Water, Sanitation and Hygiene Promotion Manual

International Federation
of Red Cross and Red Crescent Societies

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Water, Sanitation and Hygiene Promotion Manual

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Unit 2: Community Participation in Water, Sanitation and Hygiene

Module 2: Technologies and Approaches to WASH

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Water, Sanitation and Hygiene Promotion Manual

A training package for field officers and
community volunteer leaders

Module 2

Technologies & Approaches to WASH

The National Red Cross and Red Crescent Societies in the Eastern Africa Zone

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Module 2: Technologies & Approaches to WASH

UNIT 1: WATER SUPPLY

1.1 Background information

Health[1] is a state of complete physical, mental and social well-being, and not merely the absence of disease. Health is a fundamental human right and attainment of the highest possible level of health is a most important world-wide social goal whose realization requires the action of many other social and economic sectors in addition to the health sector.[2]

Lack of access to safe water and sanitation has many serious repercussions. Children, particularly girls are denied their right to education because they are busy fetching water or are deterred by lack of separate and decent sanitation facilities in schools. Women are forced to spend large parts of their day fetching water. Poor farmers and wage earners are less productive due to illness adversely affecting national economies. Without safe water, sanitation and hygiene, sustainable development is impossible.

It is evident that the disease burden caused by contaminated water or unsafe waste disposal in many developing countries is unacceptably high. The situation accounts for a third of common recurrent diseases around the world and causes lost working time when people fall sick or travel far away to collect water.

1.1.1 Inter-linkages in water, sanitation and hygiene

A recognized primary cause of mortality in children under five years is poor water and sanitation linked to unsafe hygiene practices. This can be significantly reduced by establishing safe water and sanitation facilities. WatSan also gives a window that encourages better hygiene and has an even greater impact. Potential means to reduce mortality significantly including personal hygiene, cleanliness in the home and environment, safe water and food storage and washing hands at critical times. Delivered in an integrated manner, WatSan - combined with better nutrition, immunization and disease control - has the potential to make the biggest impact. (MDG Nr. 4)

Millennium Development Goals link to hygiene, sanitation and water
Hygiene, sanitation and water are linked in many ways to health, education and sustainable development in general. It is an important input for all of the MDG goals. This is shown in the following table.

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1 World Health Organization (WHO) Alma-Ata Declarations 6-12 September 1978)

2 WES strategy paper 2005-2015

Table 1: MDG Link to hygiene, sanitation and water[3]

Millennium Development Goals	Links to hygiene, sanitation and water
1. Eradicate extreme poverty and hunger	• Household water security is an important poverty determinant, especially amongst subsistence farmers and in the increasing number of water-scarce countries. • Chronic illness reduces productivity - poor hygiene, sanitation and water is the principal cause of diarrhoea, which is linked to other major diseases. • The time and energy lost fetching water from long distances contributes to malnutrition and reduces productivity.
2. Achieve universal primary education	• Poor hygiene, sanitation and water in communities reduce enrolment levels, educational achievement and the quality of education, and keeps girls out of school. • Safe, private sanitation and washing facilities in schools increases girls enrolment and reduces drop-out rates.
3. Promote gender equality and empower women	• Women and girls are most affected by the health and security risks associated with lack of private sanitation facilities, in both communities and schools. • Women and girls bear the brunt of fetching water, and benefit the most when distances are reduced. • Increasing women's decision making power in the management of community water and sanitation systems improves sustainability, and can help to improve women's status in the community.
4. Reduce child mortality	• Poor hygiene, sanitation and water is the primary cause of diarrhoea, which causes between 1.6 million and 2.5 million deaths in children under five per year - more than any other illness. • Improving hygiene, sanitation and water is the only way to reduce the burden of chronic diarrhoea morbidity in young children.
5. Improve maternal health	• Good birth hygiene and safe delivery spaces are impossible without an accessible source of water. • Birth hygiene begins with basic hygiene knowledge and practices - especially hand-washing.
6. Combat HIV/AIDS, malaria and other diseases	• Poor hygiene, sanitation and water cause at least 5.7% of the total global disease burden. Disease related to hygiene, sanitation and water include diarrhoea, helminthes infections, schistosomiasis, dracunculiasis, filariasis, trachoma, fluorosis, arsenicosis, HIV/AIDS and malaria. • Unhygienic environments lead to chronic diarrhoea, which is a major cause of mortality and morbidity in AIDS patients. Clean sources of water are critically important in cases where HIV-positive mothers choose to use infant formula.
7. Ensure environmental sustainability	• The safe disposal of faeces and the management of water resources are core to environmental sustainability. • Halving the number of people without safe water and sanitation is one of the three targets for achieving this goal.
8. Develop a global partnership for development	• Broad partnerships amongst civil society and the public and private sectors can improve service delivery while ensuring equitable access to water and sanitation.

3 [8] WaterAid - http://www.wateraid.org.uk

1.1.2 Constraints in accessing water

The amount of fresh water in the world is of a limited volume making access to fresh water a big challenge. The fast growing world population is increasing demand for fresh water. Currently, a third of the world's population lives in water-stressed countries. By 2025, this number is expected to rise to two-thirds.

Water shortages are imposing serious constraints on the expansion of food production and industry and the provision of hygienic living conditions in many countries and regions.

The phenomenon created by lack of fresh adequate water can be classified as:

- **Aridity** - A permanent shortage of water caused by a dry climate.
- **Drought** - An irregular phenomenon occurring in exceptionally dry years.
- **Desertification** - A drying up of the landscape and degradation of land resources resulting from activities such as deforestation and overgrazing as well as from drought.
- **Water stress** - This is due to increase in the numbers of people using fixed levels of available water.

According to the World Water Development Report, population growth, accelerating pollution and climate change, are factors likely to combine to produce a drastic decline in water supply in the coming decades.

1.2 Water resources

1.2.1 Typical water resources in the region

There are three main ones in the East African region:

- **Surface water from lakes, rivers/streams and ponds:** This water is rarely pure and likely to require treatment before being fit for domestic use. Immediate and long-term use is limited where access is regulated by scarcity, strict water use customs and laws.
- **Ground water from wells and springs:** This water occurs below ground level, mainly occupying spaces in water bearing rock or sand formations. It provides the most cost effective alternative especially in times of emergencies.
- **Rainwater:** Reasonably pure water collected from roofs of buildings or tents. It requires adequate and reliable rain all the year round along with suitable catchments and storage facilities.

1.2.2 Protection of water resources from contamination or conservation of water sources

To prevent contamination of a water source, it is necessary to protect it from feacal and other types of contamination. Most contamination is due to surface runoff penetrating the catchments structure or the storage structure.

Protecting a spring water source from contamination[4]

Springs are susceptible to contamination by surface water, especially during rainstorms.

[4] WaterAid - http://www.wateraid.org.uk

Contamination sources include livestock, wildlife, crop fields, forestry activities, septic systems, latrines, garbage pits and fuel tanks located upslope from the spring outlet. Changes in color, taste, odour or flow rate indicate possible contamination by surface water. The following measures will prevent possible contamination:

1. Divert all surface water away from the spring as far as possible. Do not allow flooding near the spring.
2. Construct a U-shaped surface drainage diversion ditch or an earth berm[5] at least 15 metres uphill from the spring to divert any surface runoff away from the spring. Be careful not to dig deep enough to uncover flowing groundwater. Prevent pounding in the diversion ditch.
3. Construct an earth berm (embankment) adjacent to the spring or a second U-shaped diversion ditch lined with concrete tile for added protection.
4. Fence an area at least 30 metres in all directions around the spring box to prevent contamination by animals and people who are unaware of the spring's location.
5. Locate latrines, septic tanks a minimum of 30 metres downstream, and 50 metres upstream of all springs.
6. Avoid heavy vehicle traffic over the uphill water bearing layer to prevent compaction that may reduce water flow.
7. As much as possible, maintain the catchment's natural state by avoiding settlements or farming activities.

Protecting a shallow well/borehole from contamination

Flood waters often carry hazardous and toxic materials, including raw sewage, animal wastes, oil, gasoline, solvents, and chemicals such as pesticides and fertilizer. Flood water that enters a well can contaminate the groundwater and make the well water unsafe to drink or to use in business. The effects may last long after the flood waters have receded. Proper construction will help protect your well against contamination. A licensed well-drilling contractor can inspect your well and suggest improvements such as:

- Extending the well casing at least 0.6 metres above the highest known flood elevation or general ground level, whichever is higher.
- Installing a sanitary seal or cover on the casing.
- Curbing the casing at ground level by surrounding it with a watertight seal that is at least 10 cm thick and extends at least 0.6 metres in all directions.
- Placing grout between the casing and the sides of the bore hole to a depth of at least 2.5 metres.
- Installing a backf low valve in the water line.
- As much as possible, maintaining the catchment's natural state by avoiding settlements or farming activities.

Protecting roof catchments water source from contamination

- Clean roof, maintain the gutters and pipes regularly to remove blockage.
- Install mechanism to filter or make sure first water running off roof does not enter storage tank.
- Clean and disinfect storage tank periodically.

[5] Raised mould of earth

- Cover all tanks at the top.
- Install a grated sieve/screen at intakes.
- Fix any leaks.

Protecting earth dams and ponds water sources from contamination

- Restrict animals and people using raised earth banks.
- Have a specific point of accessing the water only on one side.
- If possible, plant tree hedges along the perimeter. Hedges should be of selected tree species which have low affinity to water and with no known poisonous roots.

Protecting surface water source from contamination

- Restrict access of animals and people using a perimeter fence.
- Construct berms around the water.

Before commissioning newly developed or rehabilitated water points for individual or public use, they must be analyzed for physical, bacteriological and chemical parameters. These tests can be undertaken by the local water authority or authorized agency.

Note: In all cases of contamination, the first step is to identify and eliminate the source of contamination. Disinfection (use of chlorine, filtration and boiling) can be carried out to eliminate the contamination in water and make it safe for drinking.

1.2.3 Choosing a water source

A source of water supply is chosen based on several criteria. Frequently, there is only one source for a family to access and use. In other cases, there may be a choice of supplies so the following criteria is used in some form to select the source that will be used:

- Water quality - How good is it?
- Affordability - What does it cost?
- Adequacy - Can it supply enough water?
- Reliability - How long will it last?
- Convenience - How far away is it from homesteads?

From a public health engineering standpoint, groundwater is usually a better option than surface water. However, communities who have traditionally had a surface water source often offer some resistance in changing to groundwater source. This is most often the case in areas where the groundwater has a high level of salt, iron or other minerals.

Table 2: General Information on types of source

Sources	Quality	Quantity	Accessibility	Reliability	Cost
Groundwater (shallow and deep wells)	Good quality for deep aquifers; poor to fair for shallow aquifers.	Good with little variation.	D location of well; pumping required unless artesian well.	Good, maintenance on pump required regularly, must not over pump the aquifer.	Moderate if need to pump.
Springs and Seeps	Good quality; disinfection recommended after installation of spring protection.	Good with little variation for artesian flow springs; variable with seasonal fluctuations likely for gravity flow springs.	Storage necessary for community water supply; gravity flow delivery for easy community access.	Good for artesian flow and gravity overflow; fair for gravity depression; little maintenance needed after installation.	Fairly low cost; with piped system costs will rise.
Ponds and Lakes	Fair to good in large ponds and lakes; poor to fair in smaller water bodies; treatment generally necessary.	Good available quantity; decrease during dry season.	Very accessible using intakes; pumping required for delivery system; storage required.	Fair to good; need for a good program of operation and maintenance for pumping and treatment systems.	Moderate to high because of need to pump and treat water.
Streams and Rivers	Good for mountain streams; poor for streams in lowland regions; treatment necessary.	Moderate: seasonal variation likely; some rivers and streams will dry up in dry season.	Generally good; need intake for both gravity flow and piped delivery.	Maintenance required for both type systems; much higher for pumped system; riverside well is a good reliable source.	Moderate to high depending on method; treatment and pumping expensive.
Rain Catchments	Fair to poor; disinfection necessary.	Moderate and variable; supplies unavailable during dry season; storage necessary.	Good; cisterns located in yards of users; fair for ground catchments.	Dependent on rain; some maintenance required.	Low-moderate for roof catchments; high for ground catchments.

Access to a safe water point is influenced by several factors, as follows:

- The walking distance influences the amount of water people can carry home on daily basis: the longer the walking distance (more than 500 metres) the less water used per person (less than 20 litres per day per person).
- The effort needed at the water source to fetch water: for example, it is easier to fetch water from a spring than from a hand-pump, which requires pumping effort.
- The duration taken at the water point filling containers, which is dictated by the yield of the water point and the number of people using it.
- Seasonality, whereby competition at the source increases as alternative water sources diminish, causing people to wait longer and often carry less water to the homes.
- The price of water determines how much people are willing to pay for clean, safe water, with several using poorer quality water for non-critical water uses.

Note: When water is expensive, (either in cash terms or in the time and energy needed to collect it) the poor often cut total consumption on essential domestic uses. This results in lower per capita consumption levels, at times falling even below the minimum 15 litres needed for survival.

1.3 Water uses and needs

More specifically, water, may be used by the community for domestic, industrial, and agricultural use.
Specifically, water, may be used by the community for:

Category / type of use	Examples
1 Domestic	Cooking, drinking, bathing, laundry.
2 Industrial	Cooling engines and moving parts, food processing e.g. drinks and beverages, electricity generation.
3 Agricultural	Livestock watering, irrigation, fish farming.

1.4 Water Quality[6]

What is water quality?

Water quality is commonly defined by its physical, chemical and biological (appearance and smell) characteristics.

The most commonly considered physical characteristics are temperature, taste, colour, odour and turbidity.

Chemical characteristics include gases (like oxygen and carbon dioxide), salts, substances that stimulate plant growth (such as nitrates and phosphorus) and other naturally occurring and man-made substances (such as Iron and Manganese).

Bacteriological characteristics include microscopic viruses, bacteria and protozoans: as well as phytoplankton (microscopic algae), zooplankton (tiny water animals), insects, worms, large plants and fish.

6 Jones and Reed, 2005

Priority Water parameters

Parameter	Priority areas to look out for
1 Physical quality	Colour, taste, smell/odour
2 Chemical quality	Arsenic, Lead, Mercury and other heavy metals
3 Bacteriological quality	E-coli (Thermo-tolerant)

Why water quality is important
Water resources are of major environmental, social and economic value to the community. If water quality becomes degraded, water resource will lose its value. Water quality is important because it protects public health, provides ecosystem with habitats, is used while farming, fishing and mining, and contributes to recreation and tourism.

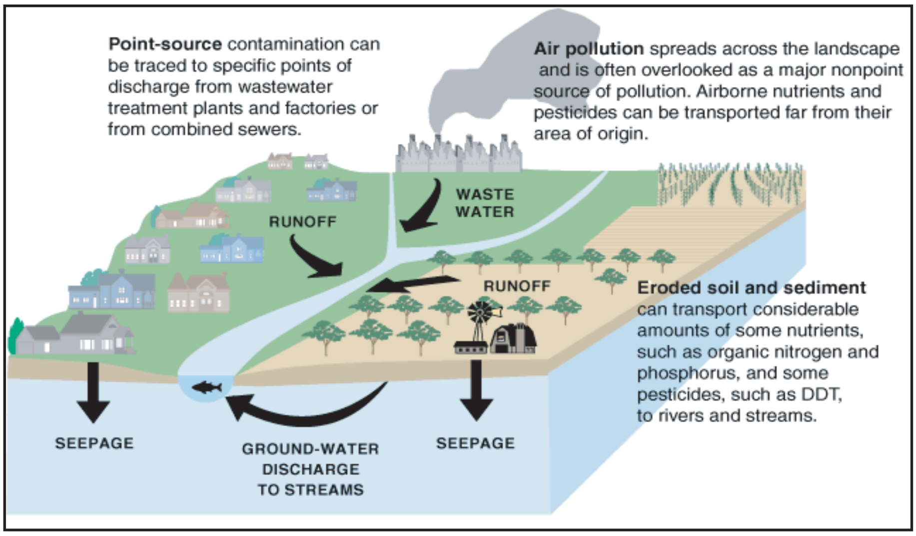
What affects the quality of water
Water quality is closely linked to the surrounding environment and land use. Other than in its vapour form, water is never pure and is affected by community uses such as agriculture, urban and industrial use, and recreation. The modification of natural stream flows by dams and weirs can also affect water quality. The weather too can have a major impact on water quality.

Groundwater close to urban or industrial development is vulnerable to contamination. Generally, the water quality of rivers is best in the headwaters where rainfall is often abundant. Water quality often declines as rivers flow through regions where land use and water use are intense and as pollution from intensive agriculture, large towns, and industry and recreation areas increase.

Often, water is contaminated after it has been collected by improper storage or unhygienic handling practices. Examples of sources of pollution are:

- Open defecation.
- Animals running loose and dipping and defecating in the water.
- Industrial wastewaters and agricultural runoff.
- Washing clothes in river.
- Throwing garbage in river.
- Using a river as a toilet.
- Poor domestic and environmental sanitation resulting into flies everywhere.

Figure 1: Sources of surface water pollution[7]



Rivers frequently act as conduits for pollutants by collecting and carrying wastewater from catchments and, ultimately, discharging it into the ocean. Storm water, often saturated with nutrients, organic matter and pollutants, finds its way into rivers and oceans mostly via the storm water drain network. Bacteria from sewer overflows or other runoff into storm water drains may also affect water quality.

Actions to improve the quality of water at sources

- Providing information to the community on the quality of water through the water quality programs.
- Enforcement of environmental laws.
- Developing environmental education programs that help the community understand how their actions affect water quality.
- Developing pollution reduction programs and regulating industrial activities, as well as controlling diffuse sources to prevent water pollution.
- Working with the community to tackle difficult water quality problems such as storm water pollution and urban runoff.
- Field officers, extension workers and community volunteer leaders working together to develop and implement effective water quality management strategies.
- Protection of water catchments areas.

[7] http://ga.water.usgs.gov/edu/waterquality.html

Source of pollution	Actions to prevent pollution
Agricultural: from both agricultural practices and livestock rearing	• Managing pastures to maintain vegetative cover and stable soils. • Employing conservation farming techniques. • Minimizing animal or livestock access to streams and damage to stream banks.
Storm water	• Locating and managing unsealed roads to reduce soil movement and erosion. • Actively controlling erosion problems. Constructing farm dams to encourage water plant growth so that they act as filters for run-off.
Sewer	• Maintaining and operating on-site household wastewater systems (septic tanks and aerated wastewater treatment units) to prevent nutrients getting into streams or groundwater.
Industrial	• Regulating industrial activities, as well as controlling diffuse sources, to prevent water pollution. • Protecting local wetlands for their role in filtering sediments and nutrients and providing a diversity of wildlife habitat. • Reusing effluent where possible.

Improving water quality for domestic uses by the community

To meet the requirements of proper water supplies, water should be taken from wells and springs that are not subject to contamination. The water sources should be examined regularly to determine the level of water safety. Water from underground or surface areas with low degrees of contamination must be disinfected. Simple treatment measures of water collected from unsafe sources can be identified as;

Boiling water: This destroys harmful pathogens and makes water safe to drink.

