Hot dry seasons (27^{o}C)**
Camels	13	25	28
Lactating camels	17	30	33
Cattle	9	20	22
Lactating cows	13	26	29
Goats	2	4	4
Sheep	2	4	4
Horses & donkeys	5	16	18
Voluntary intake is the daily amount of water drunk by an animal assuming that fodder contains 70-75% moisture during the wet season and 10-20% moisture during the dry season. (Source Coulter, 2010)			

Also important differences exist in the water requirements of different crops (Table 4.3) and these depend mainly on environmental conditions. Plants are using a very small amount of water for their growth and a lot for cooling purposes. The driving force behind the cooling process are prevailing weather conditions and the moisture of the soil. The highest crop water needs are found in areas which are hot, dry, windy and sunny. The lowest values are found when it is cool, humid and cloudy with little or no wind. The maximum water requirements of different types of crops also may not occur at the same time of the year which implies that mixing different crops may be an attractive option to reduce peak consumption in a specific time of the year. The water requirement of crops also varies from one growth stage to another and they may respond differently to water stress (Table 4.4). An important point to also take into account is that alternative options to improve rain fed agriculture without using pumps may be an attractive possibility and may involve less investment and recurrent cost making solutions more manageable.

Table 4.3. Example of approximate values of seasonal water needs of some crops

Crop	Crop water need (mm/total growing period)
Banana	1200-2200
Barley/Oats/Wheat	450-650
Bean	300-500
Cotton	700-1300
Maize	500-800
Onion	350-550
Sugarcane	1500-2500
Tomato	400-800
	Source: FAO, 1986

Whereas it seems attractive to introduce water pumps and (drip) irrigation also for small scale farming, it needs careful analysis and requires comparison with improving rain fed agriculture which may be a less costly alternative

Table 4.4: Examples of critical growth stages of some crops in Colorado

Crop	Critical period	Symptoms of water stress	Other considerations
Corn	Tasseling, silk stage until grain is fully formed	Curling of leaves by mid-morning, darkening color	Needs adequate water from germination to dent stage for maximum production
Sorghum	Boot, bloom and dough stages	Curling of leaves by mid-morning, darkening color	Yields are reduced if water is short at bloom during seed development
Beans	Bloom and fruit set	Wilting	Yields are reduced if water short at bloom or fruit set stages
Onions	Bulb formation	Wilting	Keep soil wet during bulb formation and dry near harvest
Tomatoes	After fruit set	Wilting	Wilt and leaf rolling can be caused by disease
			Al-Kaisi & Broner, 2009; based on the Colorado Irrigation Guide

Water demand will vary over the year and will not be the same for everyone within the community. This requires careful analysis, planning and discussion of the distribution of the additional cost involved in multiple use systems. Also some families and particularly female headed households may need more support to benefit from MUS. A briefing note from IMWI (2011) for example indicates that female headed households were less likely to adopt water lifting technologies as they only represented 3% of the adopters. A complicating factor for communal systems is that construction costs are largely paid by the government or NGOs. Providing a larger system that also provides water for small scale irrigation may not fit with the purpose for which financial resources are provided. Institutions and projects may just focus on providing domestic water supply and may not be willing or able to pay for the additional cost of a larger system, whereas communities may not be able to get a loan to pay for the additional cost themselves and may not be able to repay these cost as this would require growing some cash crops and selling these on the market. Hence multiple water use in communal systems may be complex and may require institutional change.

Who has or will have access

Different people within a community may be expected to have different water needs and different levels of access to water services. Some may face more important barriers than others and these may include:

- Physical barriers:
  - Long distances to water infrastructure
  - Physical difficulty of collecting water (steep slope, heavy pumping)
  - Long time to collect water because of a low discharge (flow)
  - Long queues at the water point
- Social and legal barriers
  - Source is on private land, and access is blocked by the landowner at certain times
  - Certain people are excluded from using water from certain water points
- Financial barriers
  - Water fees are too high for poorer people or for certain uses
  - Lack of resources to collect and store water (e.g. lack of a donkey to collect water from a nearby community, lack of jerry cans etc.)

Access to water resources and water services are also subject to seasonal influences. For example:

- People may have to travel long distances to collect water in the dry season if the source near to their home dries up (Figure 2).
- People fetching water may face long queues in the dry season
- Landowners may prevent other households collecting water from springs or other sources on their land at certain times of year.

These seasonal variations in access to water have impacts on livelihoods, food security and health, which often also show seasonal patterns. For example:

- Use of seasonal pools and ponds, which are unprotected sources, for drinking is associated with peaks in diarrhoea occurrence.
- Long waiting times for water during the dry season use up household labour, preventing household members (especially women) from engaging in income-generating activities or devoting time to childcare.
- Livestock which do not receive adequate water during the long dry season produce less milk, which can affect the food security of pastoral households.

Looking for opportunities?

Long waiting lines at water points are an important burden for people and particularly women and children. This is aggravated by the fact that no sanitary facilities are available in the area of the water points. This burden however can be turned into an opportunity by establishing a public toilet in the area. If separate urinals are installed the toilet can become an important source for urine that can be used as fertilizer. Local farmers may be willing to pay for this fertilizer and these resources can be used to manage the toilet.

Figure 4.2 Donkeys carrying jerry cans of water

4.4 Assessment tools for multiple use water services

To maximise the benefits of multiple water use it is necessary to make an assessment of the water resources, existing infrastructure, and the demand and access to water. Some tools that can be helpful to jointly with community members explore the situation include:

- Community water mapping
- Livelihood grouping
- Wealth ranking
- Seasonal calendar

Community mapping

Community mapping allows getting a better insight in the (seasonal) availability and use of water resources, the existing infrastructure, demand and access for water for multiple uses within the community. Community mapping can be initiated with community leaders or the WASHCO, but can also be used with other groups within the community, like different livelihood groups, different wealth groups and with men and women separately. This can give insight of the differences in water demand, access and use between the different groups, which also may help community members to better understand their own situation. Box 2 provides an overview of the steps that need to be taken to establish a community map.

It is important to take into account that community members have their daily tasks and being involved in community mapping or other activities initiated from outside the community takes time. Hence depending on the local situation you can take different approaches which may include developing the map with a group of 10 (as shown in Box 4.3), but you may also make a first map with fewer people and then use the draft to make it more precise in a community meeting or in meetings with separate groups. This has the advantage that you create a transparent process where a larger number of people will be aware of the situation and the results whilst not spending a lot of time in the exercise.

Livelihood grouping, making of livelihood zone profiles

Demand for and access to water for multiple uses may vary widely over different livelihood groups. Livelihood groups consist of people who are involved in similar activities to sustain their livelihoods, for example cow farmers or farmers mainly growing a particular crop.

All woredas in Ethiopia have already been delineated in 2009 into 'livelihood zones' by the early warning department and the Disaster Risk Management and Food Security Sector (DRMFSS). Livelihood zones are areas with similar agro-ecology, market access, and livelihood activities. Some woredas lie entirely within one livelihood zone, while others include several zones. For each livelihood zone, short profiles are available with the Woreda Agriculture Desk which includes a 'seasonal calendar' showing seasonal (month by month) patterns of food availability, disease, and main farm and non-farm activities. Finding out the livelihood zone of your Woreda by getting access to these profiles or by asking the staff from the desk is helpful to be able to get a feel for the situation and to take this information to the community for the assessment of the situation. If you do not have access to this information you can also generate it in the visit to the community. As part of the mapping exercise you can also ask about the different livelihood groups that may be present and it may even be feasible to add this information to the map. In fact you may be adopting a refined approach where you for example distinguish between farmers with and without irrigation systems.

Box 4.3 How to do community mapping

- Identify and agree with local actors who will be the team and the team leader which you will support in developing the mapping. Usually this will be either the WASHCO or other persons nominated by community leaders.
- Arrange for a meeting with a number of people from the community (not more than 10) to participate in the exercise. Ask the community team leader to make sure the participants are a good representation of the community (men / women, poor / less poor, people with livestock/ people without livestock, people who irrigate / people who do not irrigate), unless separate meetings with these groups are planned to discuss the draft map
- Ask the team leader to explain that together a map will be developed of the community with all the water sources, the houses, roads, farm land (irrigated or non irrigated) water infrastructure, communal grounds, forests etc. as a basis to identify potential problems and solutions
- Explain the use of the material (flipcharts + markers in different colours, or locally available materials, like stones, twigs etc.)
- Facilitate the mapping process and encourage everyone to have an input in drawing the map allowing ample time to draw the map(s); also ensure that distances are added to understand the time it may take different families to reach a water source
- Discuss the results by asking the group to explain what they have drawn.
- This map can now be used to discuss possible problems related to the water supply situation and to the different water uses that apply for the different water systems.
- Ensure that notes are taken of the discussion and register key points on a flipchart
- Make a sketch or picture of the map(s) as the map will stay in the community.

Wealth ranking

Just as for livelihood groups, wealth groups and their characteristics (in terms of what assets they generally possess) have already been identified for socio-economic groups in all woredas and livelihood zones in Ethiopia in 2009 through the DRMFSS's livelihoods baselines. The livelihood zone profiles describe the typical characteristics of better-off, middle, poor and very poor households in the zone. Woreda officials can use these wealth group breakdowns – found in the livelihood profiles for each livelihood zone and woreda – as a guide to help understand the different assets held by each wealth group and how these affect demand for and access to water. It may also be useful for selecting people to participate in participatory mapping exercises, like the participatory mapping, mentioned above and to establish the need for a discussion at community level about possibilities for example for differential tariffs.

You can also generate this information at community level and this may be quite relevant to explore whether for example poorer members or even sections of the community are disadvantaged in terms of water access and use. Particularly female headed households and elderly people may be poorer and may face specific problems. Creating more openness about such problems may help the community to agree on specific support measures for disadvantaged families.

Seasonal calendars

A useful way to bring together information on access to and use of water for multiple uses, is through a seasonal calendar. In preparation for the work in communities and Kebeles it will be useful to collect data on seasonal variations in water availability and in water needs for cattle and crops. With this information you can work with the community group involved in the mapping to jointly prepare a seasonal calendar, to better understand water availability and needs whilst linking it to at least one other key livelihood aspect being the incidence of diarrhoea (which can be checked with the Health Extension Worker). The approach to making a seasonal calendar is shown in Box 4.4 and an example of such a calendar is shown in Table 5.

Box 4.4 How to make a seasonal calendar

To create a seasonal calendar of water sources, draw a table with a column for each month of the year. For each of the main water sources indicated on the community map, add rows to represent different uses of the source (drinking, washing, irrigation, livestock and any others). Shade the boxes to show in which months water is used for each purpose. Then add a row to record average waiting times at different times of the year for each water point. More details can be added by collecting information from the group or the HEW about the peak months for diarrhoea (waterborne disease) and add this as a row to the table. Also it may be useful to add information on the water needs for different crops which may encourage community members to opt for crop diversification.

Table 4.5. An example of a seasonal calendar

		Ma	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Source 1 (protected spring)	Waiting time (hrs)	-	-	2	3	-	-	-	2	3	3.5	3.5	4
	Drinking &												
	Washin g &												
	Irrigatio												
	Livestoc												
Source 2 (unprotect ed spring)	Waiting time	1.5	1.5	2	-	1.5	1.5	1.5	2	-	-	2	2
	Drinking &												
	Washin g &												
	Irrigatio												
	Livestoc												
Diarrhoea	Peak months												

You can opt for different levels of detail and you may need to be very practical about it because often you do not need too much detail to get a reasonable impression of the situation. For example the collection time is an average and you may establish this on the basis of the experience of the people participating in your meeting. On the other hand it may also be useful to add some more data for example to Table 4.such as the average number of users of a specific source in the different periods of the year. Some sources may have many more users in the dry season, and average waiting times may become very high in this period. In some cases even rationing may be applied. These are important data and may help to visualize the situation to clearly identify the different problems.

A seasonal calendar helps to visualize the information about water sources and uses together. It enables community members to understand their situation and to identify specific months when there are problems such as use of unprotected sources for drinking water or long waiting times. Seasonal calendars can also show, for example, months where high labour demand for agriculture coincides with peaks in time required for water collection etc. For further information you can consult the resource materials on the CDRom.

Transect walk in the catchment area

A transect walk is a systematic analysis of the catchment area where the water from the water sources is coming from. It basically consist of an assessment of the catchment area by walking along a straight line to explore the situation. A transect walk in the catchment area may be very important to identify possible risks that may affect the long term water availability or water quality. If the water catchment is not well protected and signs of deforestation, overgrazing and erosion are visible the water source may be at risk. Furthermore farming using fertilizers and pesticides may also negatively affect the water quality of the water sources and may lead among others to increase in nitrate levels which may generate a risk for small babies. Experience is needed to implement a transect walk and additional information is available in the resource material in the CD.

Sanitary survey

To assess the water quality the first step is to implement a sanitary survey which is a systematic analysis of possible risks that may occur in the water supply chain from catchment to consumer (catchment area, water source, water supply system and household water storage and use) (Lloyd, B. and Helmer, R. 1991). The most important risk may be related to bacteriological contamination from human and animal excreta. Possible risk thus can be identified by exploring if water in the water resource can come in contact with pollution. This may include for example the inflow of dirty water in a well through cracks in the lining or well cover, but also by infiltration of polluted water just upstream of a spring, or direct hand contact with water that is drawn from springs, wells and pumps. The risks mainly concern drinking water and water for cooking (washing vegetables etc.) as this may lead to direct ingestion of bacteriological contamination which may cause disease. For other uses of water such contamination is less of a problem or no problem at all. An experienced person is likely to detect whether a water source is at risk and only in case of doubt it may be needed to do bacteriological water quality testing or testing for harmful chemicals such as Fluoride and Nitrates. Further information of water quality is included in the GLOWS manual.

4.5. Establishing multiple use services

After having done a participatory assessment of available water resources, infrastructure, demand and access related to multiple uses of water in the community, the WASHCO and the community can start thinking about what can be improved in order to better match the water services to people's multiple demand in a sustainable and equitable way.

The main point is to take the different types of water needs of people as a starting point and to carefully explore different options available to them to obtain financially sustainable and equitable water services that respond to those needs or to explore options to reduce those needs. In this process it is important to take into account that it may be feasible to both influence the availability of water (additional water points, better catchment management, rainwater harvesting etc.) and the water demand (crop variation, efficient water (re)use)

In the development of the multiple uses of water sources and systems in a specific location in general two options can be distinguished. The community mostly depend on communal systems such as handpump wells, tap stands and water ponds. Here the scope for multiple water use of existing systems may be limited but some options may be available in promoting water use efficiency and possibly more importantly efforts may be needed to ensure that people at least use water from safe systems (which may require system improvement) for drinking and cooking. To enhance the use of water for productive use in this type of communities the possibility of additional water points needs to be explored.

Management of communal systems needs to be taken into account when thinking of multiple uses of multiple systems. Within a community, there can either be one single water committee, which is responsible for the system(s) providing water for multiple uses, or separate committees for different uses, for example a committee for water supply for domestic use, and an irrigation committee for irrigation. In several communities where the CMP approach has been applied even several WASHCOs may exist as under this approach each water point that is being developed has its own committee that organizes the work, oversees construction and thereafter takes responsibility for management and maintenance. Hence depending on the situation it will be necessary to work with one or more WASHCOs.

In other communities household wells may be the most important water source and these may already be used for multiple purposes. This in a way may be less complicated particularly where such systems are built and financed by users possibly making use of a credit facility. Still different activities may be needed to enhance and improve the multiple uses of these systems. It may be anticipated for example that specific efforts may be needed to ensure that the water quality of these sources is also suitable to be used for drinking water. This may require improvement in well construction and pump installation (if available). As an alternative it can also be considered to introduce household water treatment or to construct a new safe water point where people can obtain a restricted quantity of good quality drinking water.

A common issue in both types of communities is the need to strengthen the link between the different sectors and particularly water, irrigation and health. Encouraging collaboration particularly at Woreda level (but also at higher levels) between these sectors can contribute considerably to effective multiple use systems. One of the clearest examples is the promotion of wells with rope pumps for small scale irrigation by the ministry of agriculture which is supported by the agriculture extension workers at Woreda level. By teaming up with the Woreda staff working on drinking water supply and the HEWs wells meant for irrigation (but also used for domestic water supply) can be turned into safe water supply (thus contributing to meeting the access for all targets) instead of being a health hazard for the users.

4.6 Self evaluation

This is an individual evaluation of your understanding of the information presented in this module. Answer the (multiple choice) evaluation questions and check your own answers. In case your answers had many mistakes it is suggested that you review the module again before doing the assignment.

Q1. What is the difference between a well people use for irrigation and for drinking water?

A. There may be no difference
B. Wells for drinking water always have better water quality
C. Wells for irrigation always have a larger discharge than wells for drinking water

Q2. Which of the following systems has most potential for multiple uses of water?

A. A piped system with 100 household connections and 4 communal tap stands
B. A household level shallow well
C. A community level hand dug well with a hand pump used by more than 50 households

Q3. What can be said about the following statements?

i) Multiple uses of water can be facilitated by adding a technological add-on to existing systems
ii) Multiple uses of water can be facilitated by supporting community level institutional arrangements for prioritising water uses and conflict management

A. Statement i is correct, statement ii is not correct
B. Statement ii is correct, statement i is not correct
C. Both statements are correct
D. Both statements are not correct

Q4. Which is not an example of a livelihood group?

A. The best-off / wealthy people in the community
B. Day-labourers
C. Cattle-farmers

4.7 Assignment

1) Find a water source nearby your office or in one of the communities you work and identify the different uses made of the water in the dry and the wet season (you may want to put this in a table: i.e. Separate drinking, other domestic, livestock, irrigation, other, and you can do this exercise also in the system you used in the first assignment.
2) Find 2 or 3 families using the water source, and ask about their use of other sources in the dry and wet season. Why do they use other sources?
3) Could the water source that you have studied, be improved to supply water for more of the requirements of the families living in the area? Who would benefit from the interventions? Who might not benefit or lose out through the interventions?

