



REPUBLIC OF ZAMBIA

**Water, Sanitation and Hygiene Education  
[WASHE]**

**Training Manual  
For  
Rural Communities**



**unicef**

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## GLOSSARY

|         |   |
|---------|---|
| ACO     | Area Community Organizer                                  |
| AIDS    | Acquired Immune Deficiency Syndrome                       |
| CBoH    | Central Board of Health                                   |
| CHW     | Community Health Workers                                  |
| DWA     | Department of Water Affairs                               |
| D-WASHE | District Water Sanitation and Hygiene Education Committee |
| EC      | Electrical Conductivity                                   |
| EHT     | Environmental Health Technician                           |
| FDCL    | Food and Drug Control Laboratory                          |
| GRZ     | Government of the Republic of Zambia                      |
| HIV     | Human Immuno-Deficiency Virus                             |
| HTH     | High Test Hypochlorite                                    |
| KABP    | Knowledge, Attitude, Behaviour and Practices              |
| MEWD    | Ministry of Energy and Water development                  |
| MoE     | Ministry of Education                                     |
| MOH     | Ministry of Health  |
| NORAD   | Norwegian Development Agency                              |
| ORS     | Oral Rehydration Solution                                 |
| PAGE    | Programme for Advancement of Girl Education               |
| PTA     | Parent Teacher Association                                |
| RITS    | Research Into Traditional Water Sources                   |
| SSHE    | School Sanitation and Hygiene Education                   |
| TDS     | Total Dissolved Solids                                    |
| UNICEF  | United Nations Children's Fund                            |
| V-WASHE | Village Water Sanitation and Hygiene Education Committee  |
| WASHE   | Water, Sanitation and Hygiene Education                   |
| WHO     | World Health Organization                                 |
| WQM     | Water Quality Monitoring                                  |
| WQMP    | Water Quality Monitoring Program                          |

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## **FOREWORD**

The problem of water related diseases is an indicator of poor water supply and sanitation. Indeed, diarrhoea ranks quite high in terms of morbidity and mortality and Cholera has almost assumed endemic proportions in some parts of Zambia.

The Ministry of Health, through its implementation wing, the Central Board of Health, has prioritized water supply and sanitation interventions. This is one of the six health thrusts requiring concerted efforts by health care providers to improve the quality of life of the population.

Under the district and sub-district health plans, the interventions on water supply and sanitation are some of the visible activities within the community as they are executed under preventive and promote interventions during outreach programmes.

Most of these programmes are initiated at community level, realizing the vision of delivering health services as close to the family as possible. The development of this manual, therefore, comes at a time when practical interventions in diarrhoeal diseases control have become more crucial. There is a need to control these preventable diseases to a level where they cease to become a public health problem.

The training manual for rural communities has been developed for facilitators in environmental health and other community development extension programmes at both district and sub-district levels. This is a significant contribution towards building a community's capacity to take control of its own problems.

The training package modules have been carefully selected and formulated to take into account the practical and affordable interventions that can have an impact at the service delivery level. The themes in the manual include water-related diseases, potential harmful chemicals, hygiene education, personal hygiene and sanitation, water sources, sanitary surveys, household treatment of water and water quality monitoring.

I trust that the environmental health extension personnel will find this training manual useful as they facilitate the implementation of affordable and cost-effective interventions in water supply, sanitation and hygiene education ( WASHE).

Dr.S.K.Miti  
**Director General**  
**CENTRAL BOARD OF HEALTH**

19 March, 2002

## ACKNOWLEDGMENTS

I would like to thank UNICEF Zambia for giving me the opportunity to prepare this manual, which I hope, when put to good use, will reduce considerably the incidence of faecal-oral transmitted diseases in the rural communities of Zambia.

I wish to thank UNICEF staff in general, and the WASHE Section Staff in particular for their support. I extend special thanks to Dr Shamvanth Mathur, WASHE Section Head for his assistance in providing some of the reference materials and giving valuable feedback during the preparation of the Manual. I also wish to thank the Programme Planning, and Co-ordination Office, especially Edita Nsubuga and Susan Makomo, for their help in editing and formatting the final script.

My sincere thanks also go to the representatives of the Government of the Republic of Zambia, who collaborated with UNICEF in the preparation of this Manual, especially in field-testing of the draft in the Districts. While it may not be possible to mention all the people involved, I wish to acknowledge the following officials: Mr. F. Nyirenda, Environmental Health Specialist, Central Board of Health, Mrs. Margaret Mazhamo, Officer in Charge, Food and Drug Control Laboratory, (FDCL) Ministry of Health (MOH), Mrs. Gertrude Mundia, Public Analyst, FDCL, MOH.