Settling: If water is muddy, leaving the water to settle overnight may clear the water at the top of the jar.

Filtration: Could be done using filter media made of fabric, or a combination of graded sand and stones. Water is poured over the filter media, which is usually packed in a container, leaving no gaps at the sides. Water is then slowly poured over the media and left to pass through the filter media by gravity to a collecting vessel. If properly designed, this process can remove a significant number of pathogens from the water.

Ultra violet solar rays (Solar disinfection): This is a good and low-cost way of purifying water. The process is to put water in a clear plastic bag or a clear bottle and leave it in direct sunlight for more than 6 hours during a sunny day. This kills most pathogens in the water.

Chlorination: The use of gaseous, liquid or solid form of chlorine compounds at a determined dosage to treat water and make it safe for drinking.

Settling and filtration are done to address physical water quality, while boiling and use of ultra violent rays and chlorination are done to address bacteriological contamination.

1.5 Water Borne / Related diseases

Most disease agents that contaminate water and food are mainly biological and come from animal and human feaces which find their way into water sources. Other sources of contamination include chemicals such as pesticides and industrial effluents. Contamination by contact, occurs when germs are transferred by people who wash / bath in water or when their wastes come into contact with water.

Table 3: Major water related diseases[8]

Type	Diseases	Cause	Effects	Prevention
Water borne (Disease causing organism carried in water)	Cholera Typhoid Diarrhoea Dysentery	- Drinking contaminated water - Eating contaminated food	Dehydration	- Use clean water for drinking - Keep flies away from food - Avoid unprotected water sources
Water washed (Resulting from lack of water or improper use of water)	Scabies Eye infections Diarrhoea	- Not washing - Lack of enough water forwashing	Itchy lashes Sore eyes Blindness Feverfrom lice diseases	- Increase water availability for washing - Improve personal hygiene
Water based (Vector lives in water)	Bilharzia Guinea worm	- Worms from the snails enter through the skin in infected water	Blood in stool Pain in the stomach	- Reduce contact with infected snails - Control snails
Insect vector related	Malaria River blindness	- Mosquitoes bites - Semolina fly	Fever Aches River blindness	- Removal of potential larvae breeding sites - Use mosquito netting - Introduce fish in ponds, river water

8 WES technical guidelines series No.5

Table 4: Infection and mode of transmission of water related diseases.[9]

Disease	**Mode of transmission**
Various types of diarrhoeas dysenteries typhoid and paratyphoid	From human faeces to mouth (faecal-oral): Via multiple routes of faecal-contaminated water, fingers and hands, food, soil surfaces. Animal faeces (e.g. from pigs and chickens) may also contain diarrhoea disease organisms.
Schistosmiasis (Bilharzia)	Faeces or urine to skin: Worm eggs in human faeces or urine has to reach water where they hatch and enter snails. In the snails they develop and are passed on as free swimming "Cercariae" which penetrate the skin when people come in contact with infested waters. In the Asian version of infection, animal faeces also contain eggs.
Guinea worm	From skin to mouth: The mouth discharges larvae from a wound in a person's leg while in water. These larvae are swallowed by tiny "water fleas" (Cyclops) and people are infected when they drink this contaminated water.
Scabies, Yaws	From skin to skin: Both through direct skin contact and through Ringworm, sharing of clothes, bedclothes and towels.
Trachoma, Conjunctivitis	From eyes to eyes: Both direct contact with the discharge from an infected eye and through contact with articles soiled by a discharge, such as towels, bedding, clothing, washbasins, washing water. Flies may also act as transmission agents.
Louse-borne, Typhus	From person to person: Through bites of body lice, which travel from a person to person through direct contact and through sharing clothes and bedclothes, particularly when underwear is not regularly washed.
Malaria, Yellow Fever, Dengue	From person to person through the bite of an infected mosquito. The mosquito breeds in standing water.

9 Hygiene Behaviour and Health

1.6 Water technology

The use of low- cost technology options that do not threaten the environment is a key element in the Federation's Global Water and Sanitation Initiative (GWSI). These options include spring development, non- petrol/ diesel water pumping systems and protection of water catchments.

The GWSI common approach to WatSan programming for its 186 member Red Cross and Red Crescent National Societies is maintaining a focus on low-cost, low-tech 'hardware' options where appropriate.[10]

The choice of technology, location of water points, operation and maintenance arrangements and ways of financing programmes all contribute to the goal of improving community's access to safe and affordable water sources at reasonable distances from the home.

Technology is only appropriate if its users are able to continue to adapt and innovate whatever the future brings. Appropriate means low cost, low technological requirement, easy to maintain, replicable, VLOM[11] etc.

The following are some of the considerations that are necessary for selection of the required technology in a given community:

- Sustainable: Capable of being maintained at a steady level without exhausting natural resources or causing severe ecological damage.
- Small: Appropriate community water technology is the kind of technology that fits small-scale, grassroots, and people-centered economics in terms of affordability.
- Community members must find out which technologies are manageable given their technical and financial resources, what is suitable to their community and location and where the project should be sited is recommended,
- The use of technologies, which include locally sourced materials, and spare parts, which can be easily purchased and transported, is paramount.
- Provision of training to local communities on the technology chosen is important so that they can carry out operation and maintenance works on their own.

Checklist to appropriate technology[12]

To encourage sustainability among the vulnerable, the choice of technology needs to be appropriate to the country/community context. Simple, low-cost and low-tech options are always best, especially if they have had some success in the country or region already. The aim is to build and improve on **known technologies** in order to improve the safety and reliability of both water and sanitation.

Choice of technology is further determined by relief, ecological, geological and cost considerations.

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10 Global water and sanitation initiative

11 Means Village Level Operation and Maintenance - Centre for Affordable Water and Sanitation Technology (CAWST)

12 http://journeytoforever.org/at link.html

Table 5: Checklist to appropriate technologies in the region

Type of technology	Characteristics	Advantages	Disadvantages
Spring protection	Lowest cost per capita cost and can supply 150 people. The design for spring will have 1-3 pipes to prevent congestion.	• Widely used technology in developing countries to provide safe water supply • Are an ideal source of water supply • Some locations offer excellent and economical gravity supply systems.	• Springs are susceptible to contamination by giardia, cryptosporidium and other micro-organisms and are often in boggy areas with difficult access.
Protected shallow well or dug wells	Low cost and generally reliable source for water supply to 25 households. These should preferably use pre-cast concrete rings, a caisson method of construction with a 2-3 meters penetration below the water table, and equipped with a hand-pump.	• Once a spring has been protected it provides a steady stream of clean, safe water • Protected wells are safe even for children to collect water.	• Difficult to detect water quality problems. • Seasonal variations in supply may reduce reliability.
Water kiosks	These can be connected to municipal or rural water supply mains with 2-4 taps.	• Provides households without access to in house piped water, an alternative source of potable supply with no up-front payment or connection fee. • Mobile kiosks can respond quickly to changes in demand among neighborhoods. • Daily or weekly payment to kiosk attendant may be more manageable to low-income households as compared to a monthly water bill. If realistic pricing is used, per-unit charges encourage financial self-sufficiency.	• Users face time and labor costs in queuing and carrying water to their homes. • Kiosk operating times may be inconvenient to some users. • Relatively high administrative and operation costs. Possibly little/no regulation of water quality or pricing.
Small gravity flow systems	Small GFS can provide an acceptable water supply and have relatively low per capita cost in the long run, especially for a densely populated locality, due to low maintenance cost. They should preferably be within 3 km.	• Can provide an acceptable water supply and have relatively low per capita cost. In the long run the water can be delivered to individual households.	• They are expensive to construct. • Requires the source of water to be uphill.
Machine drilled boreholes	The minimum safe yield, taken as 60% of tested yield, should be 900 l/hrs . They are relatively expensive but provide good quality water in areas without springs and shallow wells.	• Provide good quality water in areas without springs and shallow wells.	• They are expensive to construct.
Small piped (pumped) water supply systems	These types could be more economical in the long run for rural centres of 2,000-5,000 people. Such a system might consist of a borehole and pump, piping of various sizes, storage tank and standpipes/water kiosk.	• Can provide water for both livestock, small scale irrigation purposes and domestic use • Sustain water abstraction in the reservoirs throughout the dry period.	• Uncertain water quality and rarely tested. • They are expensive. • Prone to silting.

Type of technology	Characteristics	Advantages	Disadvantages
Valley tanks and dams	Such systems are relatively costly but may be provided in areas where springs, shallow wells and boreholes are not feasible. It is important that water is abstracted via an infiltration gallery to shallow well with hand pump constructed adjacent to the dam.	• More convenient than water which needs to be carried. Offers independence from outside control. • Few, no demands on public funds. • Little impact on other water sources.	• Requires 'hard' roof to collect water, hence, can be costly. • Requires spaced rainfall for best performance. • Uncertain water quality and rarely tested. • Requires space for storage on surface or underground. • Taste sometimes unfavorable compared to mineral-rich groundwater. • Difficult to collect sufficient amount for higher densities.
Subsurface Dams/ Sand Storage Dams	Subsurface dams are structures constructed across seasonal streams to increase the ground water recharge capacity of underlying sand layers. A sand storage dam is a special type of subsurface dam built across a seasonal river. It provides a means of increasing water storage capacity by accumulating sand and gravel upstream of the dam, which is raised progressively before each rainy season until it reaches an appropriate height.	• Losses from evaporation are very much lower than those from an exposed water surface in a dry tropical area. • The breeding of insects and parasites such as mosquitoes and bilharzia parasites is prevented. • Contamination of stored water, by people and animal is greatly reduced, particularly as a well and handpump can be provided to abstract water in a hygienic and controlled manner.	• Require skill is labour intensive.
Rock catchment	Similar to other run off catchment systems. Rock catchment are systems where large mass of rock ground is enclosed by a concrete or masonry wall usually upto 1meter high and run off is sored in this artifical tank. The natural rocky bottom provides the slab for the tank. In some instances inspection of the surface is required to seal off small cracks that they lead to loss of water.	• Much cheaper form of construction as base is naturally provided. • Minimised loss of water from infiltration. • Limited pollution if located on higher ground.	• Potential for evaporation is high, especially in dry periods as rocky surface promote rise in temperature.
Roof water harvesting tanks	RWH tanks have limited supply capacity for communities but are quite appropriate for schools and households. However, the high cost may limit the ability for communities to construt them on their own .	• More convenient than water which needs to be carried from a water source away from the household. • Offers independence from outside control. • No demands on public funds. • Little impact on other water sources.	• Requires 'hard' roof to collect water, hence, can be costly. • Requires spaced rainfall for best performance. • Uncertain water quality and rarely tested. • Requires space for storage on surface or underground. • Taste sometimes unfavorable compared to mineral-rich groundwater. • Difficult to collect sufficient amount for higher densities.

Steps in water supply technology choice
In a demand response approach, the following steps are proposed:

- Community must express the need to have an improvement in their current supply option (this can be preceded by promotion campaigns). Preferences for all gender groups must be considered.
- Assessing the demand level where various options (e.g. hand dug wells, spring protection) are assessed and their comparative advantages determined.
- Community level baseline survey to determine adequacy of the existing sources to meet demand, existence of local materials, skills to meet needs, community management structures, role of women, costs of existing options etc.
- Data analysis from baseline survey, which must be done by agency and shared with community members. Ensuring that issues like implications on O&M, commitment to long term sustainability, responsibilities of various stake holders among others are discussed.
- A formal agreement is entered into, and the planning for construction takes off.

1.7 Water demand

1.7.1 Introduction

The World Health Organization has established a norm of 20 litres per capita per day (lcd) for water use to satisfy basic personal and hygiene requirements. Of that amount, about 10 lcd serve drinking and cooking needs, while the remainder goes to bathing, particularly hand washing.

A number of studies have shown that the volume of water collected varies from one water source to another.
For sources closer than 30 metres from the house, usage increases, and for sources more than 1,000 metres from the house, usage falls. An important aspect of the yield available from the water source is also critical when studying the pattern of volume of water collected.

Calculation of water demand is done depending on current number of consumers. Current human population and other users include: households, schools, hospitals, livestock, shops, butcheries, hotels, bars, administrative offices. Large consumers such as large institutions, industries and factories should have either independent or separate line or reservoirs for their own use. Population projection should be done using present population. The projection should take the project life span of the components of the system, e.g. a design life of 10 years for pumping systems and 20 years for pipelines.

Determination of discharge for water sources
The well or spring yield is the amount of water that can be delivered by a well or spring in a given period of time.

The yield from a spring can easily be measured by determining how many litres of water flow from the outlet pipe every minute. This flow rate will likely vary from one spring to another.

No single method for measuring discharge is applicable to all types of stream channels. One procedure is based on timing the filling of a volume of water in a calibrated bucket (timed bucket measurement). The second procedure is based on timing the movement of a neutrally buoyant object (e.g. an orange or a small rubber ball) through a measured length of the channel, after measuring one or more cross-sectional depth profiles within that length.

These tests should be carried out by people with experience either from the water authorities or government hydrologists.

A copy of a duly filled form for the above measurements and the necessary computation are contained in Annex II.

Location of water points in relation to latrines
Water points should be located at a high-yielding site and at the same time avoid sites with high potential for contamination by surface seepage. Where water supply points are located within or adjacent to settlements, there is the possibility for contamination by existing sanitation units and/or waste disposal practices. There is need for greater understanding of the risk of contamination, and improved criteria for the establishment of safe distances between a water source and possible contamination points.

Shallow wells penetrate only the upper part of the groundwater body, which characteristically is of the poorest quality.

The risk for water contamination is very high if there is a latrine on higher ground than the hand pump. Contamination is also high if there is a latrine or other waste within 10 metres or stagnant water within 2 metres.
General rules from different sources state that water sources should be 30 metres from pollutant sources, although a distance of 50 to 100 metres can be required depending on specific local conditions. What is important is the isochron, or the time that it takes pathogens to die off and the distance of groundwater travels in that time. Most pathogens die off within 50 days.[13]

1.7.2 Construction consideration

The choice of a water point should depend on the following factors:

- Strategic position - centrally placed to serve as many people as possible.
- Availability of space (in urban informal settlements).
- Distance to the main pipe or reservoir.
- Hygiene- not near sewerage line, garbage pit or open drains.
- Accessibility -how far from the dwelling places.
- Demand - where there are few water kiosks and demand is high, a new supply is needed to boost the existing one.
- Security - it should be in a secure place for the sake of the drawers and to avoid vandalism.

An example of the construction requirement for a water kiosk is in Annex I

13 World Health Organization publication, 2004

1.7.3 Constructing a hand dug well

Hand dug well techniques vary in accordance with the nature of each site, the depth and the productivity of the aquifer. Most hand dug wells are constructed with either square or circular cross-section. This should be done by a local trained artisan with enough experience. Communities can participate through provision of labour in digging, and also during construction. However all methods employed MUST be safe to avoid injuries.

Steps in constructing a hand dug well (HDW)

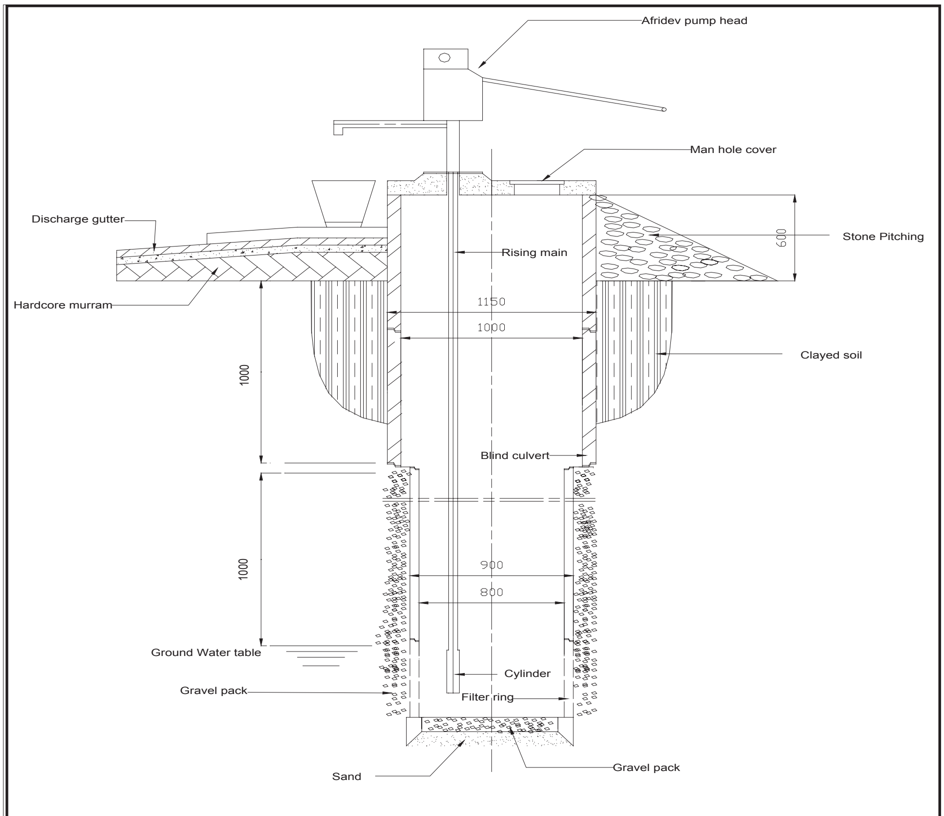
1. Site the location for the well, using hydro-geological survey or using the presence of already existing wells in the area.
2. Dig as deep as possible according to the soil conditions, until you strike the water table.
3. Lower caisson concrete rings and continue digging until an adequate water column is achieved. (This should be done during the dry period of the year when the water table is at its lowest). Caisson concrete rings can be substituted with masonry lining.
4. Include formwork especially in unstable soil, nature and type of formwork to be erected by an experienced artisan.
5. Allow for de-watering, especially when working below the water table or in waterlogged conditions.
6. Collect water samples for analysis before proceeding to finalize the construction process.
7. Install concrete ring/masonry walling to the top, at least 600mm above the ground level to form a head wall.
8. Cover the well top with a slab and apron, laid to grade to flush off waste water.
9. Install a pumping device (hand pump etc)
10. Disinfect the hand dug well before opening for public use.

Proper well location

A water well is an artificial excavation or structure, put down by any method such as digging, boring or drilling for the purposes of withdrawing water from underground aquifers.

Wells must be located and constructed to provide safe water at all times and under all conditions. Contamination of a water supply generally occurs when seepage from sewage systems or surface water enters the well. Contamination may enter the well through the top or by seeping through the walls. Tests have shown that bacterial contamination is usually eliminated after water has filtered through 3 metres of normal soil. Therefore, the well must be constructed in a way that ensures the top 3 metres of casing is watertight.

Figure 2 : A diagram of a hand dug well



Improved hand-dug well

1.7.4 Check list of requirements for the construction of a hand dug well

- The well diameter should represent a compromise between economic and practical consideration as the cost of a lined well varies in accordance to its diameter.
- The smallest practical internal diameter should give enough room for one or two men to work inside the shaft. For example excavate pit, 2.0 - 2.4 metres diameter.
- There should be effective ventilation of the pit.
- Additional room for concreting operations.
- The ability to telescope caisson tubes within the lining and still have enough room for a man to work within these tubes.
- Lower concrete rings/lay masonry blocks, leaving gaps for flow of water into the well up to concrete and drain, which should be laid to a grade/level to flush off stagnant water.
- The construction methods should be chosen after considering the characteristics of the site of the aquifer as well as the expertise available.
- Techniques used should be appropriate and should adapt to soil and aquifer characteristics.