4.8 References and further reading

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4.9 Answers to self-evaluation questions

1: **Answers A is correct**. In many locations household wells are used for both drinking water as well as small scale irrigation. Answer B is not correct as a considerable number even of protected wells that are used for drinking water in Ethiopia are polluted often as a result of poor design and/or maintenance and repairs. Answer C is not correct as the same wells may be used for both purposes and the discharge depends on the groundwater conditions

2**: Answer B is correct**. A household well can provide for both drinking water and water for other use including irrigation provide the environmental conditions are favourable. Piped systems are usually designed only for domestic water use and the large number of house connections may imply that the system is already being stretched. A communal well generally has limited scope for multiple use services that may include watering cattle, and perhaps some irrigation of land close to the well.

3: **Answer C** because multiple uses of water can indeed both be facilitated by adding a technological add-on to existing systems and/or by supporting community level institutional arrangements for prioritising water uses and conflict management (traditional or with external support)

4: **Answer A** because: "The best-off / wealthy people in the community" is a wealth group, rather than a livelihood group. The fact that people in this group are wealthy does not say anything about the livelihood activities they are involved in.

If you failed to provide several of the correct answers, then review this module again.

Module 5 Sanitation and hygiene

This module reviews options to avoid the transmission of sanitation and hygiene related diseases with emphasis on improving sanitation systems. *At the end of this module the participant will:*

- *Be able to explain the risk of the transmission of sanitation and hygiene related diseases*
- *Have identified what key aspect to assess at community and school level*
- *Can indicate the steps involved in and possible risks related to CLTS*
- *Have learned about some possible improvements.*

5.1 Introduction

Poor sanitary facilities, lack of hygiene and inadequate waste management are major public health problems. Although sanitation coverage increased still the levels are very low. In rural areas 19% uses improved latrines. 6% share latrines, 22% uses unimproved latrines and 53% practices open field defecation (WHO/UNICEF, 2012). This may explain why still highly infectious diseases such as diarrhea and cholera take a considerable human toll in Ethiopia. Diarrheal diseases kill some 2.2 million people each year, 85% from them are children under five.

Hence it is very important to help people understand the need to improve sanitary facilities and change risky hygiene behavior. The essence is to recognize that Water Sanitation and Hygiene (WASH) promotion need to go hand in hand. This includes the promotion of simple measures such as hand washing after defecation and before food consumption. The scope of this module however is in the first place on identifying possible problems and to make a plan with the WASHCO and if possible with the HEWs to improve upon the situation.

5.2 Cutting the transmission of infectious diseases

Faecal-oral contamination route

An infectious disease is transmitted from one person (or animal) to another person (or animal). All infectious diseases are caused by living micro-organisms that are classified as bacteria, viruses, protozoa and parasitic worms. Most of the harmful micro-organisms that are transmitted by men are found in the excreta of people carrying a disease. Once excreted these micro organisms can reach another person in different ways (Figure 5.1).

The figure shows that it is essential to break all the different transmission routes to effectively prevent the transmission of disease. It should be realized that this not only concerns micro-organisms from human faeces. Many wildlife species and domestic animals can potentially shed organisms pathogenic to humans.

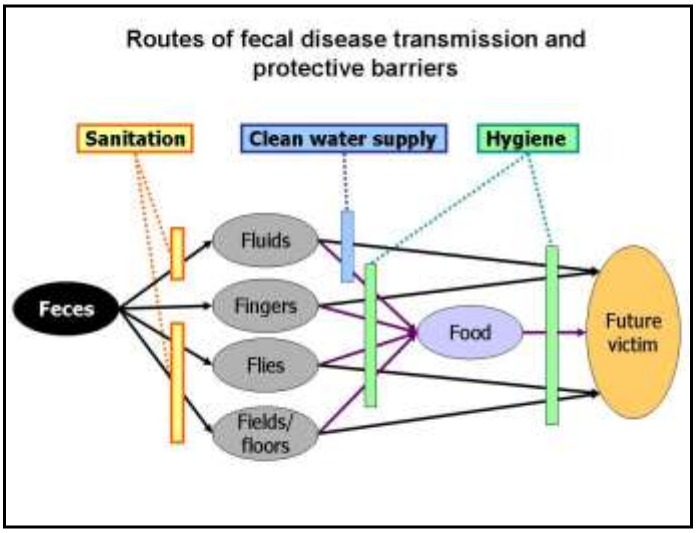

Figure 5.1 The F-diagram summarizing the feacal oral transmission routes (Source: Worldbank.org)

Figure 5.1 shows that a combination of adequate sanitation, good hygiene practices and safe water supply is needed. The 'primary barrier' is to isolate fecal matter from the environment through adequate isolation thus avoiding that it enters the environment. Here it is good to realize that in fact all community members have to adopt the use of safe excreta disposal to ensure effective reduction of the risk of contamination. The proper use of latrine alone can reduce diarrheal diseases by 36% (Scott, 2006). Yet it is also needed to ensure proper 'secondary barriers' to protect against fecal material which is already in the environment. These barriers include good hygiene practices and particularly washing hands with soap. Hand washing especially during critical times (after visiting a latrine, before preparing and serving foods, cleaning before breast feeding can reduce diarrhoea by 48% (Cairncross et. all., 2010). Other health problems like eye and skin disease can also be reduced through adequate sanitation and hygiene measures.

Two main groups of sanitary facilities can be identified being on-site or of site facilities. In addition it is good to briefly clarify the concept of ecological sanitation as experience with this concept is being obtained in Ethiopia.

5.2.1 On-site sanitation

This concerns facilities in which the excreta are disposed of on-site such as dry pit latrines, ventilated improved pit latrines as well as poor flush latrines with a soak pit. These systems can be very effective provided that they are kept clean and properly avoid that flies can access the faces. Unfortunately many pit latrines are not properly build or maintained and therewith in fact turn into a health hazard. Another potential risk of on-site systems is that they may contaminate the groundwater including shallow wells that are used for water supply as has been discussed in chapter 2. Still on-site sanitation is the main option for many rural communities and schools.

5.2.2 Of-site systems

This concerns facilities that are discharging their content or part of their content outside the plot where they are built. This may include toilets with septic tanks or toilets connected to the sewer. The problem with this type of systems is that it requires water for its operation and this may be a problem in different locations in Ethiopia. Furthermore the waste water is discharged in a sewer that may block if the water flow is too small. Also the waste water needs treatment to avoid that it contaminates the environment. So unless such type of problems can be overcome construction of sewer systems should be discouraged.

5.2.3 Ecological sanitation

Ecological sanitation (Ecosan) is a special form of on-site sanitation which embraces the principle that human excreta are not a waste but a valuable input for agriculture, as nutrients and organic matter. This is an old system and for example in 500 BC the Chinese had a collection system of excreta in urban areas which they transported to rural areas. This enabled intensive agricultural that sustained the most densely populated societies of that time. Human waste of an individual can supply nutrients needed for example to grow some 250 kg of cereals. Urine contains most of these nutrients and in most cases does not contain harmful bacteria and viruses unless it is polluted with excreta.

The idea behind ecosan is meeting with quite some success. In Ethiopia for example the Catholic Relief Service (CRS) and its partners have been introducing the Arborloo latrine since 2004 and by the end of 2008 already 40,000 families had installed this latrine (CRS, 2012). This is the simplest form where a concrete slab is located on a pit and when the pit is full (after some six month to a year) the slab and the superstructure is moved to another location and a three is planted in the old pit. In more elaborated ecosan systems urine and faeces are separated as this greatly reduces odour problems and facilitates the direct re-use of urine. This is very important because urine contains most nutrients (60% Phosphates and 90% Nitrogen) and has rarely a sanitary risk. The urine is collected in a container and after dilution used as fertilizer.

Excreta are collected in a pit or a box where the material needs to decompose, a process taking at least 6 month, to ensure that pathogens die off before it can be used to assist crop production. So instead of reusing both it may be interesting to (initially) think only of urine diversion. This is feasible even on a standard pit latrine with a sandplat, by just putting a pedestal with a diversion toilet and making a separate urinal.

The main advantages of Ecosan are:

- Safe recovery of nutrients and organic material
- Minimising the risk of pathogens contaminating water.
- Stimulating soil fertility and use of organic matter
- Higher agricultural production.
- Lower water consumption in toilet practice
- Stimulation of a more interdisciplinary and holistic way of approaching sanitation (instead one of wasting of valuable resources).

The Ecosan concept has proven itself around the world in different climates and several positive experiences of Econsan toilets are also available in Ethiopia (Oldenburg 2009; CRS, 2010, Sanderman 2012). To promote its application it is important to look both at the sanitation side where the latrine is much better in terms of smell and the fertilizer side and particularly of the urine. It is important to give sufficient guidance to the users to ensure that they properly manage their systems to prevent too much moisture (as this may attract flies and create odors).

Figure 5.2 Ecological sanitation in West Berayta Elementary School (Sanderman 2012)

5.3 Assessing sanitation and hygiene related risks

The first step we will discuss in this module is the assessment of the sanitation and hygiene situation in a community together with local actors. The situation you may find can be quite diverse as some communities in Ethiopia have been involved in a process called Community Led Total Sanitation (CLTS) which is the main approach adopted by the GoE to increase sanitation coverage, whereas in other communities no external interventions may have taken place. The challenge is to find out what problems exist and which actors can take steps to improve upon the situation. It is anticipated that your entry point with the community is the WASHCO, but in the case of sanitation it would be of great importance to also try and involve the HEW as being the person with a responsibility towards the community in this area. The fact finding that is needed will require both a discussion with the HEW, the WASHCO and other actors some as the head of the school as well as a 'sanitation' transect walk where you explore the situation with some of these actors by visiting a number of households and possibly one or more schools.

The main aspects to observe and discuss at local level include:

- **Coverage** – being the number of households and schools that have sanitary facilities that are being used in a hygienic way. It is also important to look at availability of hand washing facilities close to the sanitary facilities;
- **Convenience** – relating to the easy access at required time and place; Latrines should be rather close to the houses as this will reduce the problems of using them in the night and will facilitate the training of young children (and the hygienic disposal of child faeces. In schools this is particularly important and when few systems are available it may be considered to stagger the breaks to ensure that fewer children need to use the facilities at the same time.
- **Quality** – of the facilities which includes looking at whether the latrine slab can be kept clean and whether access of flies is controlled as well as exploring the quality of the superstructure in terms of privacy and cleanliness;
- **Cost** – is a crucial issue as many latrines just using local material (wood, mud) may not be easy to clean, but the poorer sections in a community may not be able to pay for example for a plastic latrine pan or for some cement. Hence in such cases it may have to be explored how to support the poorest families (often female headed households);
- **Capacity** to manage the facilities is an underrated issue. Even a pit latrine needs some management and at some point needs to be emptied or relocated. In septic tanks it may be important to be careful with disinfectants to avoid interfering with the treatment process etc.;
- **Culture** – is important as it will dictate the habits and beliefs of users and this may for example not allow the application of human faeces in agriculture, but perhaps urine is acceptable etc.

The assessment of the sanitation situation that you need to accomplish with the local actors needs to explore possible health hazards at household levels and in schools (Figure 5.3) in a systematic way. You will need to register what you find using for example a reporting format as shown in Table 5.1. Important aspects to take into account include:

- The general sanitation conditions (open field defecation, poor waste management etc.)
- Functioning, technical state, and management of latrines including approach to pit emptying
- Low-lying areas and areas with poor drainage including review of the functionality of drains and the organization of cleaning drains

Special attention should be given to potential hazards like:

- Visible presence of faecal material and flies
- Cleanliness of latrines (floors, pans etc.)
- Absence of materials to cover the pit opening (or fly screen in ventilated improved pit latrines. If no lid is available than at least material such as ash should be there to cover the feaces
- Absence of water and soap/ash for hand-washing
- Inadequate handling of child faeces and presence of excreta around (behind) the facilities (particularly common in schools)
- Lack of water in water based system to flush excreta
- Unhygienic handling of garbage
- Unhygienic handling of wastewater

The community is an important source of information. They know about changes in health situation of community members and may be able to give an indication of the incidence of water borne diseases in the community. Hence their information can help to confirm the findings of your general impression based on a visit to a few household. One would expect a high incidence of diarrhea if many risks are being identified.

Figure 5.3 Some health hazards that you may find?

Table 5.1 Report of the sanitary assessment

Name of community	
Population size	
Official Health staff that can help to promote change	
Interviews (# of persons)	
Type of sanitary facilities	
Coverage (different systems)	
Convenience	
Quality	
Cost	
Operation & Maintenance	
Hygiene Culture (handwashing)	
Solid waste disposal	
Drainage	
Overall conclusion about the risks	
Earlier hygiene and sanitation interventions	
Key action points	

Involving health staff and community members in the assessment is essential and may help them to better understand and "see" the risks. The problem with human nature is that daily routines make that people get accustomed to the situation and no longer 'see' possible risks.

This may also happen to sector professionals if the sanitary facilities at their training institutions are of poor quality which unfortunately still is the case in many of them. When you use a dirty latrine every day then this becomes your reference.

It is also important to learn about earlier interventions. Different organizations may have already made an effort to support the community in improving their sanitation and hygiene situation. They may have trained community members or local health staff and may have had good or less good results. Learning from these earlier interventions is essential as it may show what worked and did not work and you may find 'champions' in the community that can take the lead on establishing change.

It is equally important to be critical as earlier approaches may have not worked out well partly because methodologies were not properly applied, systems not properly constructed and/or staff and users not properly informed and trained despite all good intentions.

5.4 Promoting change

After having explored the situation with the community it is important to identify what needs to be done and how this can be done. Here you will need all the help you can get as creating change is complex and requires sustained inputs of locally based actors. It may be anticipated that you will need to develop and action plan that stimulate sanitation improvements as well as promotes changes in hygiene behavior.

5.4.1 Hygiene promotion

The risk on contamination will always exist when awareness lacks or when knowledge on how to avoid risks is absent. Therefore, health education and hygiene promotion is necessary. It is essential that people of all ages use (improved) toilets and keep them clean. The disposal of children's feaces is as important as the disposal of adult's feaces as it may contain even higher levels of contamination..

Hygiene promotion in the sector is about creating awareness and change of risky behaviour in relation to water and sanitation. It is about helping people to understand the risk and find opportunities to develop new behaviours. Often people talk about WASH, being Water Sanitation and Hygiene promotion that need to go hand in hand. WASH programmes at schools are of critical importance as it can help to instill good sanitary behaviour in children at an age that they may be still in a better position to change. Furthermore school hygiene promotion can also stimulate the link between the school and the household where children can become agents of change.

Hygiene promotion is very important because more hygienic practice, such as hand washing after defecation and before food consumption, will reduce the transmission of germs, thus cutting the transmission cycles of disease. Improved water quality reduces childhood diarrhoea by 15-20% BUT better hygiene through hand washing and safe food handling reduces it by 35% AND safe disposal of children's faeces leads to a reduction of nearly 40% (Appleton et al, 2005).

Hygiene promotion can be applied at different levels including:

- Promotion of safe use of water in the household,
- Changing sanitary practice of children in school,
- Preventing open defecation in an entire community.

Perhaps the three most important issues to explore in terms of hygiene risk are hand washing, safe disposal of excreta (including baby feces) and safe water handling/storage.

Promotion of hand washing has been tried successfully in different ways, but all more successful ones adopted longer term approaches. Weekly visits during a one year period of households in Pakistan had positive impacts on health indicators, while women group meetings in Thailand during a 9 months period had a measured and lasting impact on contamination of hands (Shordt, 2006)). In Zimbabwe local health-clubs were established, supported by the Health Ministry. Topics included sanitation, water and transmission of diseases and hand-washing (Appleton et al, 2005). Hand washing preferably is done with soap but ash is an alternative.

This is also very important in schools and interestingly school hygiene promotion is more and more taking a "life skills based approach", in which children are not only learning new things but are directly applying their knowledge in practice. In a project in Somalia school children learned about hygiene behavior through role-play, coloring and group conversations. Not only did the project influence children's' behavior it also indirectly influenced behavior at the household level. Changes included hand washing, toilet use, tooth brushing and food handling (IRC, 2006).

In your assessment you will have identified the different risks and now you will have to agree with potential actors such as HEWs, possibly school teachers and maybe other actors what steps can be taken in hygiene promotion. What is helpful in this respect is to also help them to establish some key indicators to monitor progress. These may include for example:

- Proper storage of water in households and schools (closed containers)
- Handwashing particularly after defecation (presence of water and soap close to latrine)
- Latrine coverage
- Latrine use

5.4.2 Changing sanitation practice

In earlier assessments made by participants in GLOWS trainings three main problems emerged:

- Latrines (both in schools and in households) were dirty and not maintained
- Existing latrines were of poor quality in terms of the latrine slab and superstructure not providing for example adequate privacy.
- Part of the population practiced open field defeacation.

To tackle these different problems it is important to explore different venues as indicated in this section. The HEW and local leaders may be most indicated to lead the action, but they can benefit a lot from teaming up for example with school teachers (for school sanitation) and private entrepreneurs to improve latrine construction.

Simple technical improvements
It may well be that a large part of the population has already installed latrines for example because a CLTS program has been implemented, but many of them may have considerable problems, may be dirty, attract flies and therewith are a health risk. This unfortunately is quite common after CLTS interventions as too little follow-up is being provided. In this situation you will need to find practical improvement options and the people that can implement them or you may need to encourage the WASHCO or the HEW to seek expert advice. Improvement options that can be incorporated in the action plan may include:

- Improving existing wooden/mud slabs, by improving the drop hole, making it more easy to clean, putting a lid on it and suggest people to use ash to cover the feaces
- Replacing the wood with a sand plat (small concrete slab with a hole) and putting a lid on it. Local masons may be able to help with this change.
- Introduce urine separation either through putting a urine separating device, or as a minimum introduce urinals. This can be done at household level, but may be particularly useful at schools, and has the advantage that urine separation strongly reduces odor problems in latrines.