Thanks also go to the District WASHE Committee members in the Districts of Kalomo, Gwembe, Itezi-itezi and Siavonga in the Southern Province where the Manual was field-tested.

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Finally, I wish to thank Peter Sinyangwe for assisting with the illustrations.

Gertrude. Ofosu-Barko  
(WASHE Consultant)

## INTRODUCTION

The Government of Zambia's National Environmental, Sanitation and Health Education Strategy recognises that both good sanitation practices and clean, safe drinking water are important in achieving good health. In order to promote this in the communities, especially in the rural areas, sanitary facilities should be provided and maintained, supported by effective hygiene education with community participation. It has, therefore, become necessary to build capacity in the rural areas in order to achieve this objective.

Experience has demonstrated that supplying water alone has not been enough to ensure the good health of the populace. It is imperative, therefore, that good water supply be linked to good personal hygiene and environmental sanitation practices.

**In this regard, this Water, Sanitation and Hygiene Education (WASHE) Training Package, has been prepared to assist facilitators at both the District and Community levels ) in their efforts to build capacity in the communities. These include members of the District WASHE (D-WASHE) Committee, Environmental Health Officers (EHT), and Area Community Officers (ACO).**

The training package is divided into seven (7) modules, which deal with specific topics in Water, Sanitation and Hygiene Education. Some modules are sub-divided into Units with each unit dealing with one aspect of the topic.

### **Target groups**

The manual is designed to serve as a resource material, for *facilitators* such as D-WASHE members, EHTs, ACOs, and Health Education Teachers in:

- rural community
- Schools: School children, Parent Teacher Associations (PTA) and WASHE Committees and
- the field workers of Borehole Drilling Companies.

### **Broad Objective**

- To promote environmental sanitation, personal hygiene and the use of clean safe drinking water in rural communities, in order to reduce the incidence of water-related diseases in those communities.

### **Specific Objectives**

At the end of the training participants should know:

- Types of water-related diseases and their mode of transmission, especially faecal-oral transmission.
- The control measures to take to prevent faecal- oral transmission of diseases.
- How different water sources become contaminated.
- How to protect the water sources from becoming contaminated.

- Examples of potentially harmful chemicals in water, and their effects on health.
- Simple methods of treating water at home.
- Basic personal hygiene practices and how to achieve them.
- Basic environmental sanitation practices and how to achieve them.
- How to protect and maintain water points and latrines.
- How to monitor the quality of water supply, including water sampling and bacteriological testing.
- How to conduct Sanitary Surveys, interpret, and use the results of the survey.

# MODULE 1

## WATER RELATED DISEASES AND THEIR MODE OF TRANSMISSION

### Introduction

When a disease is said to be **water-related**, it means that **water plays an important role in spreading it**. Water, is very important for our survival, but it can sometimes contain certain germs (**biological contaminants**) or certain chemicals (**chemical contaminants**), that will make us sick if we drink it.

For a water supply to meet the basic needs of a community and cause no diseases, it should have the following qualities:

- Contain no germs ( no biological contaminants)
- No colour, odour or taste (these should meet local standards)
- Contain only certain chemicals in amounts within the World Health Organisation (WHO) or locally set guidelines (no chemical contaminants)
- Be available in sufficient quantities.

In order to prevent community water supply from causing or spreading disease, it is important to know:

- What these diseases are,
- How these diseases are spread, and
- The part water plays in spreading them.

### Classification of water-related diseases.

Based on the role water plays in the spread or transmission of diseases, water-related diseases have been divided into four main groups. This classification is summarised in Table I below:

**Table 1: An overview of water-related diseases**

| Classification or group name                     | Mode of Transmission  | Common Examples   |
|--|---|---|
| <b>Water-borne</b>                               | By drinking or ingesting water containing disease germs   | Cholera, typhoid fever  |
| <b>Water-washed: insufficient water quantity</b> | Insufficient amount of water so basic hygiene practices such as washing hands, cloths and bathing are often neglected.                            | Skin and eye infections: scabies, conjunctivitis, round worm infestation e.g. Ascaris |
| <b>Water-based</b>                               | The disease parasite (worm) spends part of its life cycle in an aquatic intermediate host. It infects a person when the worm penetrates the skin. | Schistosomiasis (bilharzia), Guinea worm  |
| <b>Insect vector</b>                             | By insects that breed in water.   | Malaria   |



Module 1 is subdivided into the following **Units**:

- Unit 1: Water borne diseases and their mode of transmission – faecal-oral transmission.
- Unit 2: Control measures for faecal-oral transmitted diseases.
- Unit 3: A brief discussion on water- washed, water-based and insect-vector diseases: their modes of transmission and control measures.