Protected dug wells

A properly protected well carries the following characteristics:

- Has no sources of pollution within a 30 metres radius and is on high ground, sloped away in all directions from the well casing to divert surface water runoff.
- Has an overlapping, tight-fitting cover or sanitary seal at the top of the casing or pipe sleeve.
- The annular space outside the well casing is sealed with cement grout or bentonite clay at least 5cm thick to a minimum depth of $5^1/_2$ m.
- Has a pump house to protect equipment, storage tank, and piping from vandalism and maintain the water in proper hygienic conditions.
- Has a pitiless adapter (a sanitary seal at the point where the discharge water line leaves the well to enter the home) instead of an open well pit.
- Has a well-head protection area under the control of the operator.

Steps in the protection of a water spring

1. Identify the source of the spring, the main and subsidiary spring eyes, making sure that they are not obstructed during the protection process.
2. Construct a masonry or concrete wall around the spring eye, placing a pipe at the same level or slightly below the eye.
3. Place small pieces of stone at the base of the wall, ensuring that the eye is not blocked.
4. Plaster the inside of the walls, and continuously place stones carefully to form a roof over the pipe, at the top backfill with clay soils or plastic sheeting to make sure that hump formed is impervious.
5. Shape the hump to direct runoff from the spring point.
6. If desired, lead the pipe encased in the spring to another much bigger collection box downstream. The volume of the collection box may be determined by the number of people or the discharge from the spring.
7. Make sure an outlet is flowing free, and its location is not higher than the maximum height the spring can rise. This is to prevent blocking the spring from free flowing or cause a back flow situation.

Water quality surveillance

To keep a well operating properly, these routine operations and maintenance procedures should be followed.

- **Water testing**

After an initial analysis, the operator of a well must submit a water sample for coliform analysis (bacteria) at least once every 12 months and one sample for nitrate analysis at least once every 36 months. The coliform sample may be required more often, depending on the source, protection and construction. Other parameters for physical and chemical quality will have a frequency based on the expected fluctuation of quality. Generally, the frequency is higher than that of coliform/bacteriological analysis.

- **Disinfection**

Wells should be disinfected: 1) prior to use: 2) after construction or repair: 3) when coliform tests are unsatisfactory: 4) yearly for dug wells. Disinfection should be undertaken by a trained/qualified artisan.

Disinfection procedure for drilled, driven or bored well

Definition: A drilled well is constructed by either percussion or rotary-drilling machines that penetrate about 30-1 20 metres into the bedrock, as deeply as may be necessary to strike a stable water table. Definition: Driven wells are made by driving a tube into the earth to a water table above the bedrock. Driven wells are typically 100 mm in diameter, are relatively shallow and have high risk of contamination.

After ensuring that all sources of contamination are removed and your water system is clean, proceed as follows:

1. Determine the depth of the water in the well when the pump is running. This can be done by subtracting the static water level from the total well depth. This information can be found on the well log or well driller's report. You can also use a disinfected steel tape or well sounder (from a well driller) to measure the water depth.
2. Use Chart A below to determine the amount of household bleach required for the well diameter and depth of the water in the well. A chlorine concentration of 100 mg/L (100 ppm[14]) is desired. (see chart on adjacent pg)
3. Turn on the well pump.
4. Add the proper dose of chlorine for the entire volume of water in the well to 20 litres of water and pour this solution into the well by either of these two methods:
   a) Remove the vent plug in the top of the well head. Using a small hose and funnel, pour the disinfecting solution in the well. (Try to move the hose or tube around as the solution is added to the well so as to wash the inside of the well casing) or:
   b) Raise the top of the casing, and then add the disinfecting solution as in step a. (Note: Only raise the top of the casing a few centimetres so as not to lift the pump above the water level at the bottom of the well).
5. If there is a faucet between the well and the pressure tank, and a valve between the faucet and the tank, you may connect one end of a potable water hose to the faucet (sample tap) and place the other end into the top of the well. Shut the valve between the faucet and the tank. Start the pump motor. Then, introduce the disinfectant into the well. This allows the water to circulate up the well, through the hose, and back into the well. In this way, you can wash down the casing with chlorinated water while ensuring that the chlorine is thoroughly mixed in the well.
6. After 15 minutes, shut off the pump and remove the hose.

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[14] ppm - Parts per million in this context it means 100mg of active chlorine in 1 litre of water or in 1 million millegrams of water

7. Open all faucets on the water system and monitor each one until you can detect a chlorine odour in the water.
8. Close all faucets and allow the chlorine solution to remain in the well for at least 24 hours.
9. After 24 hours or more have elapsed, pump the well to remove all remaining traces of chlorine. DO NOT DRAIN into a septic tank, stream, wetland or lake. Any water being discharged to the ground should NOT have any chlorine in it. Chlorine test strips are available from swimming pool or spa dealers. Use a test strip to check chlorine content before pumping the well or storage tank. Also, there should be no chlorine in the well when taking a coliform sample.
10. Collect a water sample for coliform testing. If results are unsatisfactory, repeat the disinfection process until coliform tests are acceptable.

Chart A: Amount of household bleach required for water well disinfection
C = Cup =200ml Q = Quart=1litre G = Gallon= 4 litres

Depth of water in metres	Well diameter (centimetres)											
	5	7.5	10	15	20	25	30	40	50	60	90	120
1	1C	1C	1C	1C	1C	1C	1C	2C	4C	1Q	3Q	5Q
3	1C	1C	1C	1C	1C	2C	2C	1Q	2Q	3Q	6Q	2.5G
4	1C	1C	1C	1C	2C	3C	4C	2Q	2.5Q	4Q	2G	4G
6	1C	1C	1C	1C	2C	4C	1Q	2.5Q	3.5Q			
9	1C	1C	1C	2C	4C	1.5Q	2Q	4Q	5Q			
12	1C	1C	1C	2C	1Q	2Q	2.4Q	4.5Q	7Q			
18	1C	1C	2C	4C	2Q	3Q	4Q					
24	1C	1C	2C	1Q	2Q	3.5Q	5Q					
30	1C	2C	3C	1.5Q	2.5Q	4Q	6Q					
45	2C	2C	4C	2.5C	4Q	6Q	2.5G					

Disinfection procedure for dug wells

1. Use a clean stiff broom or brush to wash the interior wall of the casing or lining with a chlorine solution of 100 mg/L (100 ppm). Be sure to have adequate ventilation. Do not enter the well without another person, who stays on the surface, and is connected by a safety line.
2. Place the cover over the well and pour the required amount of chlorine solution into the well through the manhole or pipe sleeve opening. Distribute the chlorine solution over as much of the surface area as possible to get the best distribution of chlorine in the water.
3. Follow steps 5 through 10 above.

1.8 Financing

1.8.1 Project costs

Summary of Bill of Quantities (BQ) and total cost
BQ is a matrix containing materials required for a specific water project showing specific item, its quality, quantity, unity cost and total cost as shown in the table below.

Table 6: Example of a Bill of Quantity

Item	Description	Unit	Qty	Rate	Amount
1	50kg O.P.C (ordinary Portland Cement)	Bags	1000	600	600,000
2	110 mm Quality Diameter (upvc) class C	Length	200	5000	1,000,000
3	110mm sluice valve complete with flanges bolts and nuts	No	6	25000	150,000
4	50 mm Quality gate valve (peglar)	No	3	5000	15,000
5	100 mm Quality double flanged air valve with bolts	No	2	30000	60,000
6	Solfix -	Lutz	4	1200	4,800
7	Rubber gasket	M3	2	800	1,600

Table 7: An example of a Bill of Quantities for the cost of a typical size of a kiosk

Activity	Cost ($)
Site preparation	8.82
Excavation	29.41
Hardcore	22.06
Concrete	88.24
Walling: stones, cement and sand	485.29
Plastering	88.24
Roofing: timber, nails and iron sheets	79.41
Door and window (metallic)	73.53
Cost	875.00

Module 2: Technologies & Approaches to WASH

UNIT 2: SANITATION

2.1 Background information

Poor sanitation currently exposes almost half of the world's population to a range of health problems. The pathogens (bacteria, viruses and parasites) contained in sewage cause diseases that account for over 13 million deaths annually, particularly among children and people with immuno-deficiency. The provision of safe sanitation facilities is therefore identified as a vital component of the Millennium Development Goals.

Sanitation methods range from open defecation on land, to the conventional "drop and store" system (pitsan) and "flush and discharge" system (flushsan). The new concept of ecological sanitation (ecosan) is however the most hygienic and sustainable, because it prevents environmental pollution and health risks, reduces water usage, and at the same time promotes nutrients recovery and recycling.

Apart from sanitation "hardware", promoting hygiene at personal and household levels is equally essential in safeguarding public health. This usually requires changes of attitudes and behaviours and necessitates appropriate hygiene education and availability of enabling resources.

Definition of sanitation: This refers to all measures i.e. hardware (e.g. latrines and sewers) and software (regulation, hygiene promotion) that help break the cycle of disease such as the safe storage, collection, transfer and end disposal of human excreta.
Sanitation can further be defined as a process where people demand, develop and sustain a hygiene and health environment for themselves by erecting barriers to prevent the transmission of diseases (UNICEF, 1997).

Definition of environmental sanitation: community environmental sanitation usually refers to all measures i.e. hardware (e.g. latrines and sewers) and software (regulation, hygiene promotion) that involves hygienic (i.e. safe) disposal of human and animal excreta, waste water, vector control and other hygienic behavior.

2.2 Sanitation linkages

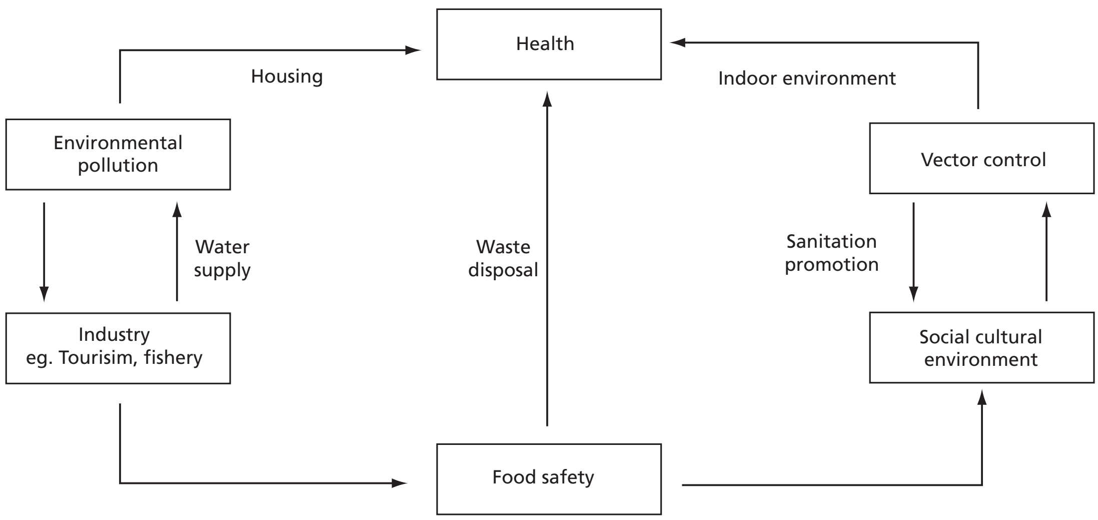
Box 2: Key issues in sanitation:

- Previously there has been more focus on water rather than sanitation.
- Sanitation is more complex and involves more collective decision making processes both at household and community levels.
- About 2.5 billion people globally live under highly unsanitary conditions.
- Poor sanitary conditions increase exposure to risks of incidences and spread of infectious diseases.
- Water stored at home is often contaminated by inadequate management and handling.
- Diarrhoea, in an environment of poor hygiene and inadequate sanitation spreads easily.
- Diarrhoea, kills 2.2 million people each year, most of them are children below 5 years.

The sanitation linkages include:

- Waste diposal: This includes wastes such as human excreta, sewage and solid waste disposal among others.
- Sanitation behaviour: This includes personal hygiene, household cleanliness, community cleanliness etc.
- Water supply: This includes methods of obtaining water e.g. rain water, ground water etc.

Figure 3: Sanitation linkages flow chart



Industries often, if not environment friendly, pollute the environment which impacts on food safety. Poor food safety affects human health. Good social cultural environment i.e. good community sanitation practices as well as vector control will reduce these impacts.

Table 8: Infection and Mode of Sanitation related diseases.[15]

Disease	Mode of transmission
Various types of diarrhoeas, dysenteries typhoid and paratyphoid	From human faeces to mouth: (Faecal-oral) via multiple routes of faecal-contaminated water, fingers and hands, food, soil surfaces. Animal faeces (e.g. from pigs and chickens) may also contain diarrhoea disease organisms.
Roundworm (Ascariasis) Whipworm (Trichu riasis)	From faeces to mouth: Worm eggs in human feaces have to reach soil to develop into an infective stage before being ingested through raw food, dirty hands and playing with things that have been in contact with infected soil. Soil on feet and shoes can transport eggs long distances. Animals eating human faeces pass on the eggs in their own faeces.
Hookworm	From faeces to skin (especially feet): Worm eggs in the faeces have to reach moist soil where they hatch into larvae and enter the skin of people's feet.
Tapeworms	From faeces to animals to humans: Worm eggs in human faeces. Tapeworms are ingested by a cow or pig where they develop into infective cysts in the animal's muscles. Transmission occurs when a person eats raw or insufficiently cooked meat.

A minimum community or household sanitation package would therefore entail, but not be limited to, the following:

- Good water storage facility
- Linen drying line
- Well kept compound
- Latrine with hand washing facility
- Refuse pit
- Bath shed or room
- Animal shed
- Kitchen separate from the living area

2.3 Requirements of sanitation

To contain and process human wastes until they or their end products are safe enough for release into the environment.

[15] Hygiene behavior and Health

2.3.1 Solid waste

Solid wastes are all the wastes arising from human and animal activities that are normally solid and are discarded as useless or unwanted.
Most solid wastes arise from domestic, trade, commercial, agricultural, industrial activities and public services.
Types of solid waste:

- Bush and land clearing debris
- Clear fill
- Clean soil waste or agricultural quality soil
- Agricultural waste
- Construction waste
- Demolition waste
- Evacuation waste
- Fire damages
- Industrial quality soil
- Reload
- Residential quality soil
- Special waste soil
- Treated lumber
- Domestic waste
- Food waste
- Commercial waste
- Yard waste

Solid waste management
Solid waste management is the discipline associated with the control of generation, storage, collection, transfer and transport, processing and disposal of solid wastes in a manner that is in accord with the best principles of public health, conservation, aesthetic and other environmental considerations and that is also responsive to public attitudes.

2.3.2 Liquid waste

Liquid waste refers to effluents and waste water.
Types of liquid wastes includes:

- **Domestic waste**

This is liquid waste which is generated from the house. Domestic wastes comprise of grey water, black water and extraneous water.

- Grey water
  Grey water is waste water coming from washing, laundry, cooking, food preparations e.t.c
- Black water
  This is water from toilets and latrines
- Extraneous water
  This is water that infiltrates or storm water that enters the house through cracks, joints, breaks or porous walls

- **Urban runoff**:-This is wastewater which results from storms.

- **Industrial wastes**

This is liquid waste that results from industries. Such wastes includes pulping wastes, petroleum refinery wastes, food processing wastes, mining wastes, acid precipitation and others.

- **Agricultural wastes**

When pesticides applied in the farm are washed away by the rain, they may cause eutrophication[16] in water bodies, as well as cause toxic pollution.

2.3.3 Medical waste

Medical waste is broadly classified into three main categories.
Non infectious waste: This is waste that presents no risks to people who handle it. It includes paper, packaging materials, office supplies, drink containers, plastic bottles and food waste.
Infectious waste: This is waste that has been in contact with human blood or bodily fluids and has the potential to cause or transmit diseases, e.g gauze, cotton, dressings, laboratory cultures, IV fluid lines, blood bags, gloves, anatomical waste and pharmaceutical wastes.
Sharps wastes: This is waste that has the potential to puncture the skin and cause or transmit disease, e.g. needles, infusion sets, scalpels, knives, blades and broken glass.
All these categories require a specific form of handling and disposal and therefore segregation and disposal techniques MUST be handled by properly trained personnel.

2.4 Sanitation promotion

In sanitation, the hardware side of the promotional activity refers to improved sanitation facilities such as:

- Latrines, hand washing facilities, dish racks, garbage disposal pits, waste water drainage etc.
- Vector control and eradication.

On the other hand, hygiene and sanitation promotion refers to the combination of, and linkages or relationship between the hygiene domains and the improved facilities. Without one, the other cannot succeed, and the sanitation facilities have to be maintained if hygiene and sanitation are to succeed.

Sanitation promotion aims at:

- Increasing awareness of the community on the benefits of sanitation.
- Promoting proper use of the available sanitation facilities.
- Promoting affordable and appropriate technology in the use of sanitation.