In addition you will have to win over the people that are still practicing open field defecation, which may require large scale interventions such as CLTS. Yet having already a number of people using latrines may be of considerable help to influence the others.

School sanitation improvements
In many communities the sanitary school conditions in schools are really poor. This may have to do with the technical quality of the systems which then need improvement, but it may also primarily a management problem. Schools are crowded and in the breaks many children try to use the facilities, sometimes even together, with obviously negative effects of really dirty facilities. A simple step may be to stage the moment different groups have their break a bit, so fewer children need to use the toilet at the same time. Other options may include the construction of separate urinals for boys and girls and use this opportunity to adopt a urine reuse concept.

Massive intervention
You may also find that only very few latrines are being used and most people practice open field defecation. Then you will need quite an intensive approach. The main option that is being applied in Ethiopia is ***community led total sanitation and hygiene (CLTSH)***. This approach focusses on the change of the sanitation and hygiene behaviour of communities rather than on making physical changes, such as latrine construction. It involves a process of social awakening stimulated by facilitators from within and outside the community. It concentrates on proper utilization of latrines, hand washing at critical times and safe handling of water at household level as a whole (involving all social classes, age group, sex group, etc) rather than at individual's level. The overarching strategy to eliminate open defecation is to adopt a "naming and shaming, fear and disgust" approach while encouraging community members to lead the process to get a 100% open defecation free community.

As shown in the detailed description of CLTS in the CLTS manuals included in the CDRom with resource material, it involves awareness raising (using sometimes quite provocative approaches in which people are shown that they literally drink water with shit), problem analysis and planning, and in some cases also showing different options for local sanitation solutions constructed and/or financed by the households themselves (see Box 5.1).

Box 5.1 The three phases in CLTSH

1. ***Pre-ignition/Pre-triggering*** phase which aims at selecting communities where success may be easier to achieve thus giving time to gain experience. (The WASH assessment may give this type of information)
2. ***Ignition of CLTSH (Triggering)*** is focusing on making people understand that if open field defaecation is not abandoned, people will be continuing to ingest each other's excreta. Different participatory techniques are used by external facilitators as presented in the CLTSH manual (on the CDRom). If the debate that usually follows results in a positive response from community members who want to change than you can start to discuss the way to go about it including establishing an ODF committee and to agree on a community action plan. At this stage participants may be asked to design latrine options, as the idea is not to prescribe a specific latrine model. The underlying expectation is that whereas initial designs may be of poor quality people over time will gradually adopt better models. As part of this approach a meeting is also needed to discuss school sanitation improvement.
3. ***Post-Ignition Monitoring and follow up*** The triggering may lead to quick results and even lead to 100% ODF in a few weeks or months, but in other communities more efforts may be needed. Also follow-up is needed to ensure that latrines are maintained and improved. This phase may require specific training natural leaders, and volunteers in methods of small group facilitation, family dialogue *(mikikir),* simple techniques for constructing latrines and handwashing facilities, and household water treatment and safe storage.
4. ***Monitoring and evaluation*** using specific tools which have been developed for actors at different levels

Source: Implementation Guideline for CLTSH Programming (available on CDRom)

CLTS starts from the principle that no subsidy is needed for hardware, and only some money is needed to pay facilitators and make the process work. Here some caution is needed and in the WASH assessment it is very important to look into possible health risks related to the existing latrines. Unfortunately most of the assessments made in earlier WASH assessments in GLOWS trainings in SSNPR and Haraghe show that most household and school latrines represent in fact a considerable health risk because they are not clean, not properly maintained and a breeding place for flies. So good guidance is needed and special measures may be required for example for the poorest families.

SNV has positive experience with CLTS where communities after becoming aware of the situation develop their own latrines (Box 5.2). The experience however also shows that continued external support is important to keep the momentum and to ensure that facilities are kept clean and not turn into a health hazard. Another stimulant may be to encourage the sales of adequate sanitation materials at a fair price in the local market. Additional information on CLTS can be found in the resource materials included in the CDRom.

Box 5.2 The outsider factor in CLTS; SNV Ethiopia experience

SNV introduced CLTS to the 6 districts in 2008 after making an assessment of the sanitary situation that showed that urgent action was needed because of the wide-spread practice of open defecation. Several factors supported the possibility to initiate the approach. Communities were interested because of the positive information they received from a neighbouring area. Unicef and the Water Bureau were able to provide support and there is a strong community bounding. Some 50 persons were trained for different organizations to implement CLTS also including putting emphasis on hand washing facilities. These trainers in turn trained people in the district to implement the approach. SNV backstopped all trainings and monitored progress. The initial result of the program was that 29,000 people in 54 villages now have developed their latrines from local materials and this is now being expanded to 100 villages. It was found that initiating the process was easier than sustaining it. Also communities receiving more follow-up visits did better in terms of achieving targets for household sanitation. In all villages however the sanitary situation at schools was not improved, mainly because there were no clear leaders were identified. (http://www.snvworld.org/)

5.4.3 What type of costs are involved

Costs for hygiene promotion and sanitation may involve salaries and costs for training and transport and the local community paying for the latrines. But still some further assessment may be needed whether for example the poorest inhabitants also can manage to build their own latrine and the related superstructure. At least in several of the communities where WASH assessments were made in earlier GLOWS trainings, this seemed to be a problem. Also specific situations other cost elements may play a role including for example the building of adequate school latrines, or finding specific technical solutions for high water tables. A related issue is that introduction of urine diversion toilets may be very beneficial for example for crop production, but may require a small loan to purchase the equipment. A very important issue is that often a pilot testing is needed to find out about the real cost.

Costs for school programs involve adapting the school curriculum, making training materials for teachers, actually training of teachers and make some arrangements for backstopping and monitoring of the program but also may involve cost of construction.

5.5 Self evaluation questions

This is an individual evaluation of your understanding of the information presented in this module. Answer the (multiple choice) evaluation questions and check your own answers. In case your answers had many mistakes it is suggested that you review the module again before doing the assignment.

Q1. Indicate which of the following statement is correct. (Several statements may be correct)

A: There are different transmission routes of water related diseases including transmission by hands, soil and flies.
B: Water supply is the most important transmission route of diarrhea.
C: Latrines can be a great support to reduce the risk in transmission of disease

A: Answers 1 and 3 are correct
B: Answer 2 is correct
C: All three answers are correct

Q2. On-site sanitation involves a higher health risk than off-site sanitation.

A: Yes
B: No

Q3. It is sufficient if

A: 50% of the population uses a sanitary facility
B 70% of the population uses a sanitary facility
C: 80% of the population uses a sanitary facility

A: Answers A is correct
B: Answer B is correct
C: Answer C is correct
D: None of the answers are correct

Q4. Promoting change in hygiene behavior implies

A: A sustained process that starts with the exploration of possible risks in the daily practice of the community
B: Carefully exploring the situation of the poorer sections in the community as these may have larger problems to change and may not be able to finance the necessary adjustments
C: Assessing which organizations have already worked in the area, with what type of approach and results and what possible champions can be identified

A: Answers 1 and 3 are correct
B: Answer 2 is correct
C: All three answers are correct

Q5. Hygiene promotion needs to

A: Be very comprehensive and address all hygiene risks
B: Needs to include children as a special group
C: include a gender perspective as the situation for men and women and boys and girls is very different

A: Answers 1 and 3 are correct
B: Answer 2 and 3 are correct
C: All three answers are correct

5.6 Assignment

Visit one or a few latrines, including one in a school. Make a brief drawing of the latrine(s) and write a short note (one page) on possible hygiene risks related to the latrines.

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5.8 Answers to the self evaluation questions

Q1. Answer A is correct. There are different transmission routes of water related diseases as shown in Figure 5.1. Latrines can indeed reduce the of disease transmission (including transmission of diarrhea and intestinal worms), but they need to be in good conditions to ensure that they do not change into a health hazard for example by allowing direct access of flies and not keeping them clean properly. Answer B is not correct as it will depend very much on the local conditions which transmission route is most important.

Q2. Answer B. is the correct answer as it will depend on the local conditions which type of system is most risky. If properly managed on-site systems can be very safe. Off-site systems have the disadvantage that they transport the faecal material to another location but often without treatment.

Q3. Answer D is the only correct answer. Even if a small part of the population continues with open field defecation, the spread of many diseases including diarrhea and intestinal worms will continue. Furthermore the answers do not indicate whether the people also have hand-washing facilities, which is an essential additional element to ensure safe hygiene behavior.

Q4. Answer C, as all three statements are correct. It is essential to start with a good assessment of risky behavior to identify which aspects to deal with first. Also special attention is needed for the poorer sections that may not be able to finance possible changes. And exploring who has been working in the area and with what results is very important.

Q5. Answer B. is correct. Involving children is crucial and looking from a gender perspective is indeed making a difference as men and women have different chores and responsibilities. The first statement is not correct as it is much more effective to focus on changing a few key behaviors

If you failed to provide several of the correct answers, then review this module again

Module 6 Management and finance of WASH

This module introduces a number of management issues related to community water supply and sanitation and possibilities to explore financing options. *At the end of this module the participant will have:*

- An overview of the management requirements of water supply systems
- *A better understanding of the importance of practical monitoring schedules*
- *Developed a management plan for a simple water supply system.*

6.1 Introduction

Management is perhaps one of the most neglected aspects particularly of rural water supply. It is very common that breakdown management is applied combined with the collection of a fee to meet operational cost. Sometimes water committees and operators obtain one-off training when systems are being installed with external support. A large number of water and sanitation systems however show substandard performance or are not working at all. Adequate financial management is another limitation which has a lot to do with lack of local understanding of cost issues.

6.2 Management and organization

Different models exist to manage and maintain rural water supply systems including:

- Systems managed by a WASHCO[2] which may hire some community members for revenue collection, tap attendance and some operation and maintenance tasks. Often they receive a small remuneration for these tasks. Local operators may be trained or just learn the work on the job from a predecessor (adopting possible mistakes that have crept in). The water committee may be elected and some regulations may apply concerning reporting to the community, duration of term, re-election, and gender balance. More advanced committees may even have a code of conduct. In some cases the water committee is an association where some or all families in the community have a membership.
- Systems managed by private individuals or small scale operators perhaps under an agreement with a water committee.
- Water vendors who manage their water supply chain. Having a strong interest to keep the chain working as they depend on it for their income.

In the context of this training the main objective is to explore which is the management model that is in place for each of the different water supply systems that exist in a community or Kebele and where can improvements be made to support the long term sustained functioning of the facilities. Questions to be addressed for each system include:

- How is the management of the water systems organized? (who is in charge and who is responsible for what)
- Does this management model needs changes (should management of systems be combined for example)
- Is the capacity of the different actors adequate to fulfill their role (here you can also think of whether management ensures quick repairs, whether spareparts are available in the community etc.)
- Is a good monitoring system in place that supports sustained performance and helps to ensure proper maintenance
- Is sufficient revenue collected to at least meet recurrent cost and possible repairs

When you have reviewed these questions with the WASHCO and other community members for each of the systems together you need to make a plan to improve upon the situation.

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[2] In SSNPR a new regulation has been adopted in which the WASHCO is replaced by a Rural Potable Water and Sanitation Association (RPWASA) with a legal status and a defined role that includes providing potable water services, collect funds to operate and expand the system and implement hygiene and sanitation work in the environment (Regulation 102-2012). For this manual we maintain the name WASHCO as the role is similar, particularly in water supply provision (but not the legal status). We also encourage to explore whether the RPASA can take up other management task related for example to multiple water use which may include management of water ponds for cattle and irrigation.

6.2.1 Exploring system management

It is essential to understand the management that is in place and the way the roles and are being implemented. What are the rules of engagement that are in place? A few key aspects can be distinguished in management as also shown on Table 6.1:

- Who are the actors and what is their role
- Who operates the system
- Who monitors and controls the system (technically and financially)
- Who carries out repairs

In addition it is also useful to know who has done the training of some of the actors and whether these will be available for further training as needed. It is important to see how things work in practice instead of coming with a list of tasks that need to be done. Local actors may have found a way to deal with problems and this may be alright or may encompass major difficulties. What you are likely to find is that management is not well organized even though the actors involved may have received training. As a result of this assessment you may be able to identify the main problems (see Table 6.1). Preferably however you keep these to yourself to be able to first explore what the WASHCO sees as their main problems.

Table 6.1 Overview of management and organizational aspects

Issue	Key actors	Details	Reporting
Overall management	7 member WASHCO	7 members; is elected every two years, but only four members are active; WASHCO regulations exist	To community every year
Supervision	Chairman and two committee members	• Chairman supervises operator • Committee members supervise tap stand attendants	To WASHCO
Audits	2 community members	• Elected every year to check the annual account, but not done for two years	To annual community meeting
System operation	Operator	• Operates generator and pump • In charge of maintenance	To chairman
	Tap stand operators	• Operate tap stands for 8 hours per day on collect and pay basis	To some WASHCO members
Technical monitoring	Operator	• No monitoring schedule except for registration fuel consumption and water production	To chairman
Fee collection and record keeping	Tap stand attendants Treasurer	• Users pay as they fetch • Attendant registers consumption from meter and income • Treasurer collects weekly, keeps books, puts money in the bank	To some WASHCO members
Repairs	Private sector	• Not organized; when repair is needed chairman gets involved	To chairman
Advise and training	Water technician Woreda Water Desk	• Some minimal training has been done	To head of Woreda Water Desk
Main problems			
• The overall management needs considerable improvement. Only some four WASHCO members are active; the others stopped coming to meetings over a year ago; • Reporting to the community has not been done since two years. • Bookkeeping is not well structured and not reported upon and a financial monitoring system is lacking • Auditing is not applied and community members are not showing much trust in the WASHCO • WASHCO members and the operator lack the necessary skills and tools to carry out their tasks • A technical monitoring system is lacking which complicates preventive maintenance • Water meters at tap stands have never been checked for accuracy • Clear information on availability of private sector support is lacking			

6.2.2 Making an assessment of the monitoring system

Monitoring is an essential instrument to be able to manage a water supply system. It is very important to collect information on a regular basis on key aspects of the system and to compare this with the expected performance. If the data deviate from required performance then then (pre-determined) action can be taken in a timely manner. In water supply this may relate to issues such as water quality, but also system performance in terms of electricity consumption, wearing of cup seals, water pressure in the system, and users satisfaction.

Monitoring is an ongoing function that provides crucial information that we need to be able to sustain the systems (Box 6.1). In fact we monitor all the time although we may not be aware of it. For example, a bicycle rider will automatically check to see if the tires have enough air, if the brakes work, and so on. The rider collects this information by using his/her eyes, sometimes by feeling and sometimes by listening. If there is something wrong, then the rider either fixes the bicycle directly or asks someone else to repair it. Sometimes he or she does not wait until the bicycle actually breaks. As preventive maintenance, for example, different parts are oiled to avoid rusting (Shordt, 2005).

Monitoring should support the technical, economical and managerial performance of a water supply system. It needs to have clear indicators that best can be established with the people involved (operator, project team etc.). It needs to spell out the actions to be taken if the desired level for specific indicators is not reached as shown in the example in Table 6.2.

Box 6.1 Monitoring made easy and effective

For a handpump the performance can be measured in terms of the number of strokes it takes for the water to appear and the volume produced per minute at a fixed stroke speed. If it takes more than three strokes for the water to appear the foot-valve needs to be checked and possibly replaced or the pipe is leaking. If the volume produced per minute falls below a set standard the cup-seals need to be replaced. The operator measuring performance in this way sees a gradual reduction in volume and can predict when it will reach the minimum acceptable level, thus enabling him or her to plan the necessary repair, instead of waiting till the pumps breaks down. Similar indicators can be established for the performance of piped systems as well as for financial and managerial performance.

Table 6.2 Model for monitoring of a handpump on a dug well

Key monitoring items	Desired Situation	Actions to take if conditions are not met
Pump performance	Check weekly	
Discharge of the pump (time to fill a bucket of 18 litres (same person stroke speed 40 per minute)	N < 40 sec. (pump specific depends on depth)	Schedule the replacements of the cup-seals (inform the area mechanic that he needs to come within a week; (Check water level in well to ensure that it is not caused by falling water table)
Discharge of pump (number of strokes it takes to start the water flowing after a short rest)	N < 3 strokes	Schedule the repair of the foot-valve (inform the area mechanic that he needs to come within a week
Technical condition (No major difficulties e.g. play in handle, loose bolts, corrosion etc.)	Pump ok	Do regular maintenance (greasing) and inform area mechanic when problems
Spare part stock is up to date?	Yes	Purchase spares (consult WASHCO)
Users complaints	No	Discuss with WASHCO
Water quality risk	Check weekly	
Sanitary inspection (no cracks or other possibility for water infiltration; no puddles around the well; or latrine construction nearby)	Sanitary inspection ok	Repair cracks and discuss other actions with water committee,
Water quality (turbidity, color, smell, salt content);	No changes No big outbreak of diarrhea	Seek external advice from district to do water quality test and assess why the quality changes
Access of animals to pump site	No animals	Repair fence

It is also important to check what external support is available. Operators of small systems may not have the necessary equipment for water quality testing. They may have to rely on sanitary surveys in combination with feedback from their users on possible outbreaks of diarrhea. It thus may be important to check if the WASHCO has any experience with sanitary surveys and has access to an external organization that has helped them at some point in time with water quality testing.

The monitoring model provides a quick overview of the situation and shows key actions to be taken when the measured performance is not in line with the previously established guideline values. This model can also be used to establish the key parameters the operator needs to measure and the ones to register in order to have an indication of the long term performance of the system. It needs to be complemented by a reporting format and models that deal with other components of the system including the catchment area, the transmission main and the distribution network.

The development of a better monitoring system may be one of the actions that will be needed in many systems and here is where the Woreda Water Desk staff may play an active role in implementing such an activity with the WASHCO as a follow up of the WASH assessment and action plan. But even if you only find some limited data that are being registered for example on fuel consumption and revenue collection you may already be able to get some indications of possible changes in system performance over time and use these to show the importance of monitoring.

6.2.3 Assessing the financial situation

Many communities may already have some kind of administration particularly for their piped supply which may be fairly simple (Table 6.3). The first step therefore is to explore what system exists, what is the experience with the system, and what is the capacity of the actors involved? What is also essential is to explore who controls the books (to reduce risk of corruption) and whether the system is used for management purposes. Comparing income and expenditures may lead to early detection of problems. Leakages for example may have increased and so less water will be available to be sold. Hence a drop in income whereas fuel consumption remains the same is a useful warning etc. Irregular fuel consumption whereas income is more or less steady may also show that something is wrong and perhaps part of the fuel is used for other purposes. A related issue is to check whether they have a bank account and what financial information is provided to the community by the WASHCO?

Table 6.3 Basic administration format

Income	Amount	Expenditures	Amount
Connection fees		Salaries	
Tariffs		Consumables (fuel etc.)	
Fines		Repairs	
Total		Total	

A special point that may need more exploration is the possible need to finance some major repairs or for example the extension of the system to enhance coverage. This often will require a user contribution and here it needs to be assessed if the financial administration that is in place can cope with these needs and for example the development of a possible request for subsidy etc. or that a first action would require the development of such a capacity.

6.2.4 Exploring possible conflicts

Community water supply and sanitation incorporates a lot of (potential) conflicts. Conflict may become visible if women jump the queue, resulting in shoving and clay water jugs being smashed. It may remain invisible, but deeply felt if, for example, a village chief's wife goes to the head of the queue or when certain wells are declared to be sacred, restricted to such uses as preparing traditional medicines rather than for general water supply. It may include friction along ethnic lines, for example, when different ethnic groups bring livestock to the watering station (MacMIllan 2001)

A (water/sanitation) conflict is "a social situation where one party tries to profit from a given situation or tries to solve its own water supply and sanitation problems in such a way that it negatively affects other parties".

It is essential to explore what possible problems exist as these may be very detrimental for system performance. Some problems may be obvious such as users not trusting the WASHCO, which often relates to the WASHCO not reporting on finance. Others may be less clear. Why for example are some WASHCO members not active anymore? Why is it that some tap stands receive more water than others etc. To find such problems you may need to create a very open dialogue with the WASHCO, but also with others such as school teachers, HEWs and users.

6.3 Finding solutions to management problems

In the problems analysis you may find that the current management is weak, but that it can be reinforced with the existing WASHCO whilst perhaps electing a few new members. But it may also be that the WASHCO is not really working and then it may be required to propose an action in which the Kebele management takes the lead and establishes a new WASHCO. You may also find that the management situation is not clear and that several systems exist which are managed by different actors. Then an important action is to jointly with the WASHCO, and possibly the Kebele management, initiate a process to explore options to join the management under one WASHCO. It is necessary to clearly identify which actor(s) should lead this process and what steps to take to initiate the activity.

6.3.1 Making a clear overview of tasks and responsible actors

A problem that is likely to be generic is the lack of a clear description of the different tasks involved in the management of the system, and the responsible actors. To develop this overview together with the WASHCO may be one of the first activities to be planned in the action plan. This action will require some support, and perhaps this can be provided by someone from the woreda water desk or from an NGO working in the area. Ideally you would be involved yourself as you have gained experience in this course that may be of use in this context.

6.3.2 Planning the development of a monitoring schedule

In your discussion with the WASHCO an important action point for the near future that is likely to arise is the development of monitoring schedules for different systems. Without a good monitoring schedule it is not feasible to really cater for preventive maintenance, detect changes in system performance and to provide for sustained systems performance. Another aspect of monitoring concerns the performance of the operator and others working in the system such as tap stand attendants. These need regular supervision from the WASHCO and this needs a schedule as well. Development of this type of monitoring will also require support and perhaps this support can also be provided by the Woreda Water Desk or an NGO but ideally you will be involved yourself as well.

6.3.3 Improving financial administration and reporting

A good administrative system is a must for a water supply system and the capacity to use this system is equally needed. Some form of system may exist and it will need to be jointly assessed what actions are needed to improve it. This may include the development of an improved or new system which may require external support which then needs to be identified as part of the planned action. Equally important is that performance is reported upon to the users. If this has not been done then an action that can be included is for the WASHCO to report at reasonably short notice to the users. This is very important as it allows being open about income and expenditures and will help for the users to appreciate the cost involved in water supply and make them understand the need for the level of the tariff they pay.

Another action that may be needed is to open a bank account for the WASHCO which may in fact first require it to be established as a legal entity. This may be facilitated by the new legislation in SNNPR in which the role of the WASHCO will be taken over by the new RPWASAs which is recognised by law.

In case a major repair, replacement or extension is needed it is also important to plan the financial implications properly and help users to understand the magnitude of the cost by making a good overview of all the cost items involved, the contribution they will need to make and the subsidy that will be received. As part of this process it needs to be assessed if the community can afford to pay the running cost and pay for repairs and replacements and if not alternatives may have to be found.

Be creative in searching for solutions. It is not obvious that funding needs to come from the government as this may take a long time. Community members may be willing and able to give some more money provided they understand what is at stake and will get a (quick) benefit. For example adding a storage tank with extra taps to a tap stand may cost 5000 Birr, but may cut waiting lines considerably. Users or water vendors may therefore be very willing to meet these costs in return for spending less time in waiting every day.

If funding needs to come from the government then the action plan needs to include the action the WASHCO will need to take to obtain this funding.

6.3.4 Dealing with conflict

Conflicts are normal and in fact may be having a great potential for growth if the negative energy can be transferred into joint action. So the challenge is not to avoid conflict but to manage it. Conflict avoidance and neglect can worsen situation. Many conflicts can be dealt with in a positive way through negotiation and joint problem solving. A few key aspects include:

- All parties need to understand the conflict and gain insight in the (subjective) views of the other parties
- Dialogue as the basis for problem solving in which actors listen to each other
- Separating the people (emotions) from the problem, but dealing with both. This aspect may require the involvement of a mediator to facilitate the process. Actors need to learn how to jointly face the problem instead of each other
- Focus on interests instead of positions to open dialogue
- Can problems be turned into opportunities by the actors allowing benefits to be enlarged and better shared?
- Develop multiple solutions to choose from and insisting on using objective criteria, independent of the will of either side, to choose the solution.

If conflicts were identified in the assessment then it is important to include actions that deal with these conflicts and that may include seeking external support.

6.3.4 Capacity building

Part of the activities needed to improve the situation will require building capacity at the local level and providing back-up support. Important limitations may exist for example in tariff collection which in turn makes adequate operation and maintenance of the system difficult or impossible. Preventive maintenance requires skills and attitudes that may be lacking.

Hence it may be expected that capacity building will be an important action to be included in the improvement plan. Different options may exist including the Woreda Water Desk staff or NGOs training the WASHCO, but it is important that those involved in training adopt adult learning approaches and include practical on the job assignments which are well appreciated by trainees. It may even be feasible to involve members from other WASHCOs who have already followed this type of training. The fact that they are peers and speak 'the same language' is an important asset as it helps to build trust and make trainees feel at ease.

6.4 Self evaluation

This is an individual evaluation of your understanding of the information presented in this module. Answer the (multiple choice) evaluation questions and check your own answers. In case your answers had many mistakes it is suggested that you review the module again before doing the assignment.

Q1. An adequate management model:

1. Requires a detailed analysis of the existing system and existing practices
2. Ensures that manuals with all technical specifications are available in the community
3. Includes appropriate monitoring formats for the tasks to be performed

A: Answers 1 and 3 are correct
B: Answer 2 is correct
C: All three answers are correct

Q2. A written report is the most important aspect of a monitoring system.

A: Yes
B: No

Q3. The most important reason to establish a good monitoring format for a water supply system is:

A: The need to have reliable data and a good performance record
B: The need to be able to review the performance of the system over time
C: The need to be able to manage the system

Q4. Indicate which of the following statement is correct. (Several statements may be correct)

A: In conflicts it is essential to explore the underlying interests with the parties instead of just looking at the positions
B: The role of the mediator is not to solve the problem but to help the actors to find solutions and try to come to an agreement
C: In capacity building of maintenance staff it is essential to understand the local situation and the experience of the participants
D: Community members may be good trainers

Q5. It is sufficient in rural areas if the community knows the tariff

A: Yes
B: No

6.5 Assignment

Establish a management plan for one type of water system (e.g. handpump, well with a rope pump, borehole with tank) which you have already described in one of your previous assignments. Include a monitoring format and make a brief overview of the cost items you need to include in the cost estimate to manage and maintain the system.

6.6 References and Further reading

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6.7 Answers to self evaluation questions

Q1. Answer A. An adequate management model requires that clear insight is obtained in existing systems and that a good overview is provided of all the tasks and responsibilities, but it is not necessary that all detailed specification of the different technologies are available locally as these will be only relevant for the technicians that will carry out repairs that go beyond the community capacity.

Q2. Answer B. In many locations reporting is strongly emphasized, but the main reason of a monitoring system is to generate action when needed. Recording of some data can be useful, but do not make this into a burden as many monitoring aspects do not need to be recorded. So the essence is to establish a monitoring system that clear shows which indicators need to be checked and depending on the results what action need to be taken.

Q3. Answer C. A good monitoring format that clearly describes the indicators to be monitored and the actions required if indicators do not fall into the prescribed levels is crucial to be able to adequately monitor the system. It may also be used for reporting and assessing the performance, but these are not the most important reason. A good monitoring format will help the operator to do his or her job and seek timely support when needed.

Q4. All answers are correct

Q5. Answer B is correct. Knowing the tariff in a rural community is essential but it is not enough. Tariffs or (upfront) contributions may felt to be high unless the community knows the full cost picture including the (often) subsidized investment. .

If you failed to provide several of the correct answers, then review this module again.

Module 7 Process facilitation

This module introduces facilitation as a very important aspect of the work of sector professionals and trainers. This module introduces a number of facilitation issues related to capacity building, group discussions, community consultations, and conflict mediation.

At the end of this module the participant will have:

- *An overview of the role of communication and listening*
- *A better understanding of the importance of facilitation of learning and dialogue*
- *Ideas about ways to clarify conflict and exploring possible solutions*
- *Tried out some facilitation techniques.*

7.1 Introduction

In the context of GLOWS different processes need to be facilitated that often will involve learning and change. Trainers and participants participating in GLOWS will be faced with two main areas of facilitation: training (learning) and communication (including conflict management). In this module these two areas are both addressed, as also the participants in GLOWS may need to improve their communication skills and at times will have to facilitate dialogue and take up the role of trainer or better facilitator of learning. Communication is essential to inform, but also to inspire others and the latter is particularly important for trainers and facilitators of change. Many of the participants in GLOWS will be faced in daily life with the situation where they will have to assist particularly WASHCOs and other community actors including health workers and heads of schools to improve the WASH conditions in the community. These actors will need to be inspired to take up the challenge to change the situation and to inspire and mobilize other community members to participate in the process.

Facilitating change is not about telling people what to do but to help and inspire them to review their situation and identify and adopt new practices to make it better for themselves and others

7.2 Communication

The purpose of communication is to get your message across to others. This is a process that involves both the sender of the message and the receiver. This process may be face to face but can also use many other tools such as publications, television etc. A common element is that communication leaves room for error, with messages often being misinterpreted by one or more of the parties involved. This has the possibility of causing confusion and negative interaction, making it important to explore whether your message got across in the way you wanted. Thus effective oral communication requires the ability to both speak clearly and listen actively and makes it necessary to take a few key points into account (see Box 7.1).

Still communication is seen by quite some actors as a one sided process in which the sender or 'presenter' brings a message to others. But in much of the WASH work it is essential to emphasize communication as dialogue which can benefit both the 'recipient' and the 'sender'. A good dialogue with community members for example provides insight among all participants and can create a strong basis for focused action.

A variety of verbal and non-verbal means of communicating exists such as body language, music, spoken language, text, pictures and graphics. In fact body language is assumed to be the most important aspect in oral communication being responsible for between 50 and 90 percent of a message's effect. Speach contains many nonverbal elements such as voice quality, speaking style, intonation, stress and emotion. These may help to get the message across but may also make it less acceptable for the listener or even lead to conflict. Often it is not about what is being said, but the way in which it is being said. Murphy and Hildebrandt (1997) suggest that non-verbal signals often express true feelings more accurately than the spoken or written language. Hence it is not only important to look at one's own body language but also of that of other participants in meetings and trainings.

Box 7.1 Some key points to consider in relation to communication

1. People respond not to the world as you see it, but to the world as they see it. They listen to your points having in mind the mental pictures of their own situation.
2. Effective communication starts with listening and understanding rather than talking. The more we know about someone, or a group of people, the more effective we can communicate with him/her or them.
3. Establish clear objectives for what you want to communicate and want to learn from the person(s) you communicate with, based on what you hope to achieve
4. Simple, clear, and sparse information can stick; when presented with too many details, people lose the essence of the message being conveyed
5. It is important to ensure that the information that is provided is reliable and evidence-based to avoid misinformation and loss of trust. It is better to say I do not know but can find out than to give an answer that is not correct
6. Identify, prioritize, and get to know your audiences which may be quite diverse and the information needs of different members may differ and you may also need to target different stakeholder groups with different messages
7. Explore multiple communication channels if you want to promote specific ideas. This may include meetings, newspapers, radio messages, pictures, songs, school programs etc.
8. Seek active feedback and stimulate dialogue, but making sure that all participants can participate. You may include the use of small subgroups or asking people to (anonymously) put a view on a card, (which you or a co-facilitator can write if a participant cannot write)

(Based on Visscher and Verhagen, 2011)

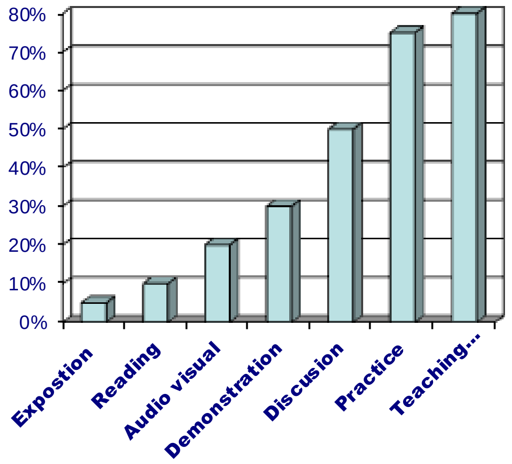
7.3 Training and learning

Training is all about communication and learning and therefore cannot be one sided. Trainees "should not be considered as empty vessels which need to be filled up with information (Paulo Freire (1970) cited by Visscher (2006). The emphasis needs to be on creating learning opportunities that build on what the trainees (participants) know. A wide range of techniques are available to trainers and teachers including lecturing, demonstrations, providing reading material, creating a dialogue, taking tests etc. The effect of these different techniques in terms of effective learning is not the same (Figure 7.1), showing that just listening is definitely not sufficient.

We apply a "knowledge filter" to whatever information we receive through our senses. This "filter" will determine, for instance, whether we are open to new ideas, whether we can grasp new information, whether we accept that the ideas of other persons may be very valuable.

The filter also applies to the sender, because knowledge as such cannot be shared with someone else. It needs to be turned into information – oral, written, graphic, gestures or body language. The receiver in turn gets the information through his / her senses, filters it and interprets it in his / her own way.

We all remember receiving lectures from very knowledgeable teachers, which unfortunately we were not able to grasp, whereas other teachers, perhaps less knowledgeable, were able to reach out to us. Ten Dam (1990 cited in Visscher 2008) argues that the human memory can be seen as a processing system, with a long and a short term memory. The short term memory is the reception desk where the information enters. The long term memory is the real memory, the place where the information is stored and can be retrieved for later use. To make the information enter here, trainees have to work with it. He found that students, in general, just remember 5 to 15% of the information given in lectures. What they remembered depended on the way they received the information, and what they did with it after the session. Results are better if information is repeated, or more importantly if it is applied in assignments



The short term memory is limited, so the trainee has to work with the information received before new information is provided, otherwise it will be forgotten. For teaching this means we could use the last part of a lecture for exercises or for summarizing (repetition) instead of presenting more information.

Figure 7.1. Relation information retention and training technique (Lang, and McBeath, in progress)

Another important finding was that trainees do not listen with the same degree of attention throughout a lecture. They do well in the first 20 minutes, but then attention is decreasing and accuracy of note taking drops from almost 100% to 50% after 40 minutes and 30% after 50 minutes. The effectiveness of the lecturer also plays a role. The finding was that lecturers are not able to lecture adequately for more than 20 to 30 minutes. So for both student and lecturer it is essential to build in alternative activities after some 20 to 25 minutes. This may include for example asking feedback from your audience listening to their comments whilst looking at their body language.

Furthermore it is good to remember that the study of written materials is more efficient than lecturing so it is very important to provide good quality written and visual material. Particularly in more oral cultures the visual material is crucial.

7.4 Facilitation of dialogue

Dialogue is crucial in interactive communication and should not be confused with discussion. In the latter arguments are being exchanged in a winner takes-all competition. Dialogue starts with active listening instead of adopting or allowing a one way information process in which one party basically has the intention to convince and teach others. This however implies that we may have to change our own daily routines and further nurture the idea of encouraging ‘dialogue’, the exchange of meaningful ideas to avoid ending up with winners and losers.