Factors that influence the selection of community sanitation technology

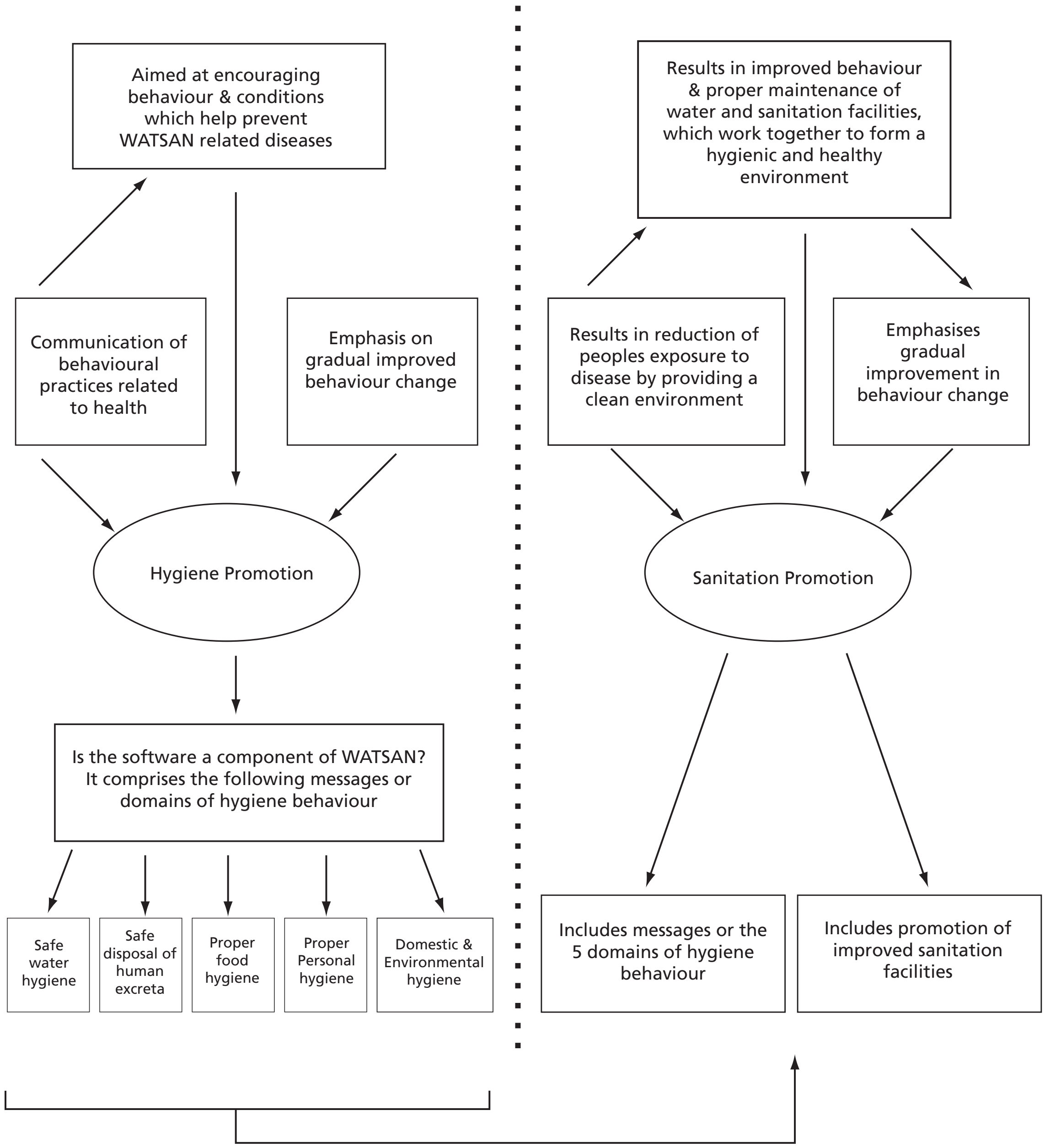
Appropriate and affordable technology options should play a central role in the selection process.
The choice of technology should aim at:

- Reducing costs
- Improving functionality
- Sustainability

16 Eutrophication refers to the addition of nutrients into water bodies, thus promoting plant and vegetation growth.

- Affordability and spare parts availability
- Community-based maintenance technology
- Attractiveness and culturally acceptability

The PHAST Concept (H&S promotion are two sides of the same coin)[17]



[17] Adapted from PHAST Manual - 2005

Essential community processes for choosing sanitation technology

- Participatory assessment of problems: This includes aspects such as hygiene behaviour, human excreta disease related problems, choice of technology, local site conditions, capacities and resources, social, cultural and religious influences and preferences.
- Raising awareness / promotional campaigns to highlight the benefits of safe human excreta disposal and its linkage with proper hygiene practices.
- Local options and preferences: Assess situation linked to environmental aspects such as potential for contamination from existing options and those proposed, determine operation and maintenance costs and resource needs and implications for proposed options. (Use sanitation ladder tool in PHAST)
- Assess skills, materials and organizational structures needed to implement the proposed options, settling at one option based on individual household choices.
- Enter into formal agreement, spelling out roles for each party.

2.5 House hold waste disposal

Methods for human excreta disposal

- **Open defecation**

This happens where there is no latrine, and people use the open places for defecation instead. This may be indiscriminate or in special places for defecation generally accepted by the community. Open defecation is the preferred option of nomadic communities and in places where digging pit may be difficult. It has very severe negative implications on human health and should be discouraged.

- **Defecation fields**

Designated defecation fields should be confined in a certain area, but require strict supervision and management to be effective. The fields are laid out by dividing a field into strips with poles and tape/ fences. Different fields will be necessary for males and females. This system can be particularly useful as a first measure in refugee camp situations. Defecation is allowed within each opened 1 .5m wide. New strips can be spaced away from old strips to reduce the fly and smell nuisance.

- **Trench latrines**

These are simple trenches, usually 30cm wide and the depth can vary from 90cm to 150 cm. Timber planks are placed on the trenches to form a solid squatting platform. After use, soil is dropped into the trench to cover the feaces, similarly to the cat method approach. This option is popular in large scale refugee populations and therefore not recommended for normal rural communities. A hand washing facility and appropriate anal cleansing materials should be provided for the users. Trench latrines should be located downstream of settlement or water collection points as the potential for contamination is high, especially during rains.

- **Shallow pit /Cat method**

People working on farms may dig a small hole each time they defecate and then cover the feaces with soil. Pits about 300mm deep may be used for several weeks. Excavated soil is heaped beside the pit and some is put over the faeces after every use.

- **Overhung latrine**

This is a latrine built over a lake, river or other body of water into which excreta drops directly into the water body. If there is strong current in the water the excreta is carried away. This method should be discouraged because it contaminates water bodies.

- **Traditional pit latrine**

This consists of a timber and murrum slab over two pits which may be 2m or more in depth. The slab should be firmly supported on all sides and raised above the surrounding ground so that the surface water cannot enter the pit. A squat hole in the slab is provided so that the excreta falls directly into the pit. A tight fitting wooden cover over the squat hole when the latrine is not in use reduces the access of flies into the pit.

- **Pit latrine with a concrete slab**

This latrine is similar to the traditional pit latrine, but the slab is made of reinforced or shaped concrete. The slab should be firmly supported on all sides and raised above the surrounding ground so that the surface water cannot enter the pit. Also, a squat hole is provided in the slab and a tight fitting wood is used to cover the hole.

- **Ventilated pit latrine**

This is called the VIP latrine. Fly and odour nuisance may be reduced greatly if the pit is ventilated by a pipe extending above the latrine roof, with fly proof netting (preferably 1.5mm) across the pipe. Wind blowing across the top of the vent causes air in the vent to move upwards. When there is no wind, air in the vent pipe moves upwards if it is heated from the sun. Smells from the pit are carried up the pipe but the flies cannot get through the netting.

- **Ecological sanitation (EcoSan)**

This form of sanitation is best suited for areas where excavation is difficult such as marshy grounds, water logged areas, high water table, loose soils and in rocky areas. The main principle in ecological sanitation is that human excreta is temporarily stored in a vault / cubicle some for 6 months to cure or until determined safe enough to be released to the environment. This means that the said vault can be re-used again. If a double vault ecosan is constructed, then this means that it can be used in an alternating manner as one vault is left to cure. There is need to investigate on cultural aspects related to the use of the bi-products of ecosan which are dry excreta and urine, especially in relation to agricultural use.

- **Pour flush latrine**

This is a latrine which is fitted with a trap providing a water seal which is cleared off feaces by pouring in sufficient quantities of water to wash the solids into the pit and replenish the water seal. A water seal prevents flies, mosquitoes and oduors reaching the latrine from the pit. Less water is needed for flushing when the finish is smooth and where the water seal used is small.

- **Septic tank**

A septic tank is an underground water tight settling chamber into which urine, feaces and water (raw sewage) is delivered through a pipe from plumbing fixtures inside a house or other building. The sewage is partially treated in the tank by separation of solids to form sludge and scum. Effluent from the tank infiltrates into the ground through drains or a soak way. The sludge is also removed at appropriate intervals.

- **Cess pool**

This is a conservancy tank, serving from one to a group of households. It's constructed of masonry or concrete, or any other approved material mainly below ground level. Its main function is to act as a temporary storage to liquid waste, which may include human excreta. When full to a designed level, the cess pool is emptied by exhausters and the refuse can be transported to a convectional treatment works.

- **Sewerage**

Discharge from WCs and other liquid wastes flow along a system of sewers to treatment works or directly into the lake or river. Many of these systems require a chamber at each house to retain solids which have to be removed and disposed of from time to time.

2.6 Sanitation ladder

Sanitation ladder describes the community's sanitation situation. It assists in deciding on options for sanitation improvement and raising awareness of the advantages and disadvantages of each option. The sanitation ladder is based on the idea of helping households to improve their situation on a gradual, ongoing basis.

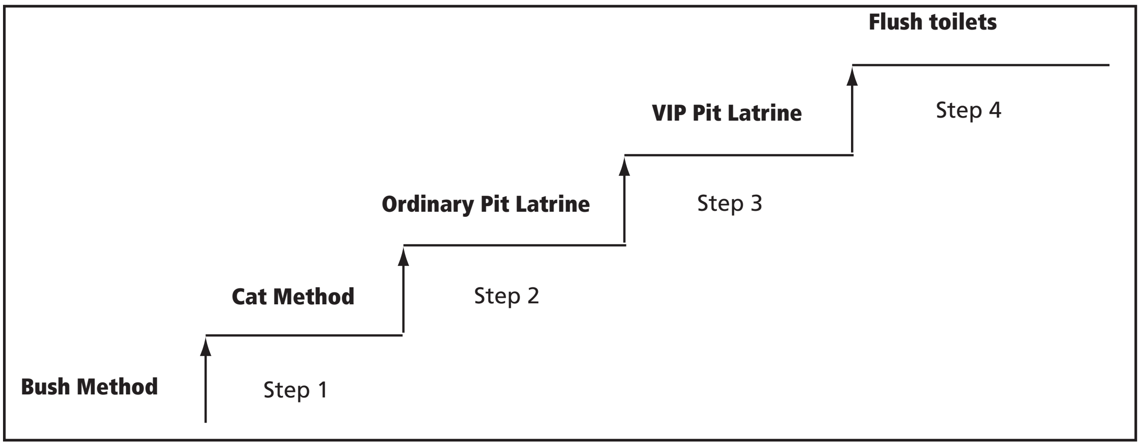


Figure 5: Sanitation ladder

Step 1:

Give the community pictures depicting the various methods of excreta disposal.

Step 2:

Ask the community to sort the pictures into steps according to improvements in sanitation practices.

Step 3:

When the community has completed this task, ask them to explain its prevalence.

Step 4:

The facilitator should then encourage the participants to divide the defecation practices into acceptable and unacceptable behavior, based on whether they result in the isolation of faeces. Place unacceptable behaviours at the bottom of the ladder and the ideal behaviours at the top.

Step 5:

After the presentation, encourage community discussions covering:

- Which practices are bad and which are good for sanitation.
- Why are people not constructing latrines in the community.
- Are there any steps they can take to improve sanitation practices and why.

2.6.1 Options available for liquid waste disposal e.g. waste water

Ineffective disposal of used or waste water can cause problems of mosquito breeding. They may also create muddy puddles in which people may slip and fall over or where children may play.

They are four main options for the disposal of waste water:

- **Soak way**

Liquid wastes from washing areas, bathrooms, water taps and rainwater can be drained into channels or pits. The size of these soak ways depends on the ability of the soil to absorb water and the amount of the wastewater to be disposed of. Trenches or pits can be filled with large stones or gravel to prevent them from collapsing. Sullage water with high solid content should be strained to stop the soil pores blocking up quickly. This should be done using woven sacking or strainers which should be cleaned frequently. Grease traps need to be used to prevent fatty wastes from kitchens blocking the soak way.

- **Evaporation pans/ evapotranspiration beds and fields**

Where soils are rocky or unable to soak up water (clay soils) and where the climate is very dry, evaporation pans can be used to dispose of wastewater. The beds should be allowed to dry out completely each week to reduce mosquito breeding. They require close and careful management if they are to be effective. They can be planted with grass or other vegetation to encourage evaporation through the plant leaves (evapo-transpiration).

- **Drains**

Natural drainage follows the contours of the land and can be further encouraged by the construction of channels or drains to divert the water to a lower area. If the gradient of the drain is shallow, it will pond. If it's too steep, it will be eroded by the speed of the water. Encourage grass growth along earth drains to keep the soil bound together but do not allow grass to grow too long. Drains should be kept free from garbage.

- **Irrigation fields or ponds**

Wastewater can be used productively for the irrigation of the quick growing fruits such as pawpaw and banana or for irrigation of vegetable gardens. Small earth dams can be used to divert water to the plants.

Options available for normal household disposal

Ineffective disposal of unwanted household material e.g. vegetables wastes, glass, cans, plastic bag and paper can cause problems of unsightliness, encourage bad smells, attract rats, mosquitoes and flies, and may cause cuts and injuries. However, different types of solid waste are useful if kept separate.

Types of solid waste disposal:

- **Composting vegetable waste**

Peelings of bananas, other fruits and vegetables wastes, animal dung and even leaves from trees can compost down to form a valuable soil conditioner and fertilizer. A small pit can be dug in a vegetable growing patch and the vegetable wastes from the household disposed in the pit for one month until it's full. When it's filled, it should be covered with soil and another pit is dug.

- **Burning organic waste**

Vegetable wastes and dried water hyacinth can be chopped up and squeezed into small bricks to dry in the sun. Animal dung can be spread thinly and dried in the sun. Once dried, these bricks and pats can be stored until required. They can be used for cooking as a substitute for charcoal or wood.

- **Burying of bones, glass and metal cans**

Glass does not compost down and if thrown in garden can later be stepped on and cause injury. Bones and metal items do decompose but the process is very slow. It's safer to dispose of these materials by digging a small pit 1 metre deep and discharging the wastes in them. These pits should be covered so that children do not fall into them. Bones, metal objects and broken glass can also be thrown into the pit latrine.

- **Burning of paper /plastic**

Plastic bags do not compost down, but they can be burned with other dry materials such as old newspapers. This can be done in a shallow pit. The resultant ash is not good for the soil and may be poisonous, so it should not be spread around vegetable and fruit growing areas.

- **Communal waste collection**

Where there is insufficient space in a compound for individual household disposal pits, communal solid waste collection is necessary. Communal containers such as empty oil drums can be located in strategic places so that households can bring their solid waste materials to one collection site. It's essential that this solid waste is collected frequently and taken to a designated disposal site. Solid waste can be transported in boxes, or in hand carts, animal carts, bicycles with box container, tractors with trailers etc.

- **Communal waste tipping**

Solid wastes must be removed from collection points and transported to a site where burial can take place. This area should be fenced to prevent scavengers. Wastes can be disposed in a trench or mound. At the end of each tipping day, the newly tipped wastes should be covered with 0.1m deep final covering to prevent fly breeding. Burning dry materials can reduce volumes of solid wastes. This waste disposal site should not be within 200m of a drinking source.

2.6.2 Sanitation technologies during emergency and disaster scenarios

Excreta and solid wastes should be buried in holes or trenches. These should be at least 60 centimeters deep and, when the contents reach 30 cm from the ground level, should be backfilled with excavated earth and trampled down. Where the evacuation is likely to take several days, the use of temporary toilets should be considered. Existing facilities such as hotels, schools and offices may be temporarily taken over where appropriate, as evacuation rest stops, and their water supplies and toilets used. When evacuation is on foot, as is often the case, rest-stops should be provided every two hours' walk, if possible, and evacuees should be given information about road conditions and access to water, food, shelter and medical assistance on the next section of the route. Special precautions may be needed to protect people living along evacuation routes from possible health risks due to the passage of the evacuees, particularly from defecation on the roadside, which may require clean-up activities.

Priorities in the acute emergency phase include:

- Providing facilities for people to excrete safely and hygienically.
- Ensuring that people have sufficient cooking utensils, equipment and fuel to cook and store food safely.
- Ensuring that people have the knowledge and understanding they need to avoid diseases.
- Ensuring that people have soap for hand washing:
- Containing or removing sources of chemical or radiological contamination.
- Evacuating people, to ensure they are no longer exposed to these hazards (WHO-Water, Sanitation and Hygiene) or
- Digging defecation trenches below the water points.

2.7 Requirements of good sanitation in reference to solid waste

Sanitation facilities should:

- Be affordable to build and maintain.
- Provide privacy to users.
- Provide convenience.
- Confer status to them, and in some cases, allow safe recovery of the resources such as soil ameliorants, animal feed, and energy contained in the waste.
- Sanitation facilities should also be culturally acceptable to users:
  - Defecating position
  - Light
  - Type of anal cleansing material used
  - Practices in ventilation and taboos on using and handling wastes
- Location of the facility relative to the house and its orientation must be considered.
- Must be secure to the users.

2.8 Rural, peri- urban and informal settlement sanitation technologies in the region

Peri-urban areas are characterized by informal land tenure, inferior infrastructure, low incomes, and lack of recognition by formal governments. The rapid growth and informal status of these high-density population areas have resulted in low levels of sanitation services. A lack of basic services, in particular the lack of adequate excreta management, threatens the public health and the environment of peri-urban settlements and urban areas as a whole.

Peri-urban areas present unique challenges to sanitation improvement activities.

Table 9: Sanitation Ladder on selection of sanitation options

Option	Description	Requirements	Advantages	Disadvantages
1.Flush toilet	Comprises of a water-sealed bowl. The flushing pours into the pit. Water drains out through the bare bottom of the pit and the holes built into its walls. The pit may be unlined in stable formations although it is always covered. Odour and fly control is effected with the water-sealed bowl.	A water-sealed bow. A septic tank may be necessary. The floor should be cleaned regularly. If a pit is used it requires emptying when full.	Hygienic. Clean Controls flies and odour. Has privacy.	Require adequate water supply It's expensive to install and maintain.
2. VIP latrine	It is an improved pit latrine. Has a vent pipe fitted with a fly screen above the roof of the superstructure. Concrete slab floor with a drop pit.	PVC vent pipe to be at least 100mm diameter and extend from pit to 1m above the superstructure. Pit should be approx 1.2m diameter and 3m deep. Pit lined with cement mortar or brick. Floor raised above the ground to prevent flooding.	Keeps off flies. Clean and odourless. Easy to maintain. Well ventilated. Has privacy. Hygienic.	It is expensive to construct. Difficult to empty once full.
3. Ordinary pit latrine	A pit of approx 1.2m diameter and 3m deep Concrete or wooden cover for the pit Superstructure (latrine house) constructed for privacy and protection on top of the pit, can be built of any material.	Should be at least 50m from nearest well or borehole. In unstable grounds the pit walls should be supported with timber, bricks or blocks.	Material locally available. Easy to construct and maintain. Requires no/ limited water.	Smell. Breeds flies. Difficult to empty once full.
4. Cat method	Digging a single shallow hole to relieve oneself then covering the excreta.	Shovel, a pick axe, or any implement that can be used to dig a small hole.	Add manure to the soil. Burying prevent access by flies.	Not applicable in rocky areas. Tedious to carry jembe. No privacy.
5. Bush method	Relieving oneself in the open field that is covered by scrubs, thicket or in the bush.	Bushy covering.	Direct manure. No cost.	Risk to spread of diseases. Contamination of surface water. Encourage the breeding of flies. No privacy.

The characteristics that set these areas apart from the urban and rural sectors are poor site conditions, unreliable water availability, high population density, the heterogeneous nature of the population, and lack of legal land tenure. These characteristics are much more complex than those typifying rural and formal urban areas. The standard technical and social solutions for low cost sanitation currently used in rural communities are not necessarily appropriate for improving community sanitation in peri-urban areas.

Latrines, however, have been shown to have serious limitations in the peri-urban sector due to population densities (population densities above 350 persons per hectare). For this reason, technologies appropriate to peri-urban areas are limited. In addition, soil conditions in most peri-urban settlements are often too rocky or too steep, contain too much clay, or have too high a water table to make latrines feasible.

2.9 Discussion on sanitation ladder

2.9.1 Description of how to move up the ladder

Refer to adjacent table 9.

2.9.2 Prioritizing the above options

The preferred household-level sanitation technology has to be affordable. If it is not, then clearly it is inappropriate.

The sanitation ladder above shows the sanitation options. These options can be given rating in regard to the hygiene conditions and the appropriateness in the community. The bush and cat methods are discouraged under all conditions. However, if it is the only option available, the cat method has a better hygienic consideration than the bush method. For rural settings, the ventilated improve pit latrine should be encouraged and if there is adequate water then the flash toilets should be encouraged. In urban set up, the flash toilet and the VIP latrines should be encouraged.

VIP toilets, when correctly designed and constructed, offer an affordable and practical sanitation option to the majority of rural and peri-urban communities.
While constructing a good sanitation and hygienic household latrine, one should keep in mind that the toilet

- should be easy to clean.
- should not encourage flies.
- should be child friendly.
- should be at least 10m from the house but should be easily accessible especially at night.
- should provide privacy.
- should have a firm floor, a good supper structure and a weather proof roof.
- should have a hand washing facility.

2.10 Implementation of the construction of a pit latrine

If there is no municipal sewage system, and if the installation of a local wastewater system is not possible, pit-type latrines are a suitable option.

2.10.1 Design

A checklist of factors to be considered while siting and constructing sanitation facilities is given in Annex V.

- **Minimum standards and specifications**

A family pit latrine should be about 1 .2m diameter, or square, (the smallest dimension that can be dug conveniently), with the pit wholly above the water table. It should be at least three metres deep and, if necessary to attain this depth, the floor level of the building above it should be raised above ground level.

Choose a site which is not going to flood. When digging a pit, leave at least 1.5 metres (between the bottom of the pit and the top of the water table.

For hygiene purposes, there should be a source of soap and wash water near all latrines. In a wilderness setting, with few people, feaces can simply be buried shallowly in the soil, at least 30 metres from water. This way the excreta will be broken down by soil organisms easily.

An example of the requirements of construction of a simple pit latrine using the Sanplat is given in Annex III and specifications and basic requirements for a VIP latrine are in Annex IV.

- **Guidelines on how to compute the minimum dimensions for a pit latrine**

The amount of faeces that each person produces per day varies widely based on diet and other variables. A good general estimate is to assume that one person will give 0.04 m^3 of solids per year. (The water content is less important, since it will drain out or evaporate).
So for 25 people, you will need a pit volume of at least $1m^3$ per year of use. (25 x 0.04 m^3 = 1.00 m^3).
Thus for a toilet of 25 people to last 20 years the minimum dimensions should be 1m wide x 2m wide x 10m deep.
In a school with 500 hundred students, a set of 20 such latrines will be needed.
Leave an additional 50 cm of depth from the surface in calculating the pit volume. This space will be needed to put dirt back into the pit once full, so make sure to set the dirt aside in a pile to put back later.

Table 10: Summary of minimum dimensions of latrines and rubbish pits

		Width(m)	Length(m)	Depth(m)	Distance from dwellings(m)	Distance from water points (downstream)
Latrine	Households	1	1	10	50	30
	Schools	1m	2m	10	50	30
Rubbish pit	Households	1m	1m	3m	100m	50
	Schools	1m	3m	5m	100m	50

- **Why sanitation in schools**

Water supply, sanitation and hygiene factors are reasons for low female school enrollment and attendance. These factors include inappropriate school sanitation, total lack of toilets/ latrines, lack of water and lack of privacy.

A focus on gender differences is particularly important with regard to sanitation facilities. Often the availability of latrines in schools can enable girls to get an education, particularly after they reach puberty, by providing privacy and dignity. It is particularly important that the public institutions with the most extensive and sustained public outreach - schools and health centre -should become learning and demonstration centres for good hygiene and its benefits.

- **Optimal standards for sanitation at school**

Excreta disposal facilities in schools need to be sufficient for the number of students and staff members. Separate blocks for male and female students should be provided. Separate facilities are also commonly built for male and female staff.

Sanitary urinals for boys should be provided separately, be independent of the toilet seats, and be designed for more intensive use. Washing facilities should be available at these places.

Box 3: Recommended sanitation facilities for school

Optimal standards for sanitation at school:

- Girls: One toilet cubicle for 25 girls.
- Boys: One toilet cubicle for 100 boys and one urinal for 40-60 boys.

There are a number of key points to be addressed when planning sanitation for schools:

- Hand washing basins with clean water and soap must be provided in each toilet block.
- Toilet facilities should be cleaned with soap or disinfectant at the end of every day. Cleaning duties can be the responsibility of the students, operating on a rotation basis. If this is done, then a member of staff should supervise the students to ensure that the toilets are cleaned properly and the students wash their hands properly when they are finished.
- Provide special wash rooms for girls, especially during their menstruation periods.
- Provide toilets which afford easy access to the disabled children in schools.
- Refuse must be disposed of safely. Bins with well-fitting lids or sacks are the most appropriate containers to prevent flies and vermin from being attracted to refuse. Refuse must be removed regularly and disposed of safely.
- There are many different types of excreta disposal facilities. The needs of the users and the resources available should be carefully considered to ensure that the most appropriate type of sanitation is selected. These facilities can range from ventilated improved pit (VIP) latrines to modern flushing toilets (where sewerage systems are available).

Schools can be instrumental in promoting different types of sanitation. Students can be involved in the design and implementation of sanitation construction projects. They can also take part in health education by designing posters and notices to reinforce hygiene education messages. Hygiene education should be part of the school’s comprehensive health education programme in order to ensure that all students are aware of the risks of poor sanitation and hygiene, and to help them develop good hygiene practices.

Inspections of school water and sanitation facilities
A sanitary inspection is an on-site inspection of the school facilities to identify actual and potential sources of contamination. The physical structures, the operation of the system and external environmental factors (such as latrine location) are evaluated. This information should be used to select appropriate remedial action to either protect the system or improve it.

Inspections of school water and sanitation facilities should be regularly conducted by a suitably trained person using a simple, clear reporting form. Such forms typically consist of a set of questions structured so that "yes" answers indicate that there is a risk of contamination and "no" answers indicate that the particular risk is absent. The reporting forms can be pictorial to enable them to be easily understood. Such forms and guidelines for the interpretation of results should be established for each different context. The results of such inspections should be communicated to the authorities responsible for sanitary inspections in order to initiate remedial actions, including a more comprehensive survey.

- **Minimum distances of latrines to other facilities**

Due to potential groundwater contamination, latrines should be a minimum of 30 metres downstream from any well, body of water, or potential drinking water source (though this is less of a problem with most composting toilets). The World Health Organization recommends a distance of at least 50 metres from water. They should also be a reasonable distance from dwellings-no less than about 5 metres (because of possible smell problems) or more than 50 metres (for convenience). Latrines should also be downwind of dwellings, especially the improvised types. When digging a pit, leave at least 1.5 metres between the bottom of the pit and the top of the water table. There should be a source of soap and wash water near all latrines.

- **Location of sanitation facilities considerations**

Benefits of gender approach in sanitation
1. Improved access to acceptable sanitation.
2. More sustainable sanitation benefits.
3. Improved protection of water resources.

Health impacts of sanitation to gender
- When women do not have access to proper sanitation, they often restrict themselves from visiting latrines and toilets by reducing and controlling their diet. This leads to nutritional problems.

Cultural limitations of sanitation for women

- Women and girls access to sanitation is limited, as they have restricted mobility in many cultures, which reduces access to facilities. Women and children face higher risks of sexual assault when they are looking for privacy to defecate. This risk is also increased in the absence of sex-separated facilities in schools.

It is necessary to incorporate sanitation improvements into rural water supply projects, if the good drinking water source is to be secured from community's waste. A copy of the checklist for siting sanitation facilities is given in Annex VI.

Module 2: Technologies & Approaches to WASH

UNIT 3: HYGIENE

3.0 Introduction

In general, hygiene is the maintenance of healthy practices. It is usually regarded as cleanliness. Outward signs of good hygiene include the absence of visible dirt, including dust and stains on clothing or of bad smells. Hygiene has further come to mean any practice leading to the absence of harmful levels of bacteria.

Good hygiene is an aid to health, beauty, comfort and social interactions. It directly aids in disease prevention and/or disease isolation. Good hygiene will help keep you healthy and thus avoid illness. If you are sick, good hygiene can reduce your contagiousness to others.

Water, sanitation and health are inseparably linked. Diarrhoea and other water related diseases are the major causes of health problems in developing countries. Although the need for water and sanitation interventions for health promotion has been recognized, these are labeled as costly and are often neglected in the primary healthcare programmes. Lack of proper water and sanitation initiatives based on appropriate techniques, technologies, knowledge and/or implementation methods have hindered the expected achievements through water and sanitation interventions. Since water and sanitation initiatives include both availability of provisions and their effective use (which mean behavioral changes), they are technically and socially challenging. Disasters and emerging water quality problems, such as arsenic in groundwater, have further been complicating this situation. After reviewing relevant articles, several research issues are suggested in the context of developing country perspectives.

3.1 Software aspects - water, sanitation & hygiene

Technical and managerial skills of the Red Cross and Red Crescent staff in WASH (Water and Sanitation and Hygiene) programming should be a common objective in all the Red Cross and Red Crescent water and sanitation programs. This will strengthen national capacities in responding to water, sanitation and hygiene needs.

The targeted community should be the key partner in this approach. As many beneficiaries as possible should be involved in conception, planning, as well as implementing activities in order to give them a voice in decision making. This is especially relevant because the ownership of the project should be with the community, and the process of decision-making should be taken by the participation of all stakeholders.

The actions should strengthen and build upon existing technical and managerial capacities while addressing gaps. The water and sanitation staff and community water and sanitation committees should address and target financial management and technical skills, willingness to pay, conflict resolution and problem solving. These committees should be recognized as the leader of the implementation process and become the organ responsible for the overall maintenance and sustainability aspects.

The use of the PHAST methodology supports the success and sustainability of the project by increasing hygiene awareness within communities. Through this process, targeted communities are able to examine existing hygiene behavior and understand how transmission of diseases take place and how transmission can be prevented at household level. The community is given the opportunity to evaluate current behavior and facilities and decide which appropriate sanitation and hygiene improvements they wish to undertake.

Other PHAST concepts include:
1. The concepts of community and community participation as key to the PHAST approach.
2. The meaning of, and difference between, participatory methodologies and participatory tools, to enable participants understand that each method has a set of techniques (tools) which can be adapted to suit a specific situation while retaining the basic concepts of the method(s).
3. Facilitation skills and techniques.

3.2 Definition of hygiene

Hygiene is the study of health and observance of health rules and measures of preserving health. This involves the 5 areas of health also commonly known as 5 hygiene domains. These include, personal hygiene, water uses and sources, protection hygiene, food hygiene, domestic and environmental hygiene, disposal of animal and human excreta hygiene.

3.3 Hygiene linkage with health

Table 11: Hygiene domains

Hygiene domain	Relevant conditions and practices
Personal hygiene	Regular washing of the body Keeping hair clean and combing it Brushing teeth daily Keeping nails short
Sanitation (excreta disposal)	Location of defecation sites Latrine structure and cleanliness Disposal of children's faeces Use of cleansing materials Number of users of facilities Sanitation habits of different groups
Water sources	Placement of latrines in relation to water sources Different water sources used, and daily and seasonal patterns

Hygiene domain	Relevant conditions and practices
	Protection of water source Maintenance of water source(s) Water quality at source and home Water storage practices (collection methods and utensils used) Methods of water treatment at source Methods of transporting water. Previous experience of water source management
Water uses	Average distance to water Water handling in the home Water use and re-use in the home Hand washing (including religious rituals) Bathing (children and adults) Clothes washing Amount of water used per person per day
Food	Food handling and preparation Food storage practices Food reuse practices Breast-feeding, weaning practices and beliefs Washing and drying of utensils
Environment and domestic hygiene	Household refuse disposal Disposal of household wastewater Condition of storm water drains Management of domestic animals Evidence of stagnant water around dwelling or water point Vector control problems Slaughtering facilities Burial of the dead

3.4 Illustrations on the five hygiene domains

Different hygiene conditions and practices

Food handling and preparation:

1. Keep food in a clean place.
2. Keep food out of the reach of children and animals.
3. Keep food in a cool place out of direct sunlight.
4. You should wash your hands with soap and water
   - after using the latrine/defecating.
   - before cooking.
   - before eating or feeding children.
   - before breastfeeding.
   - after touching animals and poultry or any kind of dirt.
   - after eating.

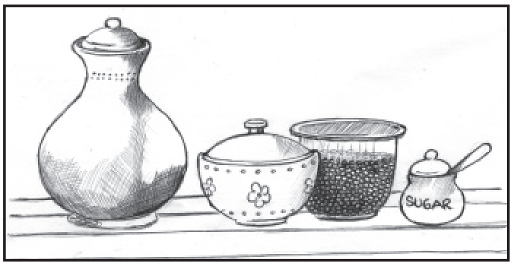
Figure 6: Hand washing

How to store your food properly

How to keep your food clean.

1. Keep food in a clean place.
2. Keep food out of the reach of children and animals.
3. Keep food in a cool place out of direct sunlight.
4. Keep food covered and in clean containers.
5. Keep plates, cooking pots and utensils clean.
6. Wash hands with soap and water before cooking.
7. Keep fingernails short and clean.
8. Teach children not to touch food while you are preparing it.
9. Keep all food scraps and waste in covered containers.
10. Provide compost pit.
11. Make sure that insects and other pests cannot get into food stores.
12. Wash all raw vegetables and peel or wash fruit in clean water.

Figure 7: Food storage practice



How to keep drinking water clean

1. Keep drinking water in a clean container, such as a bucket, in a clean place.
2. Keep the container off the ground, away from children and animals.
3. Keep the container against a wall, away from windows and the cooking area.
4. Always keep a clean cover over the container, even when it is empty. Clean the cover every day, with boiling water if possible.
5. Rinse the bucket or other container for drinking water inside and outside each time it is empty.
6. Always use the same container, such as a mug, to take water out of the bucket. Do not use this container for any other household tasks.
7. Pour the water from this container into a clean cup (or clean hands) for drinking.
8. Never put hands or fingers into the drinking water bucket.
9. Do not put hands or fingers into the cup: hold it on the outside or by the handle if it has one.

Figure 8: Cleaning utencils

Figure 9: Handling drinking water

10. Keep the mug upside down on top of the cover.
11. Make sure that the container has no leaks or cracks, and that the lid completely covers the mouth of the container.

How to keep the community well water supply clean

1. Dig wells at least 30 metres away from latrines.
2. Build a head wall around the well and provide a fence around the well.
3. Do not stand on the wall while constructing.
4. Put a cover on the well.
5. Use only one container to draw water. This container should never touch the ground.
6. The person drawing water from the well should touch only the handle and the outside of the bucket.

Figure 10: Constract a head wall around the well.

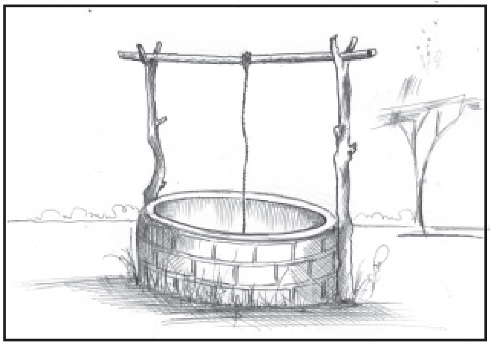
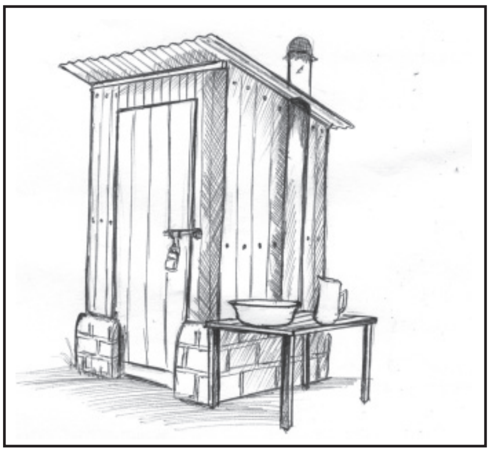


Figure 12: Drawing water using a hand pump

How to keep your latrine clean

1. Clean the walls, floor and door of the latrine regularly.
2. Wash out the latrine regularly if there is enough water.
3. Clean and wash the seat (if there is one) with soap and water.
4. Fill in any cracks in the walls, floor, door and roof, and keep them in good repair.
5. Put ashes down the latrine regularly.
6. Do not put rubbish on the floor.
7. If there is no standpipe, keep a pot of water (and some soap, if possible) near the latrine for hand washing.
8. Make sure the latrine is properly ventilated.
9. Cover the latrine vent with a fly screen.
10. Teach all children how to use the latrine properly.
11. Wash hands with soap and water after using the latrine.

Figure 12: Pit latrine

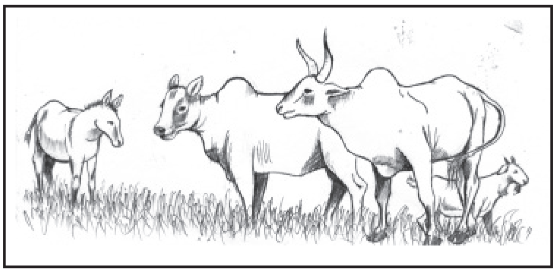


How to keep your neighbourhood clean

Action for the household to take:

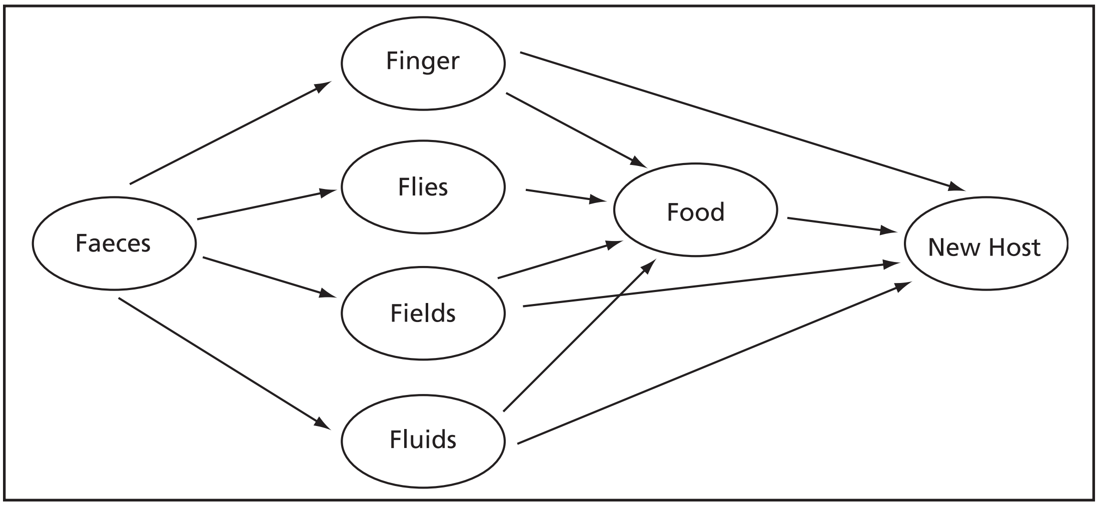
1. Put all animal and human excreta into the compost pit, and teach children to use the latrine. If there is no latrine, bury or burn excreta.
2. Keep the latrine clean at all times.
3. Put all food scraps into a special container which is covered and kept out of reach of children and animals.
4. Food scraps can be fed to domestic animals.
5. If animals are kept, keep them penned or fenced in.
6. Put all garbage in a container in a safe place away from children: keep it covered to keep out flies and rats. When it is full, take it to a special pit or dump, where it can be composted, buried or burnt.
7. If the community does not have a communal rubbish pit, dig a pit for the family, away from the water source, and fence it off.
8. Fill in holes on the floor, on the street, and close to the home.
9. Dig drains to carry away water.
10. Keep the area around the home clean and free from garbage.
11. Make a special area where the family can bathe.