Embracing dialogue is recognising that people have a wealth of knowledge from their personal experiences that can be shared with others and can help to find solutions to prevailing problems. It puts stronger emphasis on listening and may be encouraged by posing probing questions to clarify the thinking and views about issues at hand. By introducing specific questions, the facilitator encourages participants to give their ideas and make their own conclusions. This is also a great approach in teaching as it clarifies the stage where different trainees are. This type of dialogue may also be encouraged by initiating small group discussions or discussions in pairs as this is often less threatening than speaking out in public.

It is evident however that a snag with this idea is: what are the right questions? Clearly an experienced facilitator with expert knowledge about a specific issue may pose leading questions that guide the participants to specific answers. This thus may become a trap for the expert and actually prevent him or her from learning and acquiring new ideas. Hence, it is crucial to create a really good mind-set among all participants in for example workshops, to allow local insight to break through, and to distinguish between the process facilitators (who do not have a bias about a technical outcome) and possible “resource persons” with expert knowledge and a possible bias towards specific solutions. Developing sufficient trust may not be easy, particularly in a politicized environment such as the water and sanitation sector. Not only are good facilitation and a variety of techniques needed, but it may also require leadership training for community members and a review of the historical developments with the community (Visscher 2006).

A trusted dialogue is also required in the case of decision making about the priority of possible interventions. Participants who will need to take charge of the consequences of the decisions which may concern issues such as tariff levels, type of facilities, and community contributions will need to be well informed of the consequences of the different choices at hand. The end result may be that different options may be available to improve upon the existing situation and participants thus will need to make a choice.

An interesting approach could be to use the concept of the thinking hats also known as the Bono Thinking hats (School of thinking, 1983 cited by Visscher and Verhagen (eds.), 2011). This method encourages groups of participants to look at projects, activities and solutions from different but collective angles (wearing the same hat). This implies reviewing a potential solution for example in different rounds with all participants wearing the same hat. This approach stimulates dialogue and blocks debate as all participants have to adopt the same angle for example being all very positive in the first round. In a next round everybody then changes its attitude to for example negative. This implies doing away with the famous phrase "yes but ….." which is a root cause for unproductive debate. Whereas the approach defines five hats you may just want to use three of them: 1) Yellow hat round: We all are in favour and show all the good points (so nobody can say yes, but …); 2) Black hat round: We are negative about the option and show where it may fail (so all are very critical) and the red hat round: where everybody expresses its emotion. I love the proposal to change the catchment area into a nature reserve as it will have additional benefits and we can take our children there etc.

Another important aspect of facilitating dialogue is to make sure that different participants are able to provide inputs and that the meeting is not dominated by (the views of) a few participants. Different options may be available which include:

- Introducing the issue at the start of the meeting by telling the participants that you will facilitate the discussion and that one of your tasks is to ensure that everybody has an equal opportunity to contribute
- Using the 'talking stick' for example to avoid that people all talk at the same time, as only the person with the stick can talk
- Stressing the importance of listening and suggesting that a person before responding to an idea or suggestion first summarizes what the previous person has said
- Adopting a brainstorming session in which ideas can be given but not commented upon by others. All ideas are valid and will be listed for later discussion. This can also include an inventory of for example current water supply problems which may be perceived very differently by different participants. These can be registered separately (for example on different cards to make them visual) and then shared and if needed prioritised using the approach of the thinking hats.
- Nominating an external observer who keeps track of the participation of different participants and reports after a first round of say some ten minutes. This may help talkative people to reflect on their own behaviour

Another issue that is quite common in meetings is that some participants repeat their ideas and arguments sometimes in different wording. Here it may be very helpful to visualize these ideas on a sheet of paper or a blackboard as this allows you as a facilitator to point to the issue and indicate that that was already registered and will be discussed later; you can then continue by saying that the idea is for example to first complete the inventory of problems, so are there any other problems etc.

7.5 Conflict management

In section 6.3.4 we have already seen a brief section on conflict management where it was stressed that this is very important as conflict is a daily life issue and very common in relation to water supply systems. Conflicts may range from a state of open fighting to a situation where two or more parties (people, groups of people, nations or states) wish to carry out acts which are mutually inconsistent.

Conflicts can be hidden when one or more of the parties involved may not realize that they are negatively affected or are negatively affecting others. Such conflicts than go unnoticed and no efforts are made to redress them. For example you make take it as a fact of life that the pressure in your tap stand is often low whereas in other tap stands this is better, but in fact this may be caused by problems related to the system design that can be overcome. Conflicts may have the potential to put for example water supply systems at risk or may hinder or block finding solutions. To get the best out of conflicts parties involved will be required to make an effort to see it as a challenge and an opportunity.

Lazarte (2006), distinguishes between 'conflicts of interests' that can be resolved through negotiation, and 'structural conflicts' that are very difficult to negotiate as they relate to the organization of society and often are based on the unequal distribution of resources that may date back from centuries. Actors act on the basis of their own perceptions that may be based on a subjective collective memory and not on objective facts. They may try to solve problems as they see them, but often without taking into account the interests of other actors. Water involves many stakeholders that may need it for drinking water, for food production, for hygiene, cattle, but also nature. It is not just an economic but also a social good which often also brings an important ethical dimension to water conflicts. Finding proper solutions to water problems implies involving different actors in the dialogue.

Competition and conflict are unavoidable in all societies and our general attitude to and understanding of conflict has a critical bearing on our response. This attitude may range on the one end to considering conflict to be inherently destructive, which tends to trigger a response towards suppressing or eliminating it, which may even aggravate the situation. On the other end conflict may be seen as normal and inescapable and even welcome it as an opportunity for personal growth and for finding win-win solutions. Then the challenge lies in dealing with it constructively instead of trying to eliminate it. Box 7.2 gives a few important aspects that outline a facilitated approach to conflict management.

Box 7.2 Steps in a facilitated approach to conflict management

- Get a first insight in the problem and assess whether you may be able to facilitate the process to finding solution or that others may be in a better position to do so
- Agree with the main actors that there is a conflict and get their commitment that they want to make an effort to solving it.
- Help parties to understand the conflict which may require separate discussions to gain insight in the (subjective) views of the different parties
- Create dialogue as the basis for problem solving in which actors listen to each other
- Separate the people (emotions) from the problem, but deal with both. Actors need to learn how to jointly face the problem instead of each other
- Focus on interests instead of positions to open dialogue
- Have actors explore whether the problem can be turned into an opportunity that has additional benefits that can be shared
- Develop multiple solutions to choose from
- Stay independent and insist on using objective criteria for making choices, which may be particularly important to protect weaker parties.

7.5.1 Understanding and clarifying the conflict

Where different stakeholders can see a shared problem and recognise their interdependence in the persistence of the problem and in facilitating the solution, they may be prepared to enter into a constructive solution-oriented dialogue (Röling 1994). The first step therefore is to explore the problem together with the actors, taking into account that many problems are based on misunderstandings and, more importantly, to raise their awareness that they are part of the problem and therefore also have to be part of the solution. This may not be straight forward and requires a good organization of the process.

Different options may be available. It may be feasible to first explore the situation with the village leaders or a specific group more concerned with the water supply such as the water committee, the village health worker and perhaps the head of the school, after having obtained approval of the village leaders. With this initial group you can prepare an overview of the situation including all problems that affect the water supply systems and obtain insight in the actors that are involved and potential conflicts between them. Then you will need to decide with them the next steps to take. Together you may come to the conclusion that actors are quite emotional about existing conflicts, than it may be needed to first start to talk with the different actors separately. In case the situation is considered to involve limited tension then you may be able to proceed directly with a meeting where all important actors or their representatives are brought together to discuss the situation. If in the latter case the discussion becomes tense, you still can propose to first have separate meetings before coming together again, provided that you make it very clear that you will not take side of any of the actors involved.

7.5.2 Identification of actors, positions and interests

It is essential to establish the main actors, their 'positions' and the interests at stake. People have their own perceptions about the situation based on their world view, their values and their emotions. Conflict does not represent objective reality but is based on subjective thinking and emotions of the people involved. We look at conflict through the lenses of our spectacles, interpreting events according to our pre-suppositions.

Often different actor groups may exist and even within these groups positions and interests may differ. In many conflicts actors are locked in positions which make it impossible to find solutions without losers and winners. For example the debate between people in favour or against privatization may change when starting to explore the underlying interest of parties involved (Table 7.1 and box 7.3). In this case the discussion based on positions leaves just two options in favour or against privatization, but moving to a discussion based on potential interest creates a very different situation. Different actors may no longer be against each other, but may find that some of their interest overlap thus creating openings for negotiation

In case of heated conflict it may be necessary to hear parties separately, applying the skill of active listening to really try to understand the views and ideas. The advantage to include separate hearings is that problems and emotions can be better separated making it possible to thereafter present the problem situation to all actors in a 'neutral' way.

Table 7.1 Example of some actors, positions and interests

Actor group	Positions	Potential interests
Domestic users	• Against privatization • In favour of privatization	• Having a minimum quantity of affordable water • Having a larger quantity of water at low cost for household use and hygiene • Having sufficient water for livestock and other productive use
Government staff	• Against privatization • In favour of privatization	• Wanting to keep an income • Getting a different job

Box 7.3 Negotiation based on interests

If one party for example sees that cattle grazing in a catchment area has a negative effect on the quality of the water they use they may take the position (1) that cattle grazing should be banned, whereas their interest is water quality improvement. Local farmers however generate (part of their) income from the grazing cattle and therefore may take the position (2) that grazing cannot be banned, whereas their interest is getting income. Parties then may try to meet each other half way by for example accepting grazing in part of the area. When jointly exploring the underlying interests the dialogue may result however in very different solutions. In this case for example an even better water quality (interest 1) may be feasible if the catchment area would be well protected and managed (so no grazing and perhaps keeping less cattle and only close to the homes). This is likely to reduce the cost of water treatment and might also have a positive influence on the control of floods. This may free up considerable financial resources that could be used to hire the farmers to manage the catchment area thus creating an income (interest 2).

An important problem may be that some stakeholders may not want to come to the table. This may include actors involved in illicit activities or actors that are afraid to lose their benefits. In such cases it is essential to start with those that are enthusiastic and gradually try to bring in others. With the available actors you develop an overview of the situation while trying to also take stock of issues related to those that are absent. Together with the actors around the table you then will need to identify activities to involve important actors that are not present. When working with representatives good and coherent communication with the different constituencies is crucial, and may be established through meetings, but also by putting key information on specific locations.

7.5.3 Establishment and selection of solutions

Actors are often part of the problem and therefore also have to be part of the solution. With the problems and interests being clarified parties can start to identify options for mutual gain. Usually three categories of interests may exist, shared, neutral and opposite interests. The essence is to start the process with trying to find solutions to problems related to the shared and neutral interests, and only deal with the opposite interests last, when already potential gains have emerged in the process.

It is also important to break the problems down in such a way that they are manageable for the actors. Great results can be obtained if a problem can be turned into an opportunity allowing benefits to be enlarged and better shared. For example having water storage tanks at tap stands with a few extra taps that are filled in the evening would imply that early morning people can collect water much quicker, thus reducing waiting times and may therefore allow some reduction in opening hours which may lead to cost savings in salary cost of attendants etc.

Establishing solutions is a creative process that requires a clear decision making arrangements and a realistic but firm deadline. It is important to realize that it is often impossible to satisfy all interests particularly in densely populated areas. To obtain maximum cooperation from actors it is therefore necessary to clearly assess if some groups are negatively affected by the proposed solutions and whether some kind of compensation may be in order.

A major challenge is to ensure before-hand that the actors that are present can take decisions and not just negotiate a deal and after consultation with their constituency come back to the table to try to get more out of it. Negotiations may also fail unless each party, in addition to advancing its own interests also looks at opportunities to advance the interests of other parties. This often will require a change in mindset which may be achieved for example by:

- Start with a brainstorming session in which you first clarify that any idea can be put forward, but without discussion as that will be done later
- Introducing a role play in which participants take on the role of another actor
- Expose actors to experiences from others that have been involved in similar processes (e.g. adjacent community etc.), or take some of the actors to ‘demonstration sites’.
- Use the Bono Thinking hats approach to analyse potential solutions (see 7a.4)
- Bring in “neutral” experts who can judge potential solutions on their merits and implications and explain these to the actors.

7.5.4 Agreeing and signing of on solutions

When at the end of the process the preferred solutions emerge, parties are still not bound to this result. Each party will have to assess if the solution that was found is better than their Best Alternative to a Negotiated Agreement (BATNA). When their review is positive an agreement is signed and sealed between parties. It may be helpful to bring in independent advice for controversial aspects. This may help people to realize whether certain claims and interests are ‘reasonable’. Another aspect that may help is to rank potential solutions for example on the basis of technical and financial viability, environmental impact and social aspects including inclusiveness of the poor and gender sensitivity.

It will be very important to ensure that agreements are formalized (included in contracts between actors) and widely shared to ensure that relevant actors are aware of them.

7.6 The role of the facilitator or mediator

The facilitator or mediator plays a crucial role in the process by helping the parties to remain in dialogue and to use their energy to come to solutions while focusing on the future not the past. The facilitator has to be recognised and trusted and this may be achieved at organisational level through the use of well-known and well-respected people. The facilitator will need:

- To structure the process as people tend to go about things in a chaotic way
- To separate content from emotions
- Have the skills to guide the process and the actors setting some ground rules
- Have an open, impartial and respectful attitude

Some of the important skills of mediators (Fisher and Ury, (1991) and Kent and Touwen (2001) cited in Visscher, 2008) include:

- Active listening: using both verbal skills and non-verbal behaviour to show interest and learn to understand the content
- Asking open-ended questions that do not contain any judgment or criticism
- Objectivity, validating both sides, even if privately preferring one point of view
- Identification and stating of controversial points as well as underlying emotions or needs, as often it is difficult for conflicting parties to express these points, reframing controversial points in such a way that tension and blaming are reduced
- Dealing with emotions, helping to bridge gaps in communication and avoiding parties losing face
- Recognising the interests of parties
- Ability to recognise and apply different communication techniques including communicating about the communication process itself, showing the parties how they are communicating and putting question marks where needed

Active listening is a crucial skill; Experience shows that few people really listen. Often people are more concerned with their own ideas or already formulating their next intervention and barely hear what is being said. A good way to overcome this is by asking parties to restate the point the previous speaker raised. The mediator has to steer the process and it is essential to redirect "fouls" (name calling, put downs, sneering, blaming, threats, bringing up the past, making excuses, not listening, getting even) immediately. Where possible you reframe the negative statement into a neutral description or positive concern.

Many of these skills can be taught and learned through training, particularly through role play. In such training exercises, other participants can be asked to observe the mediator

7.7 Self evaluation

This is an individual evaluation of your understanding of the information presented in this module. Answer the (multiple choice) evaluation questions and check your own answers. In case your answers had many mistakes it is suggested that you review the module again before doing the assignment.

Q1. Effective communication implies (Several statements may be correct)**:**

1. A process in which a person clearly brings a message across to someone else
2. A situation in which people are involved in discussion
3. A process in which it is checked whether messages get across

A: All three answers are correct
B: Answer 2 is correct
C: Answers 1 and 3 are correct

Q2. Indicate which of the following statement is correct. (Several answers may be correct)

1. A clear message can be misunderstood by listeners
2. Body language is very important in communication both for the speaker and the listener
3. Body language includes issues such as gestures, eye contact, intonation and speaking style

A: All three answers are correct
B: Answer 2 is correct
C: Answers 1 and 2 are correct

Q3. Indicate which of the following statement is correct. (Several answers may be correct)

1. After two months we may remember some 5 to 15 % of the information given in lecturers
2. After two months we may remember 50% of the information given in a training session
3. After two months we may remember 80% of the information in a training session

A: All three answers are correct
B: Answer 2 is correct
C: Answers 1 and 2 are correct

Q4. Indicate which of the following statement is correct. (Several answers may be correct)

1. In conflicts were actors take their own positions it is essential to explore the underlying interests to enlarge the scope facilitated solutions
2. The role of a mediator is to solve the problem as actors in conflicts are not able to find proper solutions themselves
3. Community members may be good facilitators

A: All three answers are correct
B: Answer 2 is correct
C: Answers 1 and 3 are correct

Q5. If someone proposes a solution then he or she needs to accept it if in the end the other actors see it as the best option for them

A: Yes
B: No

7.8 Assignment

In this section you will find the assignments related to this module.

1. This first assignment you will need to do in pairs and it is meant to experiment with active listening and summarizing information. You will need to interview your colleague for example about a recent visit he made to a community water supply system. So will need to listen attentively and may pose clarifying questions. After a few minutes you will need to summarize what your colleague has told you and he or she needs to indicate whether you have understood the story correctly. Do this a few times and you will notice that you will make quick progress with both listening skills, posing questions and making summaries. You will need to ask your other two colleagues to take a role as observers who will be asked to give feedback on what they have heard and seen as they will also need to look at the body language. Change roles to make sure that all colleagues can experience the different roles. Take notes on the experience which you can discuss when your trainer comes and visit you.

2. Look individually at the situation presented below and list the actors and their positions. Then try to establish what might be the underlying interest for each actor. When you have completed this assignment discuss the results with your colleagues and make one short note with actors, positions and potential interests for discussion with your trainer.

In a community water supply system water is often rationed and the community is fed up with the situation. Their position is the water committee needs to be replaced and the government (Woreda) needs to provide financial support. The water committee is having difficulties as they have had some training but not sufficient to manage the system and for example to assess how much water they lose through leakage. They feel that the main problem is that the tariff is too low. So their position is the tariff needs to be increased. The Woreda water technician has no budget to subsidize running cost so his position is that the community needs to pay these costs.