Figure 13: Domestic animals



3.5 Feacal oral routes

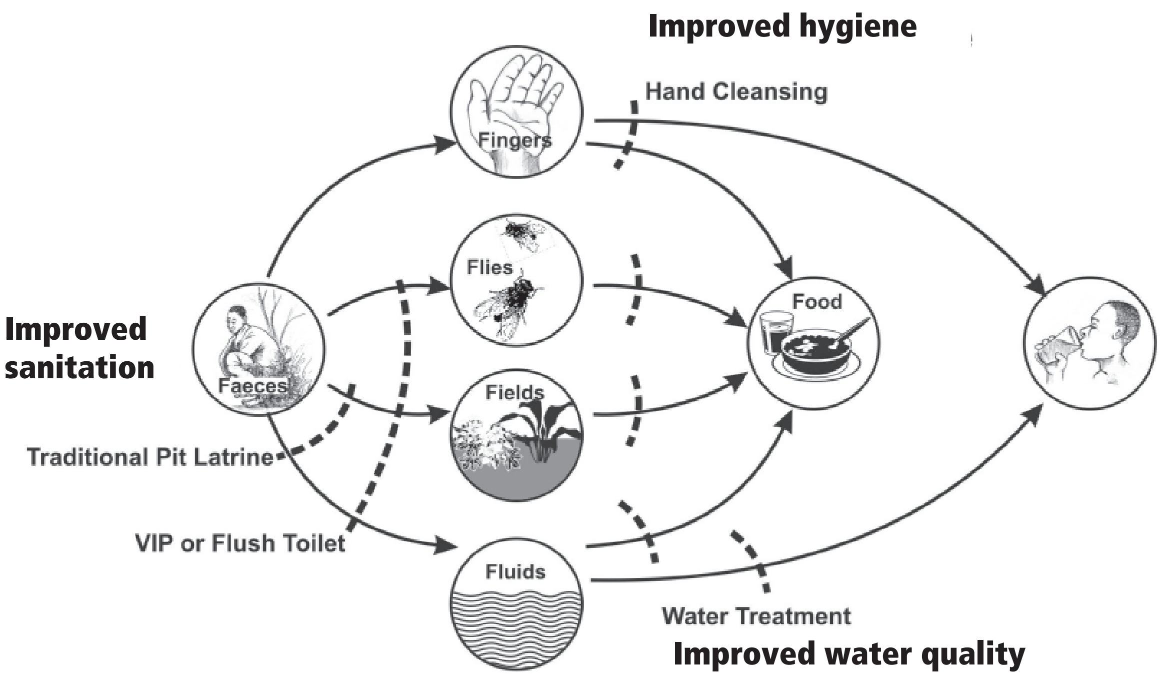
Figure 14: different routes that mircrobes of diarrhoea take



The above diagram is the famous f-diagram, which shows the different routes that microbes of diarrhoea take from faeces, through the environment to a new person. This diagram illustrates the way through which microbes are transferred from the faeces to a new host.

Diarrhoea diseases are normally transmitted from one person to another through consumption of contaminated foods and fluids. There are a few good hygiene practices that can be put in place to eliminate food contamination.
These are:
1) Proper use of latrines/toilets.
2) Flies control through spraying.
3) Hand washing with soap and water.
4) Washing fruits before eating and cooking. These practices that eliminate the risk of transmission are shown in the diagram below.

Figure 16: The barrier diagram



3.5.1 Simple and effective measures to prevent diarrhoea
This activity helps the group to analyze the effectiveness and ease of actions to block transmission routes and to choose which ones they want to carry out themselves. After wards, they are able to design a barrier chart. The focus of the activity is on actions already analyzed based on if they are easy and effective options for preventing diseases based on the previous exercise of faecal oral routes or any other transmission blocking tool.
The following are the advantages:
- Easy to communicate.
- Simplicity of the action, does not require external expertise.
- Local resources are available.
- Easy to adapt.
- Not time consuming.
- It is not foreign.

Effectiveness in relation to how effective the action is in reducing diarrhoea
Some actions may be considered to be hard to do because they need a combination of both household and communal support i.e. cleaning the environment and proper drainage. To be able to undertake this activity easily it is advisable to address each column individually. Either looking at the ease of the activity first then the effectiveness of the action.

Table 12: Effective measures to prevent diarrhoea

Example of Barrier chart for diarrhoea			
	Effective	**In between**	**Not effective**
Easy to do	Proper hand washing Boiling milk Washing utensils Cooking food properly Proper disposal of children's faeces Covering food	Washing vegetables	
In between		Boiling water Spring protection	
Hard to do	Building latrine Proper drainage system	Insecticide	

3.5.2 Safer disposal of faeces, maintaining drinking water free from faecal contamination[18]

According to the World Health Organization (WHO), the following three hygiene behaviours lead to greatest reduction in diarrhoea morbidity:

- Safer disposal of faeces, particularly faeces of young children and babies and people with diarrhoea.
- Hand washing, after defecation, after handling babies' faeces, before feeding and eating, and before handling food.
- Maintaining drinking water free from faecal contamination, in the home and at the source.

3.5.3 Hand washing

Hand washing is the single most effective way to prevent the spread of infections. You can spread certain "germs" (a general term for microbes like viruses and bacteria) casually by touching another person. You can also catch germs when you touch contaminated objects or surfaces and then you touch your face (mouth, eyes, and nose).

[18] adapted from Howard, G et al, (2002) a guide for communities and community Health Workers, WHO, Geneva, Switzerland (chapter 9)

Proper hand washing steps at critical times:
1. Place your hands together under water (warm water if possible).
2. Use soap or ashes.
3. Rub your hands together for at least 10-15 seconds. Wash all surfaces thoroughly, including wrists, palms, backs of hands, fingers, and under the fingernails.
4. Clean the dirt from under your fingernails.
5. Rinse hands.
6. Dry your hands completely with a clean towel if possible (this helps remove the germs). Pat your skin rather than rubbing to avoid chapping and cracking.
7. If no clean towel is available, air-dry hands.

3.6 Sanitation promotion

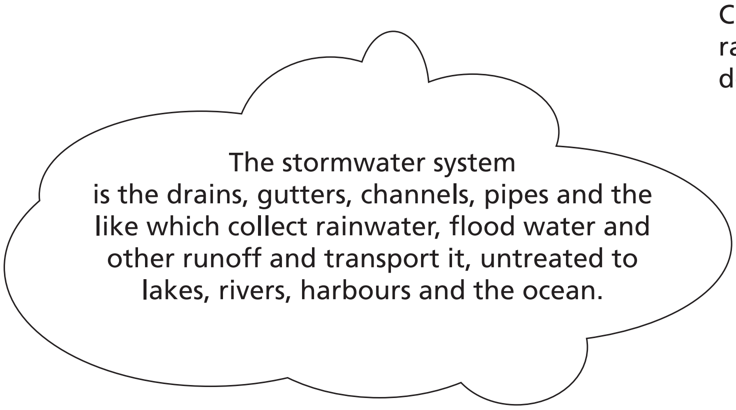
Environmental hygiene conditions and practices

Box 4: Condition of storm water drains

> **Storm water defined:**
>
> Storm water is water from rain or melting snow that does not immediately soak into the ground. Instead storm water flows across hard surfaces such as parking lots, streets, lawns and roofs and picks up pesticides and fertilizers, sediment, pet waste, cigarette, butts, litter, oil and other pollutants.

Figure 17: storm drains

Community refuse disposal
Clean the drains before rains by removing any debris, litter.



There are only two ways of disposing waste: The waste is either converted into something or it must be stored. The first option involves such technologies as incineration, composting, recycling, or partial reclamation. Storage is generally limited to storage on land, though the dumping of unpolluted solid waste into the water system is still occasionally practiced.

Disposal of household waste water
To reduce the risk of waste water contaminating water supplies, disperse the domestic effluent and maximize its contact with soil and plant roots.

Examples of factors which hinder hygiene and sanitation promotion:

- Cultural factors which negate the use of safe hygiene practices.
- Lack of economic means.
- Laziness and poor planning.
- Low levels of awareness and illiteracy.

3.6.1 Hygiene promotion versus education

Hygiene promotion encourages all the hygienic conditions and behaviours that can contribute towards good health. It aims to stimulate and facilitate the right behaviour changes. Usually, it starts with systematic data collection to find out and understand what different groups of people know about hygiene, what they do, what they want and why this is so. The results are used to set objectives and to identify and implement activities that enable the different groups to measurably reduce risky conditions and practices and to strengthen positive situations and behaviours.

Hygiene promotion is more specific and more targeted than health promotion. It focuses on the reduction - and ultimately the elimination - of diseases and deaths that originate from poor hygiene conditions and practices. For example, good hygiene conditions and practices are enhanced when people can consume water that is safe, use sufficient amounts of water for personal and domestic cleanliness, and dispose of their solid and liquid wastes safely.

A person may have good hygiene behavior, but not be healthy for other reasons. Good or bad health is influenced by many factors, such as the environment (physical, social and economic). For example, in social environments where people are marginalized because of their gender, economic status or religious affiliation, and have no influence whatsoever on decisions that affect their daily lives, they are likely to be prone to anxiety or depression, which can lead to mental problems.

Hygiene education usually means teaching people, e.g. about what makes them ill and what they must or must not do. Often it is didactic. In the case of hygiene education for example, the educators may want to teach people the germ theory of disease in order to discourage transmission through unhygienic practices. Such information has its place, e.g. when people themselves want to know how they can avoid getting a particular disease. However, successful promotional programmes do not 'instruct' people. They promote healthy conditions and practices in other, usually more effective, ways than 'teaching', e.g., by improving access to the means for better hygiene and health, social marketing, participatory learning and peer influence. In hygiene promotion, the individuals and communities themselves review their hygiene practices and develop ways of improving them.

Many hygiene education programmes focus on increasing people's knowledge. Planners and implementers assume that when people know better how water and sanitation diseases are transmitted, they will drop unhygienic practices and adopt improved ones.

However, this is often not the case. Increasing people's knowledge does not automatically lead them to change behaviours.

Cigarette smoking is a typical example. Although people generally know that it is a danger to health, a large number of people all over the world are still smoking, even health practitioners - doctors and nurses themselves.

To be able to develop interventions to promote hygiene behavioral change, planners and implementers need to take account of why people act as they do and what people think and understand about hygiene. In other words, they need to know the insiders' view.

Most of the health benefits of water supply projects stem from changes in hygiene behaviour. While access to hardware itself can sometimes induce changes (such as increased water consumption), it is cost-effective to devote some resources to promoting the better hygiene behaviours that the new facilities make possible, and that have greater health impact than the hardware alone.

Research shows that hygiene-related practices such as safe disposal of faeces and hand washing after contact with faecal material can reduce the rates of intestinal infection considerably.

3.6.2 Hygiene promotion through a Social Marketing Approach

Hygiene promotion is a planned approach to preventing diarrhoea diseases through the widespread adoption of safe hygiene practices. The underlying principle behind it is that improvements in water supply systems and sanitation (called the hardware) will not result in change in disease patterns unless behavior change too is emphasized. For behavior change to be permanent, people must want to change because they see perceived benefits in doing so.

Hygiene promotion then, seeks to market 'what is liked' about certain behaviour changes to communities with a view of creating demand for the facilities. This has a double advantage: the first is that health and socio-economic benefits are experienced due to behaviour change: the second is that, facilities i.e. hardware, will be seen as important to the community and they would be more willing to maintain and pay for the services that they get from it, making projects more sustainable.

Key components of social marketing:

- Systematic data collection and analysis.
- Creating products/services that respond to the felt needs.
- Strategic approach to promoting the product/service/behaviour.
- Method of effective distribution so that when the demand is created, consumers know where to get the product.
- Improving the adoption of products/service with the willingness of consumers to contribute.
- Pricing so that service is affordable. Price goes beyond money, cultures / value systems and these must not be compromised when advocating for change.

Just like in commercial marketing, social marketing operates using the 4 Ps:

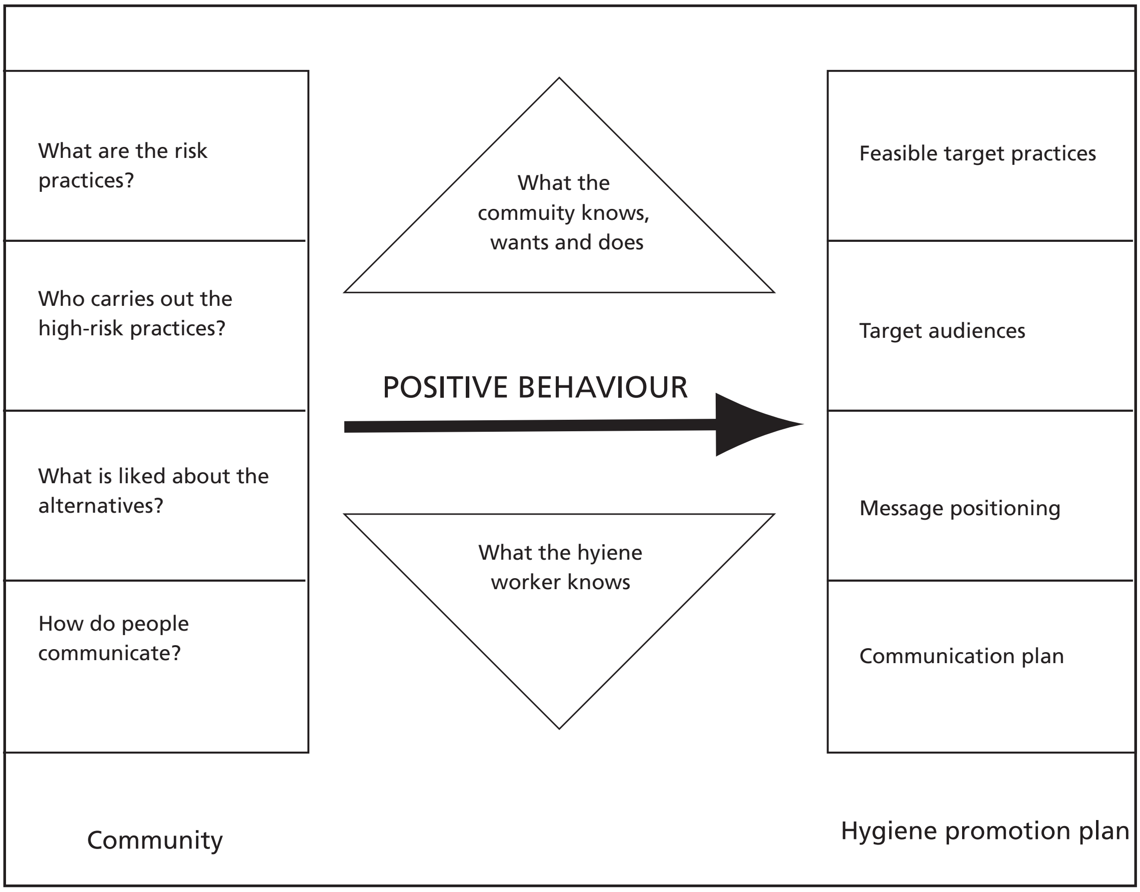
- **Product** - Decide what the product is, in what form and how it will be presented.
- **Price** - What people will pay in terms of money, in kind or change in terms of culture.
- **Place** - Where the product will be located.
- **Promotion** - How everyone else will know about the product / service and begin to use it.

The messages developed to facilitate behaviour change must not be too many. Key messages should be developed and focused on specific people. The audience targeted should be that which is deemed to be at the greatest risk of a particular negative behaviour. This is the primary audience, which can vary depending on the message. For instance, for hand washing after contact with faeces, the primary audience may be mothers and other caretakers who may come into contact with faeces especially children's. On the other hand, messages on how to construct latrines would primarily target men (in cultures where men do the construction). Secondary audiences are people who would influence behaviour for instance husbands, mothers in law etc. Tertiary audiences are also called opinion leaders, for instance religious leaders and politicians.

In targeting practices, it is important to understand transmission routes. Faeces are the main source of diarrhoeal pathogens and messages that stop faecal material from contaminating the domestic environmental are vital. Priorities then would include hand washing with soap after contact with faecal matter, safe disposal of stools particularly those of children and safe water source and proper food and water handling and storage.

Message positioning is a process that involves the selection of positive values that a primary target audience associates with target practices. For instance, if latrine use is valued for self respect and dignity, then the messages should be worded towards this goal and will ultimately result in better hygiene. Once the target practices and audiences are agreed upon, short and repetitive messages are communicated through acceptable and affordable channels.

1. Hygiene promotion is founded on knowledge of key aspects of what people know, do and want. It is incorrect to assume that adults do have their own notions of cleanliness and what causes diseases. The germ theory is not always accepted as the only explanation for disease.
2. Hygiene promotion uses repeated, coherent and simple messages. These are disseminated through a mix of communication channels designed to reach target audiences for the greatest effect at the least cost. This will work because adults rarely have the time or motivation to learn new ideas especially using school teaching /didactic methods.
3. Because new knowledge does not equal new practice, hygiene promotion is based on what people can do and want to do. It works to find solutions rather than problems.
4. Hygiene promotion is built by providing simple, attractive alternatives to a few common risk practices. The process is systematically planned and monitored and the impact on the targeted behaviour is measured.



The process of promotion
These include a wide range of practices that promote health, and prevent catching and spreading water and sanitation related diseases. Health-related behaviour is partly determined by a complex mix of the people's knowledge, beliefs, attitudes, norms and customs. Socio-economic determinants and even political factors also play important roles. Without the resources to construct and maintain water supply and sanitation facilities, it is difficult to attain levels of personal, domestic and environmental hygiene conducive to health. Resources relate not only to money, but also to the availability of land, time, materials, and technical and management skills for achieving improved facilities.

Hygiene promotion begins with and is built upon what local people know, do and want. It seeks to answer five key questions:

1. Which specific practices are placing health at risk? Identify SMART objectives with regard to the risk practices.
   The acronym SMART stands for:
   SPECIFIC
   - Well defined.
   - Clear to anyone that has a basic knowledge of the project.
   MEASURABLE
   - Know if the objectives are obtainable and how far away completion is.
   - Know when it has been achieved.

ACCU RATE

- Agreement with all the stakeholders what the objectives should be REALISTIC
- Within the availability of resources, knowledge and time TIME BASED
- Enough time to achieve the objective.
- Not too much time, which can affect project performance.

2. What could motivate the adoption of safe practices? What does the community know and want to do to change to the safe practices?
3. Whom the programme should target? Identify your primary and secondary audience as well as opinion leaders.
4. How can one communicate with these groups effectively? What will we say to the audience? The messages need to be short, few and focusing on positive aspects of the safe practice to be adopted. What channels shall one use?
5. How do we measure success?

3.6.3. The target audiences for hygiene promotion/education

The community is made up of many different groups. For maximum efficiency and impact, there is need for larger audience to be educated on unsafe practices. Each group may need to be addressed separately, e.g. house-to-house visits to reach mothers and other careers of small children such as older brothers and sisters or grandparents. Street theatres and focus group meetings may be a good way to reach fathers, and public meetings with a video show and discussions will perhaps suit opinion leaders. It is also important to ensure support for the programme from authorities and collaborating agencies: they may also be an audience to target.

Table 13: Audiences for hygiene promotion

Target audiences - or who the project needs to contact
• Primary target audiences are those people who carry out the risk practices, e.g. mothers handling baby’s faeces: adult men: male adolescents, who may use latrines less than women and girls.
• Secondary target audiences are those who influence the primary audience and who are in their immediate society, e.g. fathers, mothers-in-law. In drought-prone areas, fathers and mothers-in-law tend to criticize wives and daughters (in law) when they use more water for hygiene: so changing the attitudes of these secondary target groups needs to be included in the hygiene promotion strategy.
• There is a third target audience, which is very important: people who lead and shape opinion, e.g. schoolteachers, religious leaders, political leaders, traditional leaders, and elders. These people have a major influence on the credibility and hence on the success or failure of the programme.

3.7 Design of a community hygiene intervention program[19]

Figure 16: Alternative 1: Steps for hygiene intervention program design

Carry out stuation analysis

- Identify risk practices.

↓

Select practices for intervention

- Identify wide spread risk processes.
- Identify risk practices that can be altered.

↓

- Identify motivating factors for safe practices.
- Identify the comunities perception of safe practices.

↓

Define the target audiences:

- Identify those who practice risk practices.
- Identify who influences the community in primary education.

↓

Select communication channels:

- Identify modes of communication in the community.
- Identify the trusted channel of communication.

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Figure 17: Alternative 2: Steps for hygiene intervention program design

Initiate action
Define target area, make outline plan, arrange for funding, set up the team, hold a planning workshop, contact the communities and build a network.

↓

Make a detailed formative research plan
Make a list of questions, choose methods to answer each question, put it all together and train the research team.

↓

Carry out the research
Identify risk practices, select practices for interventions, determine the messages, define target audiences, and identify the communication channels.

↓

Analyze research results, report and feedback

↓

Make communication plans
Behavior change objectives, target practices, target audiences, message positioning, Channels of communication, communication materials and monitoring and project management budget.

↓

Step up and run the project
Pilot test and revise everything, carry out a baseline survey, set up supervisory and monitoring, evaluate the project.
Easy to do practices to another community.

Module 2: Technologies & Approaches to WASH

UNIT 4: EMERGENCY WATER AND SANITATION

Emergencies and disasters fall into two major categories, natural or man made. Depending on timeframe, they can be further classified as sudden or slow onset.

Rapid and slow onset disasters require a different approach to mitigate the negative impact on the health of affected communities. The response in disaster situations must be appropriate and aimed at saving lives or alleviating human suffering within the shortest time possible. Deployed staff should be aware of the SPHERE standards in service provision to the affected population. It is important to avoid situations, in which teams arrive with high-technology equipment, remain for only short periods of time, and then withdraw without making adequate exit strategies, which may give way to dealing with the more chronic WatSan problems. Sophisticated equipment for water-supply systems or vector control is useless in the longer term if supplies of spare parts are not continued, qualified repair and maintenance staffs are not available locally, and local people are not properly trained to operate the equipment. Proper hand over of deployed equipment to local stakeholders is important.

Disasters and emergencies therefore, precipitate a situation where WatSan infrastructure is destroyed, over-burdened or non-existent and an appropriate response is therefore required in order to:

- Protect public health from:
  - Unhygienic conditions
  - Contaminated water
  - Spread of vectors
  - Secure development and economic activities
  - Protect the investment in WatSan infrastructure

Within the Red Cross and Red Crescent, a response in water, sanitation and hygiene usually encompasses the following package, either in whole or part depending on the situation on the ground:
- Water supply
- Hygiene promotion
- Excreta disposal
- Vector control
- Solid waste management
- Drainage, mainly around camp and residential areas to flush off stagnant water pools

The key to responding in emergencies and disasters is to quickly and effectively mobilize existing resources to undertake the following:

- Lead a rapid assessment of the emergency situation through existing staff (emergency response teams) and partners who are already in position and familiar with conditions at the site of the emergency.
- In consultation with partners, decide whether or not the deployment of existing resources is sufficient to adequately address the emergency situation.
- Temporarily re-direct project equipment, materials and staff to respond to the emergency.

Priorities in emergency phase response include

- Assessing the vulnerability of critical WatSan components.
- Defining how systems will operate during emergencies.
- Developing a plan for restoring services promptly during the emergency.
- Ensuring that water supplies are protected from contamination.
- Ensuring there is at least a minimum amount of water for drinking, cooking and personal and domestic hygiene.
- Protecting water supplies from contamination.
- Providing a minimum amount of water for drinking, cooking and personal and domestic hygiene.
- Ensuring that people have enough water containers to collect and store water cleanly.
- Ensuring that people have sufficient cooking utensils, equipment and fuel to cook and store food safely.
- Ensuring that people have the knowledge and understanding they need to avoid diseases.
- Clean up and control free defecation.

Response sequence in displaced large populations in order of priority - based on careful assessment

Water supply

- Water trucking by private or Red Cross/Red Crescent trucks.
- Rehabilitation of existing water supply systems.
- Construction of new water sources and laying of water collection points.

Sanitation

- Defecation fields combined with the cat method and hand washing facilities.
- Trench latrines, with hand washing facilities.
- Communal pit latrines and bathing facilities.
- Individual household latrines.

Hygiene promotion

This is the planned, systematic attempt to enable people to take action to prevent or mitigate water and sanitation related diseases. It provides a practical way to facilitate community participation and accountability in emergencies through:

- Community and individual action through consultation and involvement.
- Participatory design and location of facilities and maintenance of WatSan facilities.
- Selection and distribution of hygiene kits.

Vector control

An intervention is critical in an emergency situation as:

- The movement of people into endemic areas of non- immune human populations increase the number of people at risk.
- Environmental changes with natural causes (e.g. floods, droughts, rising temps) result in an increase in vector populations.
- Human activities with impact on environment, e.g. agricultural practices that create conducive environment for vectors.
- Pattern of living: Population density/over crowding. Broad categories of vectors include:
  - Harmful: Cause nuisance, discomfort, loss of blood by their bites (mosquitoes, bugs, flies).
  - Ectorparasites: Live and feed permanently on the exterior of hosts without transmitting diseases. (head lice, pubic lice).
  - Mechanical transporters: Transmit diseases passively by picking infections from faeces and then contaminating human food (cockroaches, flies).
  - Vectors: Actively transmit parasitic disease causing organism. The pathogens develop and multiply in the vector and are transmitted into humans via bites. (mosquitos, tsetse flies, fleas, body lice).

Common pesticides

- Organochlorines
  - e.g. DDT, Dieldrin
  - residual effect of six months
  - some insects developed resistance
- Organophosphates & Carbamates
  - e.g. malathion, fenitrothion, temephos
  - residual effect of two to three months
  - moderately toxic to mammals
- Pyrethrins
  - are quickly broken down when exposed to light, moisture, air
  - no residual effect
  - natural extracts of Chrysantemum Cinerariaefolium flowers.
  - replaced by synthetic pyrethroids
- Synthetic Pyrethroids
  - e.g. Deltamethrin, permethrin- (deltamethrin is commonly used in the Red Cross and Red Crescent interventions)
  - not so quickly broken down
  - residual effect of two to three months

Precautions

It is the obligation of the officer in charge of a vector control program to enforce the following precautions:

- Spray personnel MUST be properly instructed and fully trained in pesticides use.
- Workers' faces must be protected and they MUST wear rubber gloves.
- They MUST receive detergent and soap (each week/ enough) for bathing and washing their working clothes.
- Their working clothes must cover the entire body, must be removed immediately after use and frequently washed.
- Workers must not spray for more than 4- 5 hours per day.
- Spraying must be supervised.
- Insecticides must be handled using spoons, mixed with sticks in basins having handles.
- Workers must take a shower with soap after each days work, or after any instance they get into contact with insecticides.
- Equipment must be kept in good working conditions, tested and approved before use.

ON THE SPOT EMERGENCY TREATMENT SHOULD BE AVAILABLE INCASE OF CHEMICAL POISONING. IN CASE OF EMERGENCY, IT IS WISE TO LOOK FOR MEDICAL ASSISTANCE.

Basic computations

- Number of shelters to treat say 200.
- Average surface area of shelters, say 50 sqM.
- Quantity of active solution /sqM e.g Deltamethrin is 0.025gm per sqM.
- % of active ingredient by weight, Del is 2.5% which means 2.5gm in 100gm or 25gm in 1000gm.
- Amount in litres of the spraying solution/ sq Meter, in our case 0.040L/sq M or 40ml per SqM.
- Computations.
- Amount needed to treat 200 shelters= 0.04 x 50= 2 l per shelter
- Total litres = 2 x 200 shelters = 400 litres.
- Quantity required of active Del when a dose of 0.025/sqM is needed is 50 x 0,025 = 1.25gm.
- Determine the amount of Del needed for one shelter. If 100gm has 2.5 of active Del, then how many gm are needed to make 1.25.
- Answer is 50 gm is needed.
- Total amount for 200 shelters is 200 x 50 gm = 10,000gm or 10Kg
- This has to be mixed with 400 litres of water.
- Spray speed is 0.76 litres per minute. If you divide 0.04L/ Sq Metre by 0.76 litres per minute, then it means a spray man should spend 1 minute to spray 19 sqM. At a pressure of 6 bars.

Water and sanitation kits and emergency response kits (ERU)
The International Federation of Red Cross and Red Crescent has developed a response mechanism to meet water, sanitation and hygiene promotion needs at national, zonal and international level, depending on the needs and service level needed by affected communities.

1. WatSan disaster response kits
There are three kits to address needs of 2000, 5000 and 10,000 people/ beneficiaries.

WatSan KIT 2
This kit provides water treatment at household level for up to 2,000 people (400 families), with no central treatment or storage capacity. This kit provides very basic sanitation facilities for a small population and is designed for response to the needs of scattered populations at household level and when beneficiary numbers are limited. Hygiene promotion, as well as training in the use of materials and tools in the kit, is an essential part of the operation and must be carried out alongside distribution activities.

WatSan KIT 5
This kit is designed for the treatment and distribution of water for small populations and can treat up to 75,000 litres of water a day for a population of up to 5,000 people. This kit requires the availability of local surface or ground water supply. Limited sanitation capacity for fast response is supplied within the kit, as well as some capacity for water trucking. The kit allows for the transport of treated water to several distribution points (capacity of up to 15,000 litres of water a day) with limited possibility of setting up different storage and distribution points (preconditions are the availability of flatbed trucks, fuel, road access). The kit should be pre-positioned at country level.

WatSan KIT 10
This kit is designed for the treatment and distribution of water for medium size populations, providing up to 150,000 litres of water a day for a population of up to 10,000 people. This kit requires the availability of a local surface or ground water supply. Limited sanitation capacity for a first or fast response is supplied within the kit as well as some trucking capacity. It can provide the transport of treated water to several distribution points (capacity of up to 30,000 litres of water a day) with limited possibility to set up different storage and distribution points (preconditions are the availability of flatbed trucks, fuel, road access). The kit should be pre-positioned at zonal level.

2. The Emergency Response Units (ERU)
ERUs are part of the International Federation's disaster response tools. They provide specific support or a direct service when local facilities are either destroyed, overwhelmed by needs, or do not exist.

Water and Sanitation Module 15
This Module provides treatment and distribution of up to 225,000 litres of water a day for a population of up to 15,000 people, with a storage capacity of a maximum of 200,000 litres a day. This unit can also provide limited sanitation. The module is designed for response to scattered populations, with a flexible approach due to a number of smaller treatment units (minimum three), which can be split and set up as stand-alone units in

different locations. The availability of local water sources is required. Module 15 has integrated distribution and trucking capacity, for transport of treated water to dispersed populations with a capacity of up to 75,000 litres a day, with the capacity to set up nine different storage and distribution points (preconditions are availability of flatbed trucks, fuel, and road access).

Mass Sanitation Module 20
This module provides basic sanitation facilities (latrines, vector control and waste management) for up to 20,000 beneficiaries as well as initiating hygiene promotion programs. Hygiene promotion is an important part of the revised mass sanitation module, to maximise the health benefits particularly from appropriate excreta disposal and hand washing.

Water and Sanitation Module 40
This Module provides treatment and distribution of water for larger populations, and can treat up to 600,000 litres a day for up to 40,000 people. This unit can also provide limited sanitation. Availability of local water sources is required. Module 40 has integrated distribution and trucking capacity, for transport of treated water to dispersed populations with a capacity of up to 75,000 litres a day and the capacity to set up nine different storage and distribution points (preconditions are availability of flatbed trucks, fuel, and road access).

National Societies providing WatSan ERUs:

Austrian Red Cross: WatSan Module 15 and 40, Mass Sanitation Module 20

British Red Cross: Mass Sanitation Module 20

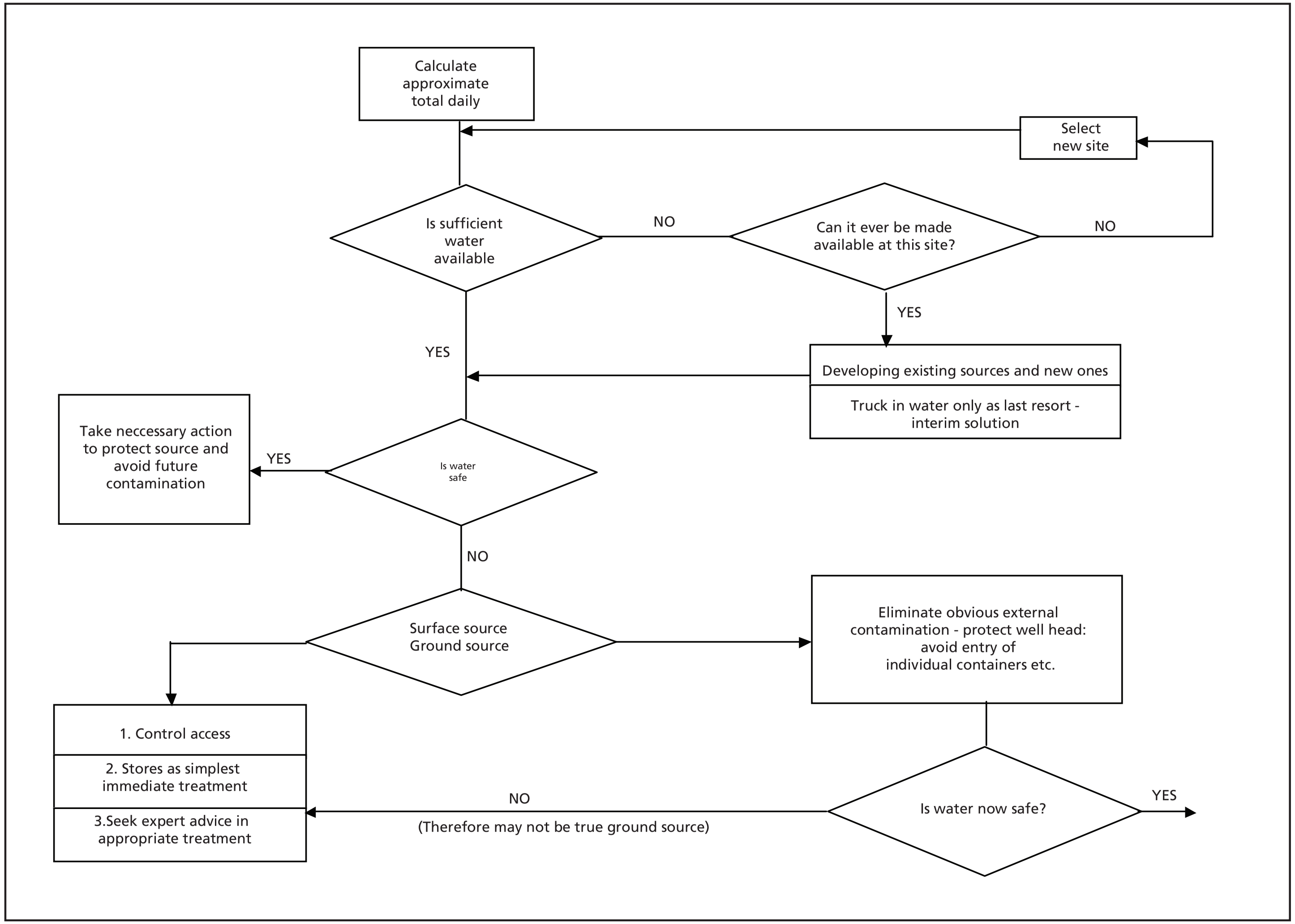
French Red Cross: WatSan Module 40

German Red Cross: WatSan Module 15 and 40, Mass Sanitation Module 20

Spanish Red Cross: WatSan Module 15, Mass Sanitation Module 20

Swedish Red Cross: WatSan Module 40, Mass Sanitation Module 20

Figure 18: General considerations in emergency water supply



Water Manual for Refugee situations UNHCR

ANNEXES

ANNEX I: Guidelines and specifications for construction of water points /kiosk

Water point/ kiosk, internal dimensions (size 2.4 m x 2.4 metres)

- Clear the site by removing the vegetation, grubbing up roots over an area measuring 6m x 6 m.
- Strip the vegetable soil over the area described above to reach a firm ground.
- Measure out 3m x 3 m on firm ground and excavate foundation base for the kiosk, to a depth of 450mm, if rock formation is reached before this depth is reached, level site and move to the next step.
- Lay a hardcore packing, 300mm deep.
- Spread a layer of blinding, 50mm with a concrete mix 1.4 .7 (cement, sand and coarse aggregate measured by volume).
- Lay a concrete slab thickness 100mm over the 3mx 3 m foundation and cure with water.
- Measure out the size of the kiosk over the dry concrete surface 2.4m x 2.4 m (internal dimensions) and construct walling in cement sand mortar 1.4 or as per design to reach lintel level, usually 1.8 Metres above the concrete level. Provide for positioning of door during measurement.
- Cast lintel and continue with another 0,6 metre of walling or three courses of walling.
- Install piping system or electrical wiring if required.
- Erect roof structure and roof as required.
- Plaster internal walls and lay floor screed.
- Finish external walls as per requirements.
- Spread material over whole areas and compact to grade (slope outwards to flash off water) to form firm surface.