Actor	Position	Potential Interest

7.9 References and Further reading

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7.10 Answers to self evaluation questions

Q1. Answer C is correct. In effective communication indeed the idea is that a person brings a clear message across and so it is essential that it is also checked whether this actually has happened. This requires dialogue to find out whether the message was understood, but this is different from discussion where you have winners and losers

Q2. Answer A. All three statements are correct. Clear messages can be misunderstood because listeners filter the message using their own experience and fitting it into their own 'world view'. Body language is considered to be crucial in communication and may even lead to messages being rejected. It involves different aspects such as gestures, eye contact, intonation and speaking style. For the speaker it is important to get the message across and to be attentive to the body language of the listener(s). For the listener(s) it is important as the body language of the speaker may confuse them if it is not in line with the message and by their own body language they give signals to the speaker and to fellow listeners.

Q3. All statements are correct. If you are a passive listener in an oral session without visual elements, you may remember only 5 to 15% of the information after some two months. But if the training session also includes active dialogue you will remember a lot more and may reach 50%. If you are the trainer however you will be in a position to remember on average even some 80%. So for effective training it is very important to use different communication techniques and let the participants work with the information (discussion, practice) or give presentation themselves.

Q4. Answer C is correct.
Re A: people often take positions when they are in a conflict situation and then may try to come to an agreement by giving in a bit. This however may not lead to the best results as these can only be found by looking at the interests of the actors involved and how solutions can be found that best meet these interests.
Re C: Community members can be good facilitators, provided that they can take enough distance from the issues that need facilitation.
Re B: The mediator is not charged with the solution but only with the creation of the conditions that will allow the actors to find the solutions that is most suitable for them. In the course of the process mediators may contribute some ideas for possible solutions, but have to be very careful and often it is better to bring in an independent advisor for such type of suggestions.

Q5. Answer B is correct. In brainstorming sessions the idea is that everybody can come up with suggestions, but this does not mean that they need to agree even with their own suggestion. They may find after further analysis that the idea they gave does not sufficiently meet their own interests. This is crucial and needs to be explained to the participants at the beginning, as otherwise people may not be willing to make creative suggestions without checking them first against their own interests. So no solution is binding until at the end of the process actors agree and are in the position to sign-off on the decision.

If you failed to provide several of the correct answers, then review this module again.

Module 8 Community WASH assessments and Action Plans

This module introduces the key elements of a community based approach to improving the water and sanitation situation using the experience you obtained in the previous modules. It aims at developing an assessment of the WASH situation and a structured plan to reach practical improvements in the water systems from source to consumer and in introducing better sanitation and hygiene. An example assessment is shown in the annex 8.1 and more elaborated examples are presented in Module 9. An example of an action plan is presented in Annex 8.2 and more elaborated examples are presented in Module 10.

The detailed examples in Modules 9 and 10 provide generic information on a wider range of systems from which you can keep for reference when looking at specific systems in a community. When gaining experience with the method, you will find that quite a few actions may be fairly similar for different communities. So once you have helped to develop a first plan, subsequent plans will be easier. *At the end of this module the participant will have:*

- *Developed a WASH assessment and action plan jointly with other participants, the WASHCO and other community actors which where feasible also will look at multiple water use*

8.1 Introduction

Most water supply systems in rural Ethiopia are operated and maintained by WASHCOs with limited specialist skills, (financial) resources, amounts of time and formal training. In their challenging task they receive support from the Woreda Water Desks. In some communities the WASHCOs may also be involved in sanitation promotion, but this is often more in the hands of other actors including HEWs who receive support from Woreda Health Desks and possibly school teachers.

The development of a structured assessment and an improvement plan will help to improve the WASH situation, but may also help to make the external support more effective and where necessary linking the community water and sanitation action plans with the broader Woreda planning. The WASH assessment and action plan (see special Modules 9 and 10) need to include the following main components:

- A comprehensive assessment of the water supply systems exploring the physical conditions, system performance, type of use, seasonal problems and the hygiene risks.
- A comprehensive assessment of the sanitation situation at household and school level
- A description of the management performance of all water systems;
- An action plan describing actions to be taken (including a priority setting) and which as a minimum includes a proposal for developing effective operational monitoring of the different water supply systems to facilitate timely intervention in future
- An indication of costs and potential resources

8.2 Steps to develop the water component

To develop the water assessment and action plan a number of steps can be envisaged:

- Establishment of a community based development team (often the WASHCO whilst perhaps involving HEWS, and some teachers)
- Comprehensive assessment of the water supply systems, their performance, the management and the (critical) hygiene risks
- Identification of short- and longer-term corrective water actions including the planning of the development of specific management and monitoring schedules for the different systems
- Reporting back to the community which makes it necessary to have a simple reporting format that can be easily discussed.
- Implementation and evaluation

8.2.1 The water team

You may take a short term approach in which you develop the activities with the WASHCO perhaps strengthened with a few other actors (HEW, teachers). But you may also take a more comprehensive approach and explore the option that the community develops a team that also can take the activities forward. An advantage of developing a more comprehensive team is that it may be easier to subsequently implement the plan. The starting question is therefore what type of organization already exists and in how far can these structures be used to manage and organize the assessment and the plan. It is essential that the team has time, is active and representative. In most cases the WASHCO will be the indicated organization to be the core of the team. But even if you build on existing systems you need to check who can participate in the team, in what role or capacity and with what level of time inputs. A few of the most important aspects to take into account include:

- ***The team needs to be able to take actions forward.*** This makes it important to work with the WASHCO being responsible for management of at least one system. In addition however it may be important to include some other leaders that can make a difference in the community whilst also exploring if you can involve dynamic newcomers have a role to play. Another important point is that relevant groups are represented. This includes paying attention to gender representation as well as participation of both better off and poorer community sections whilst also exploring involvement of the youth.
- ***Availability*** is often an overlooked issue as 'external as well as local interventions' often work around the same people. So can the individual team members spend the time needed to take up their roles? Also women or poorer groups may have already many chores and therefore may not be able to afford spending time unless some of their other chores are taken over. Here you can be creative looking at options such as collecting water with a donkey in return for working on the team, joint child care or some other compensation.
- ***Knowledge and experience*** embedded in team members will make it easier to move forward. So try to find a number of team members with experience. This may be experience in different fields including local technicians, HEWs, teachers etc.
- ***Roles and realities*** implying that you need to look at the functioning of the group and as needed explore changing some of the roles in the team to ensure that opportunities for growth are shared.
- ***A clear plan for the team with an agreed division of roles*** as people work much better if they understand what they need to do and how activities hang together. A range of activities may need to be established and this may require to establish even sub groups within the team dealing with different aspects of water and sanitation assessment and improvement
- ***Monitor progress*** as a regular activity of the team
- ***Establish training or peer-learning*** as part of the plan. Some team members may have experience they can share including by working in pairs, whereas new skills may also need to be learnt.

8.2.2 Comprehensive assessment

The comprehensive system assessment aims to determine whether the different water supply chains (up to the point of use) as a whole can deliver water of a quality that meets the requirements. It is much more than a brief report on a visit to a community. It includes as we have seen in module 2 the systematic and detailed assessment of the systems as a whole including technical performance, management and prioritization of hazards based on system conditions and water handling practice. It also explores multiples water use (module 4)

Not every hazard will require the same degree of attention as its priority will depend on the likelihood of occurrence (e.g., certain (3), possible (2), rare (1)) and the severity of consequences if the hazard occurs (e.g., insignificant (1), major (2), catastrophic (3)). The aim should be to distinguish between important and less important hazards or hazardous events. Simple scoring based on 'expert opinion about the risks' can be adopted by multiplying the occurrence score (1, 2 or 3) by the consequence score (1, 2 or 3) and looking at those with the highest scores as these may require immediate attention. Remember that there is little value in spending large amounts of effort to block small risks.

It is important to take an action oriented approach from the beginning. The review of the system will show a number of hazards which sometimes may be very serious. It does not seem fair to just leave the community and write a report instead of already exploring possible 'emergency' improvements the water operator or community members can take. In high risk systems for example it can be suggested as a minimum that water needs to be boiled, chlorinated or treated by solar disinfection at household level at least for children and elderly people.

The water system assessment as shown in module 2 and module 6 comprises:

- A sanitary inspection and if feasible/needed water quality analysis
- The review of the actors and their roles in system management
- The water handling practice of users during collection, storage and use

Community members are an important source of information and may for example reduce the need for water quality testing (which is often difficult as equipment and chemicals may not be readily available). An important limitation of water quality testing is that it only provides a snapshot of the situation and the sample may not be representative of conditions at other moments. This can be partly overcome by asking the water operator and/or community members about the situation.

They know about changes in water quality during and over the years in terms of turbidity, colour and taste (salinity, iron). Also they may be able to tell whether there are many children with diarrhea. Hence their information can help to confirm the findings of a sanitary inspection even without testing. Yet testing is necessary if you expect problems with chemical contaminants such as fluoride or arsenic.

A very important point that is becoming easier with the growing number of cell phones with camera is to take pictures of the situation and particularly the problems. This is very useful as it allows you to show the problems to colleagues, use the picture to support the presentation of results and keep them as a reference for comparison in the future.

8.2.3 Organizing the work

As you are doing this assignment together with your colleagues from the same Woreda the basic idea is that you do the field work together and after the initial meeting in the community split up in smaller groups comprised of members of the community team and your group. In this way the activities to be carried out can be distributed over these smaller groups to allow for a quicker implementation of the assessment of different water systems (as well as the analysis of the sanitation situation).

8.2.4 Presenting and discussing results

Results need to be documented as much as possible in bullet form. To help you in this task an example is provided in Annex 8.1 and a comprehensive format is presented in module 9. The advantage to develop a presentation in Powerpoint is that you can print the slides on single sheets and take these to the WASHCO and the other team members to discuss and improve. You can also use these to jointly initiate the discussion on possible improvements. Another important point is for the team (WASHCO) to provide feedback to the community and here they can also use the A4 sheets. An alternative is to use large sheets of paper to document the assessment.

8.2.5 Identification of actions

The comprehensive assessment including a review of management practices is the basis to establish corrective actions (Modules 3 and 6) in the systems, the community, and community habits and to identify the external support requirements which will need to be embedded in the Woreda Water Plan. An example is presented in Annex 8.2 and more detailed examples in Module 10 where actions have been divided in:

- ***Short term actions*** (to be implemented within weeks), often comprising activities the community can do themselves, and/or urgent repair jobs. This may include emergency actions such as the identification of safe sources, or the repair of one or more sources in such a way that safe drinking water can be obtained, whereas other sources can be used for other purposes. This will also have to include helping people to be more careful with water transport and water storage. It may also include simple repairs of cracks and improvement of preventive maintenance by community members. The key word is

organised collective action. People can do a lot to improve upon their situation if they join hands, understand what they can do, how they and their children will benefit, and see some short-term results.

- ***Longer term actions*** which can be organized mostly with available means and within a few weeks or months or require a more comprehensive approach and more complex arrangements including involvement of external intervention teams. This can include some of the actions mentioned as short term when they are expected to take more time from community members, capacity building and perhaps external materials and therewith may need more planning and organization.

For each of the actions a description is needed of the:

- Problem
- Remedial action
- Leading actor who takes responsibility (and supporting actors as applicable)

8.2.6 Establishing management, financing and monitoring systems

One of the actions that often will need to be included is the development of a management and monitoring system (see module 6) for each of the water systems in the community which also looks at financing. This essential aspect is often overlooked in many systems. But management becomes much easier with adequate monitoring including the prediction of possible problems that may require external support. These management and maintenance schedules are not part of the WASH assessment and not included in the example format that is provided in Module 10, but the schema in module 6 can be used to develop them for each system.

8.2.7 Implementation and evaluation

The implementation of the action plans (see Module 10) needs to be monitored by the community team. This requires the development of a plan which clearly marks the activities and expected results over time. This will very much contribute to the practical implementation of the plans.

8.3 Steps to develop the sanitation component

To develop the sanitation assessment and improvement plan a number of steps can be envisaged:

- Establishment of a community based sanitation team
- Comprehensive assessment of the sanitation situation and related (critical) hygiene risks in households and at schools
- Identification of short- and longer-term corrective actions
- Reporting back to the community
- Implementation and evaluation

8.3.1 The team

The development of the sanitation team follows the same principles as the team for the water assessment and perhaps it can be done with the same team. It is essential however in this case to involve those with formal responsibilities in sanitation in the home environment and at schools. This makes it less obvious to use the WASHCO as the core team for this part of the work. The lead role in this case may be more with the HEWs and the school teachers as well as the community or Kebele leaders.

It may also be that already sanitation intervention have been made including CLTS and that a committee already exist which is prepared to take charge of the assessment and the plan. A special point of attention is to explore whether local sanitation champions, e.g. family leaders that have already installed latrines and are aware of changes in hygiene behavior that is important to improve the health and wellbeing of their community.

8.3.2 Comprehensive sanitation assessment

The comprehensive sanitation assessment aims to determine the hygiene risks that exist in household and school sanitation as discussed in module 5. It includes the systematic and detailed analysis of the different sanitary facilities and the open field defecation sites as well as an exploration of possible risky hygiene behavior.

Not all hazards will be equally severe, so you will need to give priority to the most risky ones. Here it is essential to be very selective in order not to overload the team and the community. Schools may require special attention as they may in fact present considerable health risks for the children and can be a good place to start changing hygiene behavior.

It is important to take an action oriented approach from the beginning. The review of the sanitation systems will show a number of hazards which sometimes may be very serious. Some of these however may be quickly reduced by very simple means. Just putting a lid on a squat hole and putting some ash on feces in the latrine can greatly reduce the access of flies. So this type of 'emergency' improvements you can suggest already after having done the first transect walk. Also hand washing facilities can be established rather quickly by just hanging a small water bottle close to the latrine.

The sanitation assessment as shown in module 5 comprises:

- A review of the different sanitation systems (transect walk)
- An assessment of the hygiene practice of users
- Discussion with users about their perception of the situation and the way they manage the facilities (emptying problems) and for example child feces
- An inventory of local capacities to support sanitation and hygiene improvements

Results need to be documented as much as possible in bullet form. To help you in this task a comprehensive format has been established shown in module 9.

8.3.3 Identification of actions

The comprehensive assessment is the basis to establish corrective actions (Module 5) to improve the latrines in the houses and schools, encourage changes in risky hygiene habits and to identify possible external support requirements which will need to be embedded in the planning at Woreda level. An example is presented in Module 10 where actions have been divided in:

- ***Short term actions***, often comprising activities the community can do themselves, and/or urgent repair jobs. This may include emergency actions such as the promotion of putting a lid on latrines, hanging water bottles close to the latrines for hand washing etc.
- ***Longer term actions*** which can be organized either with available means or external support and within a few weeks or months. This can include some of the actions mentioned as short term when they are expected to take more time from community members, capacity building and perhaps external materials and therewith may need more planning and organization. It may also include actions such as the implementation of CLTSH that need a more comprehensive approach and more complex arrangements including involvement of external intervention teams for example to help communities to initiate a total sanitation campaign.

For each of the actions a description is needed of the:

- Problem
- Remedial action
- Leading actor who takes responsibility (and other actors as applicable)

8.3.4 Implementation and evaluation

The implementation of the action plans (see Module 10) needs to be monitored by the community team. This requires the development of a plan which clearly marks the activities and expected results over time. This will very much contribute to the practical implementation of the plans.

Annex 8.1 Example of a WASH Assessment *(developed in a GLOWS training)*

Item	*Information*
Name	*Fayoo Kebele (Mieso Woreda)*
Population size	*2695 (estimated)*
Main occupation (s)	*Agro-pastoralist*
Type of water supply systems	• *Borehole (motorized) with 3 WP* • *Three seasonal ponds (4 months)*
Water access (% with 15 litres < 1.5 km)	*22% (many have to walk > 1.5 km; hence officially no access)*
% population using improved water sources	*100% use scheme during dry season less during wet season*
Sanitation situation	*15% use pit latrine and 85% use open defecation.*
Schools	*Ventilated improved latrine (dirty)*






System 1	***Borehole with pump and generator***
Details	*Constructed in 1995 E.C (government fund); 1 reservoir (10 m^3); Borehole depths 200 m, pump depth ?? m. 4 WP (1 NF) two cattle trough (1 NF)*
Technical quality of system	*Nine years old; lacks preventive and corrective maintenance (broken taps, leaking water meters, poor drainage, broken cattle trough, 1 NF water point*
Water quantity	*Is a problem as number of users is high leading to long queues*
Water quality	*Good taste, no odor; no turbidity; no sign of fluorosis; sanitary inspection showed no risk (protected borehole); risk during transportation and storage*
Continuity	*System operated 8 hrs/day; in dry season long waiting queues (4-6 Hours).*
Cost	*People pay 0,5 Birr per 20 litre; Not known if people restrict water use because of cost*

Main technical problems of piped system	
1	System has several technical deficiencies broken/leaking taps, leaking water meters etc.
2	A (mostly dry) river crossing is broken causing one WP and one cattle through not to work
3	Lack of drainage systems around water points
4	Generator needs technical check
5	Pump needs performance check

Main management/financial problems with piped system	
1	WASHCO no gender balance (5 male/2 female)
2	WASHCO members do not get training (financial and scheme management)
3	No financial and operational monitoring and reporting
4	Lack of preventive maintenance and keeping spare parts
5	Conflicts arise among users and tap attendant due to unclarities in financial management

System 2	**Pond**
Details	Surface area some 40x50m, draining from surrounding catchment area
Technical quality system	Catchment area is not protected and lacks good drainage facilities into the pond; Pond is not fenced; No abstraction mechanism in place
Water quantity	Water is used for cattle but several HH also use for drinking water; They fetch between 3 and 5 jerrycans per HH per day
Water quality	People report that water has bad smell; Sanitary survey shows severe risk of bacteriological and possibly chemical contamination (fertilizer); Also contamination risk in water handling and storage
Continuity	Provides water during 4 months per year
Cost	Financial contributions are not clear
Two other ponds exist with similar characteristics	

Main technical/management problems with pond	
1	Not fenced
2	No catchment protection, no drainage system (water way) from catchment with silt trap
3	No extraction mechanism
4	People do not treat water from pond even if used for drinking
5	Pond is weakly managed by traditional leaders
6	No official tariff and financial contributions are not clear

Sanitation	**Households**	**School**
Systems	15% Simple pit latrine 85% OFD	Ventilated improved pit latrine
Technical quality of system	Few latrines with superstructure; some have life fence; Drophole has no cover; Shallow systems, several not in use	Concrete slab, walls made off mud; corrugated plated roof and door
Handwashing	No hand washing facilities	No facilities; no drinking water
Cleanliness (hygiene risk)	Considerable hygiene risk as latrines are not clean and allow direct fly access. OFD is observed among others close to HH (small children)	High hygiene risk as latrines are very dirty (faces on ground) and direct fly access; around the latrines there are also a lot of feces and litter;

	Annex 8.2 Example of a WASH Action plan (developed in a GLOWS training, originally made in power point see CD Rom)	
	Proposed short term water actions	**Leader**
1	Inform community members on the risk involved in the unhygienic handling and storage of water	HEW with support WASHCO
2	Improve drainage around water points	WASHCO with support users
3	Explore capacity building options with Woreda for WASHCO (Financial and scheme management, monitoring, reporting) and for skills training of pump/generator operator(s)	WASHCO with support from Woreda Water Office
4	Explore option to improve the gender balance of the WASHCO	WASHCO with support from Woreda water office and Kebele leaders
•	***Time line*** within next four weeks • ***Budget requirements***: no budget requirements except for travel to visit Woreda Water Office	
	Proposed longer term water actions	**Leader**
1	WASHCO seeks support from WME and Zone to analyze the entire system and find solutions for the problems (low pressure in some WPs, valves to manage system, possible water leakage, check of water meters, repair of river crossing etc.)	WaSHCO with support from woreda and zone WME offices
2	Develop and introduce a technical and financial monitoring and reporting system	WaSHCO with support from woreda office
3	Seek support to explore possibilities to improve the water catchment and protection of water ponds	WaSHCO with support from woreda office
4	Improve the water supply situation at school to facilitate handwashing and making drinking water available to children	School principal with support HEW, teachers and pupils
•	***Time line*** within next three months • ***Budget requirements***: Budget will be required for the travel to the Zonal office; Perhaps the analysis can be covered by Zone, but thereafter repairs will require resources; Woreda Water Office may be able to cover WASHCO training and development of management tools (monitoring formats etc.); handwashing and drinking water facility in the school will require funds;	
	Proposed short term sanitation actions	**Leader**
1	Awarness creation about risk of unclean latrines and lack of hand washing	HEW
2	Reduce hygiene risk school latrines and improve cleanliness of school grounds. Include handwashing facilities and promote their use (soap/ash)	School principal with support HEW, teachers and pupils
•	***Time line*** within next four weeks • ***Budget requirements***: limited requirements for purchase of a water tank and soap	
	Proposed longer term sanitation actions	**Leader**
1	Explore the interest in construction and maintenance of a public latrine	HEW
2	Seek support to establish locally appropriate latrine options (slabs, walls, roofs)	HEWs with support Woreda
3	Seek support for developing and implementing a Community Led Total Sanitation Approach involving Community based volunteer HEW and community to avoid OFD	HEW with supoprt woreda HO
•	Time line within next three months • Budget requirements: need to be explored in more detail as they among others depend on the designs that will be adopted	
	More examples with greater detail and of different systems are presented in modules 9 (WASH assessment) and module 10 (WASH action plan)	

Module 9 Example: WASH assessment report of Wahira

This is a comprehensive example including many types of water systems that can serve as a reference for you when reviewing specific systems. It also provides a format for reporting; yet you may consider putting the assessment in the form of a Powerpoint as this has the advantage that you can print slides on A4 sheets and take them to the community for discussion.

9.1 Introduction

This report summarizes the assessment of the prevailing water, sanitation and hygiene (WASH) problems in Wahira (see Table 9.1). It was developed in April 2010 by a group of people from the community with external support (see Annex 9.1). It looks at all water problems and also at the sanitary situation.

This report comprises four main components.

- The description of the water supply situation looking at all available water sources and existing (multiple) use
- The assessment of the risks involved in each of the water sources
- A review of the management of the different water systems
- An assessment of the sanitary situation and an identification of main problems

Table 9.1 General data from the community

Item	Data
Name of community	Wahira
Population size	2015
Main occupation (s)	Farming, cattle raising
Type of water supply systems	Piped supply, 2 handpumps, 1 traditional wells, 2 ponds
Water systems	1 piped water supply 1 drilled well with handpump 1 dug well with a rope pump 2 traditional wells 2 ponds
Water access (% official access 15 litres < 1.5 km) [1]	90%
Water coverage (% using improved water systems) [2]	80% (dry season); 60% (wet season)
Quality water supply	Systems are not well kept and all systems as well as water transport and storage involve hygiene risks
Sanitation coverage (% with improved facilities) [3]	40% (latrines); 60% open field
Quality sanitation systems (spot sample in few houses) [4]	Latrines are not very well kept and involve health risk (fly breeding) as openings are not covered
Health situation	According to HEW incidence of diarrhoea is considerable and increases in wet season
School situation	1 school but with very poor sanitary facilities

1 Water access is the official Ethiopian standard being the % of the population (households) that can be served 15 l/p/d with the installed capacity of improved systems and live within a distance of 1.5 km. Improved water systems according to WHO/UNICEF are: household connection, public standpipe, borehole, protected dug well, protected spring, rainwater collection. In practice many of these systems do have water quality problems and some also water quantity problems
2 Water coverage is the estimated % of the population (households) that actual uses the system as their main source (This % may be lower than the water access figure if many people use other water sources or higher when particularly in the dry season no other water sources are available)
3 Sanitation coverage is the % of households that have a latrine or other sanitary facility
4 This information is based on a brief visit to a few households and discussions with the WASHCO

9.2 Water supply assessment

9.2.1 Situation analysis

The community uses different water sources with different problems in terms of functioning and use and in hygiene risks (Table 9.2). The estimation gives the % of households that use the specific source as their main water source and some may collect also from other sources to complement the main source. In this case we see that 4% of users from unimproved sources actually collect and pay for some 'drinking water' from the piped system. The estimates are very indicative as they are just based on discussions with the WASHCO, some tap stand attendants and some users. A schematic drawing of the location of the community with the different water systems is presented in Figure 9.1. For each of the type of systems a summary description and a risk assessment have been made that are presented in Annexes 2, 3, 4 and 5. The overall situation shows that important problems exist with the water supply which can be summarized as follows:

Water quantity
Some problems exist as some 20% of the households have to walk more than 1.5 km to reach a standpost of the piped system or a handpump. Furthermore waiting lines at the standposts are sometimes more than an hour.

Water quality
In the dry season some 80% use improved water supply at least for drinking but these supplies and the way water is transported unfortunately does imply a risk of contamination. In the wet season the use of improved systems for drinking water reduces to 60% as part of the population drinks rainwater but mostly not in a hygienic way. Water handling in general entails a risk of contamination and containers are not cleaned. Particularly poorer households more often use unimproved systems as these are free.

Technical quality and management of the systems
All systems show serious limitations in terms of their technical quality because of lack of preventive maintenance and inadequate repairs. Management of all systems faces considerable problems including financial and organizational difficulties and they receive very limited back-up support. This is further aggravated by the fact that the piped system is managed by the WASHCO and the pumps by local user groups who do not work together.

Table 9.2 Overview of water supply systems

Type of system	Users[1] (%)	Water quantity	Water quality	Quality of systems
Piped water supply with 3 tap stands	65/45	Intermittent supply, but people are satisfied with quantity and pay 15 cents per 20 litres	Good taste, no chemical contamination, some risk of bacteriological contamination including during transport and storage	The system is not well managed and has considerable leakages. Some are visible. A further analysis is needed to check the distribution system
1 Handpump and 1 rope pump	15/15	Continuous functioning, people are satisfied with the service and pay	Good taste, chemical quality not known but seems not to pose a risk. One pump with very low risk of bacteriological contamination, the shallow well has a moderate risk	Both pumps need servicing as the water appears only after a few strokes. Also according to the users filling their buckets takes more time.
Traditional wells (2)	15/15	One of the wells strongly reduces in quantity in dry season	Good taste (according to population), very high risk of pollution	No organized management Superstructure of both wells shows cracks and people use their own tools to extract water
Pond (2)	5/5	Year round supply, but less in dry season. People use for washing, gardening and animals	High risk of bacteriological contamination but people say that it is not used for drinking water (so less problematic)	The catchment area is showing signs of erosion which may lead to siltation of the ponds
Rainwater	0/20	Rainfall is considerable during four month of the year	Involves a risk as it is not collected in a hygienic way	Use of pots and pans and uncovered containers to collect water from roof
	100/100			
Drinking	Some 4% of the users of not improved systems take water for drinking from tap stands			
1. Coverage in dry season/wet season = % of households using this water system as their main water source				

(insert your drawing here).

Figure 9.1 Schematic overview of the water supply systems *developed together with the WASHCO with an indication of the water su*pply systems (*showing community, main roads, piped network and estimated distances*)

9.3 Sanitation assessment

9.3.1 Situation analysis

The sanitary conditions in the community are cause for serious concern as they situation poses a serious risk to the population (Table 9.10). Some toilet facilities exist but are generally in poor conditions and few have hand washing facilities. The percentages of users shown in the table have been roughly estimated based on discussions with the water committee, the HEW and some users. A more accurate estimate can be established over time with the WASHCO and the HEW. The very high hygiene risk that exists and the indication of the HEW that the incidence of diarrhea is considerable shows that urgent action is needed. It is interesting to note that even some of the better houses have very poor sanitation facilities clearly suggesting that sanitation is not a priority.

Table 9.3 Overview of sanitation system

Type of system	Users (%)	Quality of systems	Hygiene risk
Ventilated pit latrines	5	Most systems are not well maintained and present technical deficiencies including lack of fly screens.	A considerable risk exist in most of the systems, but some are kept very clean and have hand washing facilities (plastic bottles and soap)
Open pit latrines	35	All systems present problems as latrines are not covered, many do not have a good (mud) slab and all have direct fly access	A considerable hygiene risk exists; Pits are not covered and no ash is put on top of faeces.
Open field	60	In part of the community vegetation cover is nearby whereas in other areas people have to walk a distance	Considerable hygiene risk as part of the areas that are used can drain into the water sources. Particularly for women situation is difficult
School sanitation		Facilities are in poor condition and only used by part of the children and trainers; no hand washing facilities	High risk exists and situation is even more difficult for girls
Personal washing areas	30	Simple fenced areas exist for personal hygiene in some of the compounds	Positive for personal hygiene and very low hygiene risk as no important drainage problems exist

9.3.2 Sanitation management

Maintenance of the facilities is done directly by the households with cleaning (if at all) left entirely to women. Most facilities need some form of repair. The overall impression is that limited experience exists with good facilities. When pits fill up people may dig a new pit, but some also seem to abandon the latrine and go back to the field.

School latrines are cleaned only once a week by a sweeper and are a serious health risk. Children using them are reinforced in unhygienic behavior and many prefer the open field.

9A. 1 List of persons involved

The following persons were involved in the development of this report:

9A. 2 Assessment of piped water supply

9.A2.1 overall assessment

This section presents the overall assessment of the piped water supply (Table A2.1).

Table A2.1 Overview of the piped system

Item	Description	Remark
Pump	Electrical pump (2 yrs old) with generator (5 yrs old) Bulk water meter Depth borehole: 70 metres Installation depth pump: 30 metres	Borehole not protected as the well head is cracked and electricity cables exposed, preventive maintenance is lacking, repairs needed, water production and fuel consumption registered daily
Treatment	No treatment	Source has good water quality
Water storage	One overhead tank in community (next to bore hole)	In good shape but never cleaned or flushed
Water distribution	3 km distribution network 10 yrs old, HDP pipe with 3 tap stands	Maintenance is insufficient. Pipes are exposed; stand posts are muddy and unclean. Water loss is estimated at 20%
Water transport and home storage	Water transport and storage is mostly done in closed plastic jerry cans	Safe way of transport but at filling point water may be contaminated by dirty plastic funnels and dirty caps
Water disposal	Spill water is not properly drained leading to puddles	This may lead to mosquito breeding, unpleasant smell and mud pools
Coverage	65% of the community use the piped system in the dry season as their main source and 45% in the wet season	People try to cut cost by using other sources when easily available or for certain activities like cloth washing
Continuity of system	Water supply is available 8 hours per day	People are satisfied with the 8 hours, but find waiting times (> 1 hour) too long
Continuity of source	Water table has fallen two meters in 5 years	It need to be explored with higher level authority what is the cause and whether this will affect long term sustainability
Quantity	Stand post users use on average 20 lpcd	Poor households take only 5 to 10 litres per day
Cost	People pay 20 cent per 20 litre of water	Cost family of five using standpost 30*5*0.2 = 30 Birr/month
Water culture	People like the taste of the water; very few treat it at home (boiling, disinfection)	People not aware of risk of (re) contamination of water
Quality[1]	Sanitary survey suggests that water is safe at source although small risk exists of infiltration through cracks in the well head; high risk of infiltration in distribution system because of intermittent supply and pipes crossing poorly drained areas	Water should be considered a bacteriological risk which needs confirmation by water quality testing. Treatment/disinfection at source not an option as contamination is most likely in different locations in distribution system. Distribution lines need to be repaired with special attention for poorly drained areas.
Overall assessment	The system requires better maintenance and needs upgrading to reduce water loss. The water involves a considerable hygiene risk and will require treatment as long as distribution system has not been repaired. This however is not useful at the source as contamination occurs in the distribution system. So disinfection may be considered at the standposts (would require extra storage tank) or at household level	
A schematic drawing of the system is shown in Figure A2.1		

(Insert drawing of water system)

Figure A2.1 Schematic drawing of the water system

9.A2.2 Water supply management

The piped water supply (Table A2.2) has a WASHCO (only dealing with water), a pump operator and plumber, an assistant operator and two paid standpost attendants who collect the users' contributions. The management has different problems partly because they have received very little training and conflicts have grown over the past. They never presented the accounts to the users and mistrust seems to exist which is a cause for conflicts.

The link to the Water Bureau is very weak and only some technical backstopping is provided when the system breaks down. The water production and energy consumption are registered daily and users contributions weekly but results are not compared over time.

Table A2.2 Management of piped water supply system

Item	Description	Remark
Management	Water committee with 5 male members already in place for 5 yrs.	It is necessary to explore if gender interests are properly safeguarded and how the committee can become more balanced
Training	Administrative and technical training were provided during construction.	No refresher training is provided and no training was received on management issues and consumer relationship
Daily operation	Operator and an assistant are responsible for pump management, and new connections	Preventive maintenance absent; repairs and new connections don't meet quality standards. Supervision and backstopping lacks
Financing	Tariffs have been set to cover operation and maintenance cost. No funding is available for larger repairs	People pay for water from standposts With the aging of the system cost will increase and repairs are needed. This needs to be discussed with users and relevant authorities.
Tariff collection	Two standpost attendants collect the tariff from the users and hand this to the treasurer of the WASHCO.	People pay 10 cents per ten litres but some can only afford 5 litres.
Conflict management	Conflicts exist between the water committee and standpost attendants and some users	Conflict management is not an issue that the water committee has learned and no trained external support is available either.
Spare part management	Few spares stored in community, thus high risk of long repair periods.	Could be considered to invest part of user contributions in spare parts, also as their cost tends to increase with time
Maintenance	Typical breakdown instead of preventive maintenance is applied	Preventive maintenance is essential and often less costly in the long run.
Back-up support	An area mechanic is supposed to give backstopping. Mayor repairs require input from regional office	Area mechanic only comes if called for repairs. Interventions are strictly technical; no support for management. Repairs may take weeks
Monitoring	Data of pump operation and fuel consumption and users contributions are registered.	Monitoring schedule is too limited and not properly used to support management of the system

9A. 3 Assessment of handpump systems

This section presents the overall assessment of the handpump systems (Table A3.1).