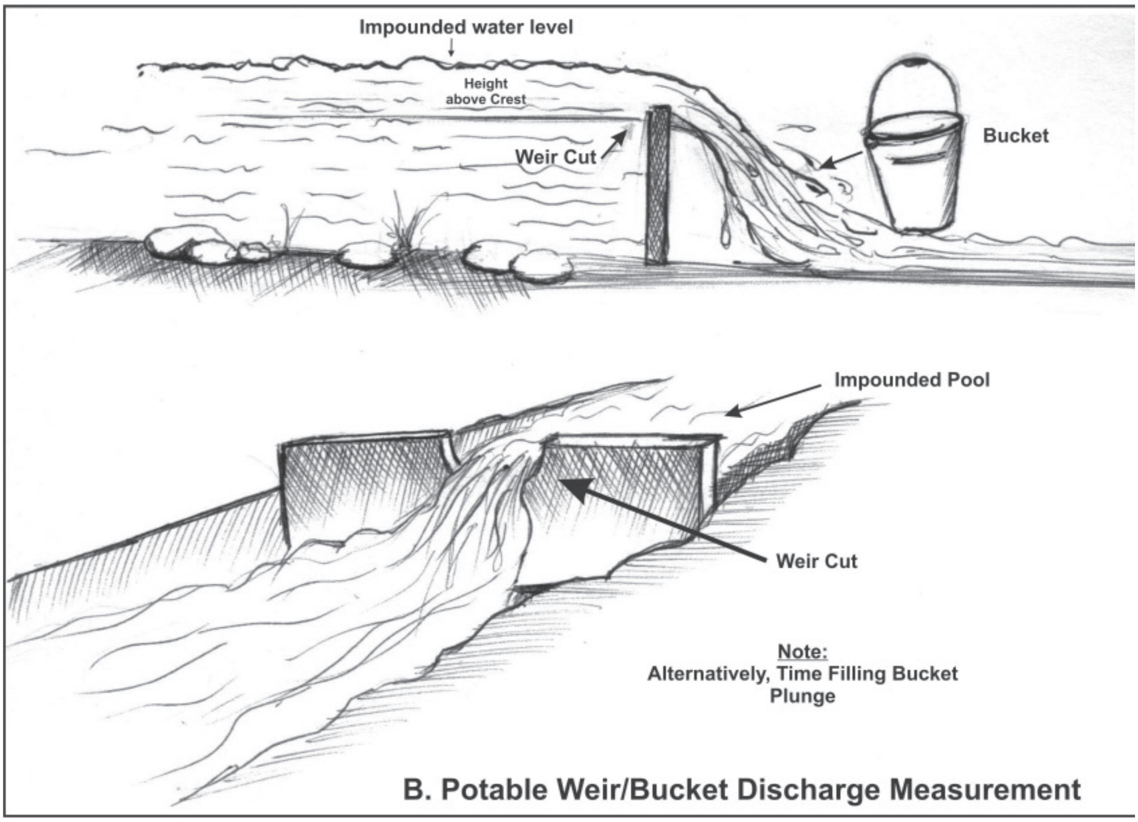
ANNEX II: Stream discharge measurements

Timed filling procedure for determining stream discharge

Note: If measuring discharge by this procedure will result in significant channel disturbance or will stir up sediment, delay determining discharge until all biological and chemical measurement and sampling activities have been completed.

1. Choose a cross-section that contains one or more natural spillways or plunges, or construct a temporary one using on-site materials, or install a portable weir using a plastic sheet and on-site materials.
2. Place an "X" in the "TIMED FILLING" box in the stream discharge section of the Stream Discharge Form.
3. Position a calibrated bucket or other container beneath the spillway to capture the entire flow. Use a stopwatch to determine the time required to collect a known volume of water. Record the volume collected in litres and the time required in seconds on the Stream Discharge Form.
4. Repeat Step 3 a total of 5 times for each spillway that occurs in the cross section. If there is more than one spillway in a cross-section, you must use the timed-filling approach on all of them. Additional spillways may require additional data forms.

A weir can be V shaped as shown in the diagram to block and control the water.



B. Potable Weir/Bucket Discharge Measurement

Sample of a filled data form with measurements taken using the bucket filling method

Repeat	Volume (litres)	Time (seconds)
1	20.0	24.5
2	20.0	25.0
3	20.0	25.4
4	20.0	24.8
5	20.0	25.2
	100	124.9

To calculate the discharge from the stream do the following:

Discharge = 100/1 24.9 = 0.8 litres per second.

Assuming a stream flow of 5l/sec, determine if a population in 2500 people, 3500 local cows, a dispensary with 40 people daily attendance, a primary school with enrolment of 450 pupils, can be safely served. Assuming a growth rate of 4% per year the population is expected to increase to 3559 in the next 10 years.

Using the recommended minimum water consumption of 20 litres per person per day, 35 litres per cow, 5 litres per out patient and 3 litres per school going child then the following can be deduced from the community:

Using the above assumptions to compute the water available for the community we have:

1. 1hour has (60 x 60= 3600) seconds
2. The stream yield per hour is: 5l x 3600 seconds =18000 litres /hour
3. 5 l/sec = 5l X3600 x 24 litres per day. = 432,000 litres per day
4. The population will require 20l x 2500 people= 50,000 litres per day
5. The cows will require 30l x 3500 cows =105,000 litres per day
6. The dispensary will require 5l x 40 patients = 200 litres per day
7. The school will require 3l x 450 pupils = 1350 litres per day

From the above calculation, the initial total water requirement is 156 550 litres per day.

Computation of the daily consumption of water in the above community setting

user	**Initial number of water user**	**Minimum amount of water required per day(litres)**[20]	**Total amount required per day**	**Time (hours) required getting enough water**
People	2500	20	50000	2.78
Cows	3500	35	105000	5.83
Hospital (out patients)	40	5	200	0.01
School pupils	450	3	1350	0.08
Total			156550	8.7
user	Number of water users after 10 years assuming a general growth rate of 4% per year.	Minimum amount of water required per day (litres)	Total amount required per day	Time required getting enough water
People	3500	20	70000	3.89
Cows	4900	35	147000	8.17
Hospital (out patients)	56	5	280	0.02
School pupils	630	3	1890	0.11
Total			219170	12.19

Therefore since the stream is able to yield 432,000 litres per day and the total daily consumption is 156,550 litres per day then it can be able to serve the community. The table above indicates that the people will require 2.78 hours, cows 5.83 hours, dispensary 0.01 hour and the children 0.08 hours in order for the stream to serve each individually. All the users will require a total of 8.7 hours to get their total daily water requirements. But the water requirements are normally at specific times of the day e.g. the animals may be allowed to drink their water after feeding maybe in the afternoon. Therefore in order for the community to utilize the stream effectively there is a need to schedule the times that they follow in order to get the daily requirement for each user.

[20] The daily rates have been adopted from the SHERE standards

After 10 years, the population in the community will require 219,170 litres of water every day and it will take the stream 12.19 hours.

Therefore, in order for the community to utilize the stream effectively there is a need to schedule the times that they follow in order to get the daily requirement for each user. Otherwise, the community can develop the stream by creating a dam on the stream and constructing a storage tank so that they can store water that is enough for their daily consumption.

ANNEX III: Constructions of Latrine using SanPlat

SanPlat Preamble[21]:
The word "SanPlat" stands for Sanitation Platform. It is a high quality Demand Driven Sanitation squatting platform. The SanPlat System was initially developed in 1979-89 in Mozambique and Malawi as a team work initiated and coordinated programme by Björn Brandberg to make sanitation affordable and accessible for the lowest income groups. It was developed based on the experiences and opinions from many people and many countries, mostly African countries, and it continues to develop today. Since then, around 1 million SanPlat have been built all over Africa.

A SanPlat is an improved latrine slab that has the following features:
1. Smooth and sloping surfaces which encourage regular cleaning.
2. Elevated footrests to help the user find the right position, even at night.
3. A drop hole which is both comfortable to use and safe for the smallest children.

A SanPlat can also be made with a tight fitting lid which effectively stops smell and flies.
- The SanPlat is the easiest way of improving a traditional latrine to become hygienic, child safe and modern.
- Instead of paying for skilled labour and building materials, more sanitation programmes in Africa are introducing the SanPlat as a simple form of reducing subsidies.
- Commonly, a SanPlat is provided free of charge as a project contribution to sanitation improvements. The family contributes materials and labour for the latrine in which the SanPlat will be installed. In most cases, the traditional latrines can be built by the family itself using local freely available materials at no cost.
- As a second step, many projects are introducing a price for the SanPlat which now becomes a more prestigious product.
- Decentralizing production is another way to cut costs and pave the way for local management and privatization. It has, however, proven to be time consuming and expensive to control.

Steps involved in making a SanPlat
SanPlats can be made in different shapes and sizes. The size will depend on the moulds used. The method for making them is, however, the same.

How to make dome-shaped SanPlats
Circular SanPlat of 1 .5m diameter; dome shaped SanPlats are used where wood is in short supply. The following moulds are required for SanPlat production:
- Girdle moulds
- Drop-hole moulds
- Arch moulds
- Foot-rest moulds (one or two should be enough)

[21] http://www.sanplast.com

Tools

- One or two shovels or a hoe for mixing the concrete.
- Mason's trowels, one large and one small.
- A steel-float (floor trowel) for finishing off the surface.
- A wheelbarrow for transport of material.
- One or two buckets for measuring the material.
- A hammer for various purposes.
- A hacksaw or a chisel for cutting the reinforcement bars (they can also be cut with a hammer against the edge of a pick-axe or any other sharp edge).
- A piece of a water pipe is useful when bending reinforcement bars for the handles.

Material

The SanPlat slab is made of reinforced concrete. The quantities will depend on the dimensions.
You will need:

- Normal cement (standard Portland).
- River sand.
- Gravel (12mm or similar).
- Plaster sand (if cheaper than river sand) can be used for the moulding. Plaster sand can also be used to 'modify' the river sand if it is too coarse.
- A roll of sisal cord or any other string for tying the ends of the girdle mould together unless the griddle clip is used. (Iron wire is not recommended as it will damage the girdle mould when it is pulled with the pliers.)
- 6mm mild steel reinforcement for the handle of the lid.

The casting yard

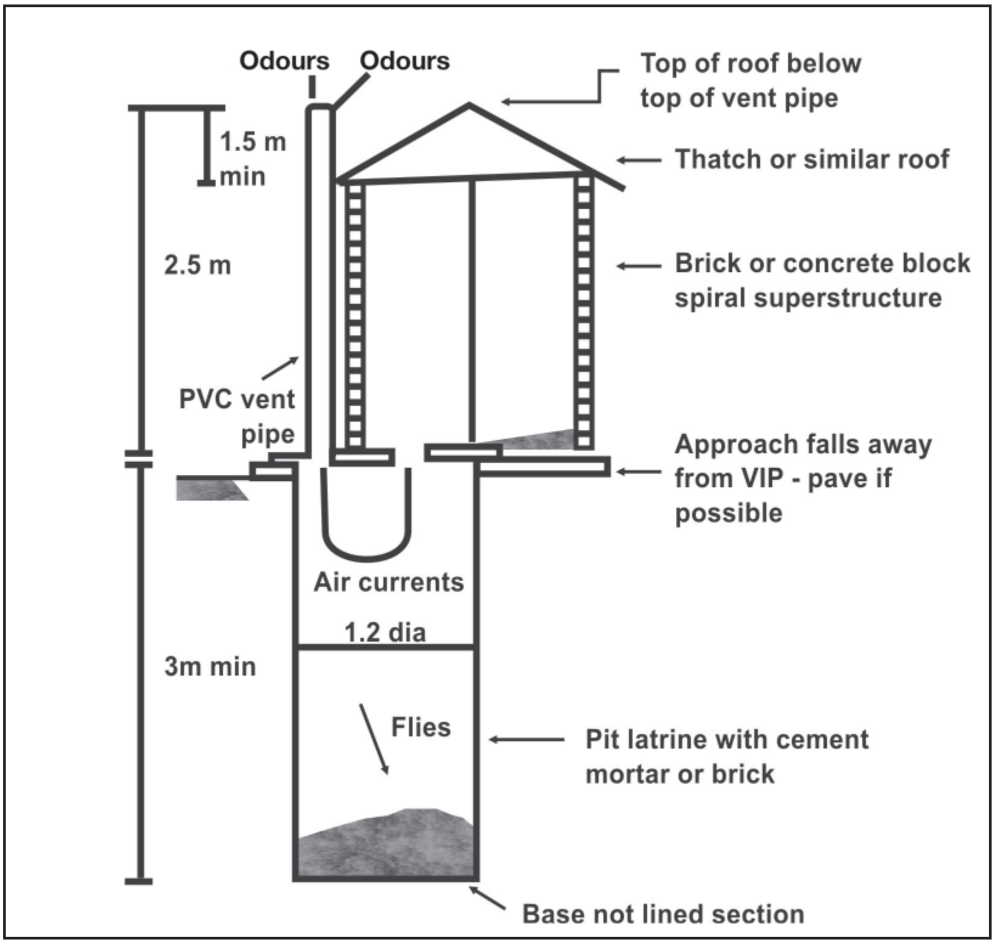
Before you start, make an assessment of the area and the use of the space in your casting yard. You will need a flat, hard and smooth surface for mixing the concrete and later you will need space for spreading out the slabs for making foot-rests and lids. Finally you may need some space for storing finished slabs.
The mixing area should be horizontal and flat. To make cleaning easy, it should be very smooth and have no elevated edges.

Mixing of aggregates, casting and curing should be undertaken by a trained artisan.

ANNEX IV: Example: Construction of a ventilated improved pit latrine

The ventilated improved pit latrine essential features are illustrated in the following diagram:

Figure 8: Ventilated improved pit latrine



Resources needed

- Shovel, pick, miner's bar
- Special VIP slab
- Mosquito netting (preferably nylon)
- Pipe of PVC or building material
- Material for superstructure and door

Method

The VIP uses the movement of air across the top of a ventilation pipe to draw odors up the pipe and out of the latrine. Flies entering the pit are attracted to the light at the top of the pipe and die trying to escape through the mosquito netting.

Construction

1. Choose a site downhill and at least 30 m distant from groundwater points; the latrine (or group of latrines) should be not less than 5m and not more than 50m from the dwellings.

2. Dig a pit, assuming that the solids accumulation rate will be about 0.04 m^3 per person per year. Thus, for a group of 25 people (maximum number per latrine recommended by WHO), it needs a pit of at least 0, 04 x 25 = 1 m^3 per year. If possible make the pit big enough to last 5 years.
3. If the plan is to use a concrete slab, it may be necessary to build a foundation on the upper part of the pit to support it.
4. Cast a slab and place it over the pit. The slab should have a second hole behind the defecation hole with a diameter of about 150 mm to fix the ventilation pipe.
5. Construct a superstructure of brick, stone, wood, plastic sheeting etc, but preferably using local materials. A spiral form may be suitable; if it is acceptable to the population this saves having to fit a door. The superstructure should provide a minimum of darkness so that when flies leave the pit they are attracted to the light coming from the ventilation pipe and not that coming from inside the superstructure.
6. Fix the ventilation pipe at the back of the latrine. It may be round or square, made of PVC, metal, bricks, reeds with earth plaster, etc. It should be vertical, with an internal diameter of about 150 mm. A screen of mosquito netting is fixed at the top of the pipe to prevent the entry and exit of flies. Fit a roof to the superstructure with the slope carrying rainwater towards the back. Important: the ventilation pipe should extend 50 cm above the highest part of the roof.
7. Dig a drainage channel around the latrine to prevent erosion of the pit walls.

Important:

- The slab and surroundings should be cleaned every day.
- If possible, provide lighting for night use.
- Never put disinfectants (chlorine products, Lysol, etc.) in the pit: this only serves to inhibit the natural decomposition of feacal material. The only situation in which it is recommended to pour disinfectants in a latrine is during a cholera epidemic.
- On the other hand, it is recommended that fire ashes be put into the pit after each use. This gives a perceptible reduction of odors and accelerates decomposition.
- When the pit is nearly full (50 cm from the top), demolish it or move the superstructure and the slab to a neighboring place and fill the pit with soil. Do not dig this place again for at least two years.
- Alterative method: If the subsoil is very rocky or if the water table is very high and it is not possible to leave 1.5 m between the bottom of the pit and the groundwater level, it is possible to dig the pit partially in a very well-compacted earth mound. In this case the aboveground part should be lined with bricks or stones.
- Do not use a hole; this prevents the circulation of air.
- Do not forget the mosquito netting, which traps flies at the top of the pipe where they die. Use a synthetic or painted metal mesh because the gases, which escape via the pipe, are corrosive to metal.
- The VIP latrine should be built in a clear space, away from trees, which impede air movement. Pay attention to the wind direction so as not to cause an odour nuisance.

BQ/ Checklist for items in latrine construction

S/No	Description	Qty	Units	Rate	Amount
1	EXCAVATE PIT DEPTH IN FIRM SOIL 10 M, RATE TO INCLUDE COST FOR DEWATERING, AND SHATTERING FOR THE FIRST 2 METRES				
2	LINNING FOR 2 METRES				
3	TOP SAN PLAT and COVER				
4	WALLING				
5	VENTPIPE WITH FLY SCREEN				
6	ROOF				
7	DOOR				
TOTAL COST					

Typical tools for various purposes

S/NO	Description	Quantity	Unit
A	Digging tools - standard set		
1	Hand hoes- large size	5	No
2	Pix axes(min2.5Kg)	5	No
3	Fork axe	3	No
4	Standard hammers (2.5- 5 Kg)	5	No
5	Standard hammers (5.0- 7.5Kg)	3	No
6	Wedges- small	3	No
7	Wedges- medium size	3	No
8	Spade	3	No
9	Manila Rope- medium (30M)	2	Roll
10	1.8metres twisted steel rod-(32mm) with bevel-finished ends.	1	Bar
B	Construction tools- standard set		
1	Spade	2	No
2	Wheel burrows	3	No
3	Mason spirit level- medium size	2	No
4	Metal troughs- medium	4	No
5	Steel floats	2	No
6	Wooden floats	2	No
7	Mason trowel	4	No
8	Standard sand sieve trays	2	No
C	Clean up campaign tools- standard set		
1	Wheel burrow	4	No
2	Spades	10	No
3	Rakes	10	No
4	Hoes	5	No
5	Hand gloves (medium duty)	15	Pairs
6	Face masks	15	No
7	Gum boots	15	Pairs

ANNEX V: Factors to consider while sitting community sanitation facilities

Sanitation checklist

- Location of defecation sites
  - Where are latrine areas located?
  - How far from the community?

- Latrine structure and cleanliness
  - How will the latrine structure be constructed?
  - Who is responsible for maintaining its cleanliness? Is it necessary to have a committee or group of people who will organize the community to maintain cleanliness?
  - How many people will use the latrine facilities? Are the people from that particular community or will outsiders be allowed to use the facilities?
  - Disposal of children's faeces.
  - Use of cleaning materials.
  - Purchase of cleaning materials that include soap, and brushes.
  - Appoint someone to be in charge of the cleaning equipment.
  - Sanitation habits of different groups.
  - Religious beliefs e.g. Muslims.
  - Cultural background of some tribes.