Table A3.1 Overview of the handpump systems

Item	Description	Remark
Pump 1.	India Mark 2 on a deep borehole (150 meters; static water level 20 m, 5 yrs old)	Borehole reasonably protected, preventive maintenance is lacking, foot valve and plunger seals need repair.
Pump 2	Rope pump on a dug well (16 m, static water level 5 m, 1 yr old)	Well is not sufficiently protected. Pump is in good working condition
Treatment	No treatment	A few people boil water at home for babies
Water transport and home storage	Jerrycans and open containers. Some use donkey for transport	Jerrycans are a safe way of transport. Few containers are closed with a lid.
Water disposal	Waste water is not properly drained at pumps leading to puddles	This may lead to mosquito breeding, unpleasant smell and does not positively influence good hygiene behaviour
Coverage	10% of the community use the handpump 1 and 5% handpump 2 both in the dry and wet season	Several people use also other water sources when easily available
Continuity	Water supply is available 8 hours per day. At other time pumps are locked Fear exist however that the groundwater level is falling as in dry season pump is producing less water	People are reasonably satisfied with the 8 hours. If pumps breakdown they may be out of service for several weeks Close to the community several irrigation schemes have been developed that pump groundwater
Quantity	On average people use some four jerrycans of 20 liter per family per day	Water use is on the low side and confirms the use of other sources
Cost	People pay 2 Birr/month per family	Income does not adequately cover O&M cost. For larger repairs they try to get support from outside
Water culture	People like the taste of the water; very few treat it at home (boiling, disinfection). One of the two pumps is not kept clean by users	
Quality[1]	Sanitary survey indicates that the deep well is reasonably protected but the water from the shallow well has a considerable sanitary risk because of infiltration possibilities of surface water and presence of nearby latrines	Water in the shallow well should be considered a bacteriological risk. Would be good to obtain confirmation from water quality test. Disinfection of the well may be an option in combination with the removal of potential sources of pollution.
Overall assessment	Both pumps require better maintenance and need repairs. The water in the deep well is reasonably safe, but the shallow well has a high sanitary risk which requires improvement (or household level treatment). In both cases home storage is needed and this is often done in containers that are not properly cleaned, hence also involving a considerable hygiene risk. This requires improved storage or household level treatment.	
1. A schematic drawing of both pumps and the related risks is shown in Annex 7		

(Insert your drawing of the water system)

Figure A3.1 Schematic drawing of the system

The two handpumps are managed by a user committee (Table A.3.2). This has been established with the help of an NGO but without creating a relation with the committee managing the piped supply. A local caretaker controls the pump but has no repair skills.

Table A.3.2 Management of handpumps

Item	Description	Remark
Management	A community health committee with 3 male and 2 female members was established by an NGO 5 yrs ago.	It is necessary to explore the link between the water committee and the health committee as it is better to keep water supply in one hand
Training	Administrative and technical training were provided during construction.	No refresher training is provided and no training was received on management issues and consumer relationship
Daily operation	Pump caretaker looks after both pumps	Preventive maintenance is virtually absent. Supervision and backstopping is not sufficient.
Financing	Tariffs have been set to cover O%M cost. No funding is available for larger repairs	With the aging of the pumps maintenance cost may increase somewhat. This needs to be discussed with users and relevant authorities.
Tariff collection	Committee members collect the monthly tariff from the users.	Some poorer families have difficulty to pay the tariff
Conflict management	Sometimes conflicts arise among users jumping the queue	Conflict management is not an issue that the committee has learned and no trained external support is available either.
Spare part management	Very few spare parts are stored in the community	High risk of longer repair periods if no spares are available. Also cost of spares tend to increase over time, hence good to invest user contributions in spares
Maintenance	Breakdown maintenance is used (no preventive maintenance)	Preventive maintenance is essential and often less costly in the long run.
Back-up support	An area mechanic is supposed to give backstopping	In practice the area mechanic only comes if called for repairs (and usually only after several days). His support is strictly technical leaving a big gap of management support
Monitoring	No data are registered except for tariff collection.	Monitoring schedule is too limited and not used to support management of the system

9A. 4 Assessment of traditional wells

This section presents the overall assessment of the traditional wells (Table A4.1).

Table A4.1 Overview of the traditional wells

Item	Description	Remark
System	Four open unlined traditional wells exist that are used by household, cattle and wildlife	Wells are not protected by a fence. People draw water with unclean bags
Treatment	No treatment	A few people boil water at home for babies
Water transport and home storage	Jerrycans and open containers. Some use donkey for transport	Jerrycans are a safe way of transport. Few containers are closed with a lid
Water disposal	Waste water is not properly drained leading to puddles	This may drain into the well and causes a muddy environment
Coverage	40% of the community use the wells in the wet season and 20% in the dry season	People try to cut cost by using well water instead of piped water supply.
Continuity	Water supply is available continuously in the wet season, but two wells dry up in the dry season	People are partly satisfied with the wells but don't like then to dry up
Quantity	On average people collect some three jerrycans of 20 liter per day for their family	On average people use some 12 lpcd, which is on the low side. Some however supplement with water from other sources and washing is done in the wet season at the pond
Cost	People do not pay	People have some cost (annual replacement of the bag and rope to collect the water) indirect cost as the ponds are at a distance of 20 minutes
Water culture	People like the taste of the water; very few treat water at home (boiling, disinfection)	
Quality[1]	Sanitary survey indicates that a huge sanitary risk exist in all four ponds	Water involves a high bacteriological risk. Treatment/disinfection of the wells is feasible provided they are first better protected
Overall assessment	The wells are contaminated hence the water involves a considerable hygiene risk and will require treatment. Treatment at household level can be an option (solar disinfection, chlorination, boiling). An alternative is to use safe drinking water from the deepwell pump or from the piped system (provided this is safe or is disinfected at the standpost (equipped with extra storage tank and disinfection).	
The four traditional wells are very similar and for that reason only a general description is made		

The traditional wells are managed by users directly following long term tradition (Table A.4.2). When needed money is collected from users with better off families often paying more.

Table A.4.2 Management of traditional wells

Item	Description	Remark
Management	The wells are not managed	
Financing	No cost are charged for using well water	Because of high level of pollution indirect cost (health, loss of working days) may be high if water is used for consumption
Conflict management	Sometimes cattle owners push their way if water gets scarce	Conflict management is not dealt with
Maintenance	No maintenance is applied	Wells are gradually deteriorating.
Monitoring	No data are registered	Gradual deterioration and volume reduction but this is not visible for lack of monitoring

Module 10 Example: WASH action plan Wahira

This is a comprehensive example including many types of water systems that can serve as a reference for you when reviewing specific systems. It also provides a format for reporting; yet you may consider putting the plan in the form of a Powerpoint as this has the advantage that you can print the slides in A4 format and take them to the community for discussion.

10.1 Introduction

This section presents a number of actions that need to be taken in the shorter and longer run. It is very clear that only a small part of the community has access to potable water and that urgent action is needed. Also the different systems are not performing well, are not adequately managed and lack adequate back up support. The required actions to improve upon the situation involve different actors and for each action a clear indication of the leading action will be needed.

10.2 Water supply improvement plan

This section presents a number of actions that need to be taken in the short and longer term. It is very clear that only a small part of the community has access to potable water and that urgent action is needed. Also the different systems are not performing well, are not adequately managed and lack adequate back up support. The required actions to improve upon the situation involve different actors and for each action a clear indication of the leading actor is indicated.

10.2.1 Short term action

The short term actions (Table 10.1) aim at taking immediate steps that do not require mayor external intervention, reconstruction and considerable external resources. The focus is on doable actions within existing means and often mainly involving community based actors.

Table 10.1 Short term action

Problem	Description	Remedial action	Actor
Access to potable water	Only one handpump provides potable water; piped water system is intermittent thus involving a health risk except for the tap stand located near the pump	Inform the community about: ▪ using handpump water for drinking ▪ using water from tap stand near pump for drinking ▪ disinfection at home for water from other sources (solar disinfection in plastic bottles) ▪ Initiate hygiene promotion activity ▪ Explore if bacteriological water quality testing is feasible to confirm assessment	HEW with WASHCO
Lack of chlorine	Chlorine can be used to disinfect water at home or in the well but not in piped supply	Explore the possibility to supply chlorine to disinfect the well with the rope pump and possibly for home treatment. The piped supply cannot be treated as contamination enters in the distribution system	Water technician in consultation with the HEW and the community
Lack of maintenance	Both preventive and some corrective maintenance are needed	Make a good overview of the necessary activities; explore with the operators and the committees what can be initiated and what requires additional resources (see table 4.2)	Operators and committees with support from water technician
Lack of monitoring	Good monitoring can very much enhance performance and is crucial to plan interventions	Develop and introduce a monitoring system for the piped supply and for the handpump supply and for the rope pump	Water technician with water committee and health committee
Lack of coordination	The current piped water supply and the handpumps fall under responsibility of different committees which is not effective and efficient	Initiate the discussion between the two committees to explore how best they can collaborate or possibly merge	Water technician or other external agent

10.2.2 Longer term action

Longer term actions include issues that may need relative quick intervention say in the next three to six months but also more structural interventions that require often the work of external agencies or considerable financial resources. It implies that more time is available to develop proper plans and explore possibilities to finance improvements (Table 10.2) Several of these actions do require external support particularly from the water technician. This implies however that the water technician also needs to have a background in management issues. If not other external staff will be needed to facilitate or train (including perhaps peer training by water committee members or operators from other communities). Some actions however need even more support and may need to be embedded in a district plan. It is expected that the water technician to either initiates this type of action or directs the community (water committee) to relevant agencies and help them to take appropriate action using for example the water action plan to explain the situation to these agencies.

Table 10.2 Longer term action

Problem	Description	Remedial action	Actor
Contamination of piped water supply	The piped supply is contaminated because it is intermittent. Disinfection at the source therefore is not helpful and opting for continuous supply requires upgrading of the distribution network.	Explore the possibility to repair the distribution system and avoid or drain low lying areas. As an alternative it may be feasible to construct small storage tanks at the tap stands and introduce disinfection in these tanks. It may also be explored to replace part of the distribution system.	Water technician and water bureau in collaboration with the water committee
Contamination of shallow well with rope pump	Possible contamination from two nearby latrines and cracks in the well structure.	Repair cracks; test the water and explore the possibility to relocate the latrines. Improve the well head wall to avoid contamination and explore disinfection	Water technician in consultation with watsan committee and community
Poor quality traditional wells	The traditional wells involve important risks of infiltration and contamination	Protect the traditional wells with a proper head wall, an extraction device and a fence. Disinfect the wells after repair and explore need for and possibility of continuous disinfection	Water technician with water committee and possibly external funding
Falling ground water table	Ground water table is falling possibly due to over abstraction by nearby farmers	Explore the situation in more detail and identify what corrective action can be taken	Water technician and water bureau with the water committee
Lack of skills and knowledge of committees and operators	Maintenance and repair is not adequate and committees do not really manage, also because some have changed over time	Initiate a training programme for both the operators and the (united) water committee and ensure that in case of future changes training can also be taken by new operators and committee members	Water technician with other external authorities
Inadequate conflict mediation	Problems exist between the water committee and the pump attendants and several users	Assist the committee to better handle conflicts (training) and if needed initiate conflict mediation with support of the water technician, the HEW and/or external mediator	Water technician with other external authorities
Lack of financing	Part of the maintenance is not taken care of because of lack of funding	Explore possibilities to: ▪ Increase the tariff (perhaps with special tariff for the poorest households) ▪ Obtain external resources ▪ Quickly repair some of the leakages in the system to reduce pumping cost	Water technician with water committee
Environmental contamination	The inadequacy of the local sanitation practices result in a wide spread bacterial contamination which contributes to water contamination	Explore if the HEWs or others are already actively promoting sanitation improvement, assess the effectiveness and if needed stimulate the initiation of a community sanitation programme	Water technician in collaboration with HEW and relevant external agency

10.2.3 Time line

For each of the plans it is essential to make a good time line. In this section just one example is provided for the short term plan (Table 10.3). Furthermore it needs to be clear for all involved how much time is needed for the activities, what is the role of everyone involved and who is the activity leader.

Table 10.3 Time line for water supply improvements

Activity	Leader	Wk 1	Wk 2	Wk 3	Wk 4
Develop plan to inform about safe source and plan repair of two handpumps	Aaa	X			
Inform about the safe source	Aaa	xx			
Contact repair team and inform committee	Bbb	X			
Develop monitoring schedules	Ccc		X		
Apply monitoring schedules	Ddd		xx		
Review experience with monitoring	Ccc			x	x
Etc.					

10.2.4 Budget and contributions

To ensure that activities can take place often a budget will be needed and community contributions may have to be arranged. This needs to include all cost related to the activities and a plan how to generate resources through community contributions or in other ways.

10.3 Sanitation and hygiene improvement plan

This section presents a number of actions that need to be taken in the short and longer term. It is very clear that only a limited part of the community has access to adequate sanitation facilities and that many of these are not in good conditions. The required actions to improve upon the situation involve different actors.

10.3.1 Short term action

The short term actions (Table 10.4) aim at taking immediate steps that do not require mayor external intervention, reconstruction and considerable external resources. The focus is on doable actions within existing means.

Table 10.4 Short term action

Problem	Description	Remedial action	Actor
Direct fly access to faces in latrines	Latrines are not covered and no ash is use to cover faces	Inform the community about: ▪ Need to put a lid on the latrine to block fly entrance ▪ Ash on the faces to block fly access	HEW with health committee, health volunteers
Lack of handwashing facilities close to latrines	No water and soap are present close to latrines	Inform the community about: ▪ Need to wash hands after defecation ▪ Possibility to hang a water bottle (and soap) close to the latrine	HEW with health committee health volunteers
Lack of maintenance of latrines in homes schools	Latrines are not well cleaned thus presenting a hygiene risk	Explore the problem with the users, while discussing the risks involved and encourage improvements in cleaning	HEW with health committee health volunteers School teachers
Presence of child faces close to the homes	Child faces not deposited in latrines or buried as they are considered harmless	Explore the problem with the parents, while discussing the risks involved as child feces may contain a lot of germs. Encourage improvement (deposit in latrines)	HEW with health committee health volunteers
Feces behind school latrines	The number of school latrines may be too few or they may be dirty	Explore the problem with the teachers and encourage that latrines are kept clean and suggest adjusting breaks. Do not release all children at the same time as this will create crowded latrines	HEW worker School teachers

10.3.2 Longer term action

Longer term action concerns issues that my need relative quick intervention say in the next six months as well as but which require more resources or more structural interventions requiring more resources and more external support. It implies that more time is available to develop proper plans and explore possibilities to finance improvements. Table 10.5 shows a number of these actions and indicates the leading actor and other actors involved. The longer term actions in sanitation often will require inputs from external agencies and particularly from health staff. The HEW is envisaged to either initiate this type of action or to direct the community (health committee) to relevant agencies and help them to take appropriate action using for example the sanitation analysis and the sanitation and hygiene plan to explain the situation to these agencies. This often will also include several actions that go beyond the community level requiring a more regional or even national approach

Table 10.5 Longer term action

Problem	Description	Remedial action	Actor
Open field defecation	A relatively small part of the community practices open field defecation	Initiate a discussion about the risk of open field defecation and explore the reasons why some do still practice this. Analyze if they can change to latrines (have the means) Develop an intervention with external support such as community led total sanitation	HEW with health committee, health volunteers
Quality of latrines in insufficient	Latrines are of poor quality (free fly access, no slab, dirty)	Explore possibility to improve the latrines (improved wooden slab, concrete slab). Seek support for external support from Woreda	**HEW** with health committee, health volunteers Local mason Woreda Health Desk and district level organizations
		Explore possibility to establish regional outlets or production of some latrine components	Woreda Health Desk and district level organizations
Quality of school latrines is insufficient	Latrines are of poor quality (free fly access, no slab, dirty)	Explore possibilities to improve the facilities with community support; include handwashing facilities and urinals for boys and girls; Contact Woreda for external support programme	**HEW** with School teachers health committee, health volunteers Local mason
		Establish if feasible an external support programme	Woreda Health Desk and district level organizations
Hand washing facilities lacking in school	There are no facilities were children can wash their hands	Install facilities perhaps starting by just putting water containers (drums) preferably with a tap and soap (with community support)	School teachers with HEW,,health committee, health volunteers Local plumber
Hand washing is not practiced	Many people do not wash their hands after defecation or before preparing meals	Initiate a hygiene promotion process with the community and the schools	HEW with health committee, health volunteers School teachers

10.3.3 Time line

For each of the plans it is essential to make a good time line. In this section just one example is provided for the short term plan (Table 10.6). Furthermore it needs to be clear for all involved how much time is needed for the activities, what is the role of everyone involved and who is the activity leader.

Table 10.6 Time line for the sanitation and hygiene improvements

Activity	Leader	Wk 1	Wk 2	Wk 3	Wk 4
Develop a plan to inform the community about the sanitary situation	Aaa	X			
Identify practical improvement measures	Aaa	xx			
Train a small intervention group	Bbb	X			
Inform the community about the situation and proposed ideas	Ccc		X		
Initiate improvement campaign			xx	xxxxx	xxxxx
Inform the school teachers	Ddd		xx		
Inform the school children	Ccc			X	x
Etc.					

10.3.4 Budget and contributions

To ensure that activities can take place often a budget will be needed and community contributions may have to be arranged. The budget needs to include all cost related to the activities and a plan how to generate these resources through community contributions or in other ways. In sanitation improvements most of the cost may need to be financed by the individual households, but it is very important to explore if the poorer households can indeed afford the minimum types of improvements that are needed

Organizations involved in developing GLOWS

RAIN is an international network with the aim to increase access to water for vulnerable sections of society in developing countries - women and children in particular - by collecting and storing rainwater. RAIN focuses on field implementation of small-scale rainwater harvesting projects, capacity building of local organisations and knowledge exchange on rainwater harvesting on a global scale.
www.rainfoundation.org

Research-inspired Policy and Practice Learning in Ethiopia and the Nile region (RiPPLE) is a 5-year Research Programme Consortium funded by DFID aiming to advance evidence-based learning on water supply and sanitation (WSS). Thereafter it has established itself as an independent organization
www.rippleethiopia.org

Building on the development priorities set out in Ethiopia's poverty reduction programme and consistent with its commitment to strengthen synergies with the programmes of its key partners, SNV Ethiopia is working in two impact areas: *Access to Basic Services* and *Increase in Production, Income and Employment.*
www.snvworld.org

IRC International Water and Sanitation Centre is a knowledge-focused NGO that works with a worldwide network of partner organisations in order to achieve equitable and sustainable water, sanitation and hygiene (WASH) services. IRC's roots are in advocacy, knowledge management and capacity building. The organisation was founded in 1968.
www.irc.nl

MetaMeta Communications tries to close the gap between knowledge suppliers and practitioners through a range of services in capacity building, training and communications. MetaMeta Communications offers specialized communication services for international development agencies and resource management institutions.

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