## UNIT 1

### WATER-BORNE DISEASES AND THEIR MODE OF TRANSMISSION

**Table 2: Examples of water-borne diseases.**

| Name of disease   | Name of disease in <b>Zambian languages</b> |
|-------------------|---|
| General diarrhoea |   |
| Cholera           |   |
| Dysentery         |   |
| Typhoid fever     |   |
| Amoebiasis        |   |
| Hepatitis         |   |

**Where do the germs that cause these diseases come from?**

- The germs are found in the intestines of the sick person. This is why most of these diseases are also called **gastrointestinal diseases**.
- The germs are mixed with the faeces, or stools and vomit of the sick person
- Millions of the germs come out in the faeces of the sick person, when he or she defecates.

### How do the diseases spread from person to person?

The steps involved are as follows:

1. A person sick with, for example cholera, defecates near water or directly into a water source (well, river, lake).
2. The faeces of the sick person, containing the disease (cholera) germs, get or are washed into the water.
3. Another person drinks water from the source containing the disease (cholera) germs and gets the same disease, cholera.

This process by which a disease is transmitted and shown below in Figures 1 to 4 is called **faecal-oral transmission**.

**Figure 1: Faecal-oral transmission of disease.**

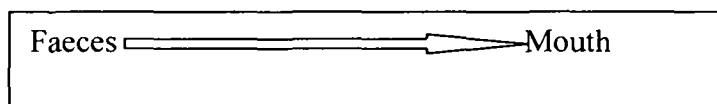
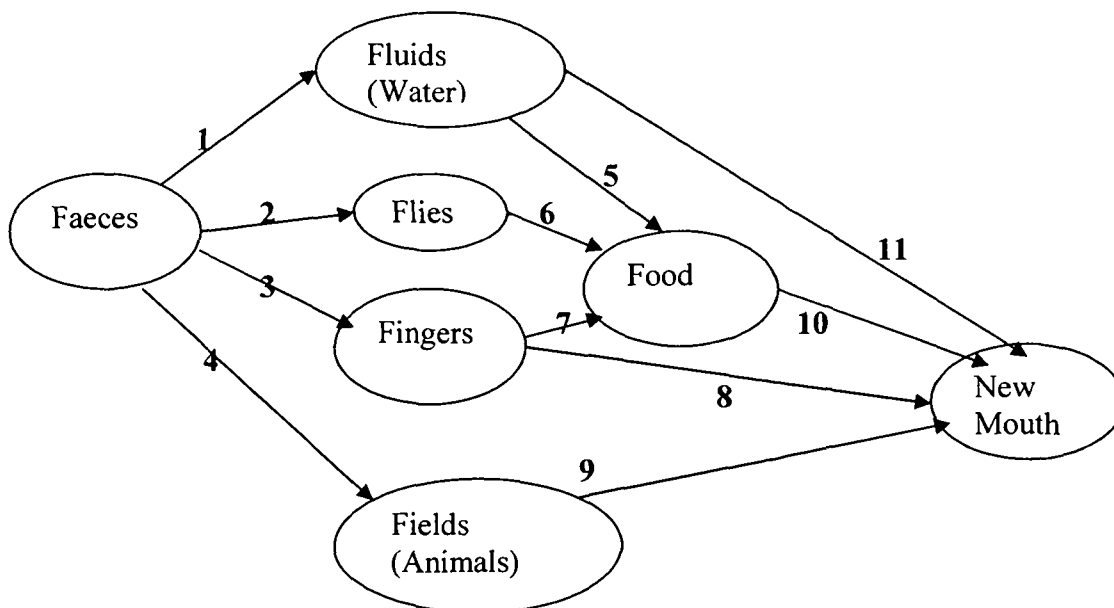


Figure 1 shows the simplest meaning of faecal-oral transmission - from faeces to mouth.

**Figure 2: Faecal-oral transmission of diseases via different routes.**



The germs usually go from the faeces via some route to reach the mouth. Thus in addition to a person getting these diseases directly by drinking contaminated water, Figure 2 shows that there are other routes of faecal-oral transmission of diseases. These routes, which are represented by the arrows numbered 1 to 11, are as follows:

- **Fluids (Water):** Drinking water and other fluids, that are contaminated with faeces.
- **Fingers:** Faeces get on fingers when we use the latrine or clean children after they have defecated.
- **Food:** Faeces left in the open field get on our fruits and vegetables. Fingers contaminated with faeces used for eating. Preparing food with hands that have been contaminated with faeces. Using contaminated water to prepare food.
- **Flies:** Flies land on exposed faeces, and contaminate their feet, then they land on food, and transfer the faeces onto the food.
- **Fields (Animals):** Domestic animals walk in exposed faeces and bring them to our living quarters. Children playing on the floor contaminate their fingers, which they then lick or eat with.

Figure 3: Faecal-oral transmission of diseases

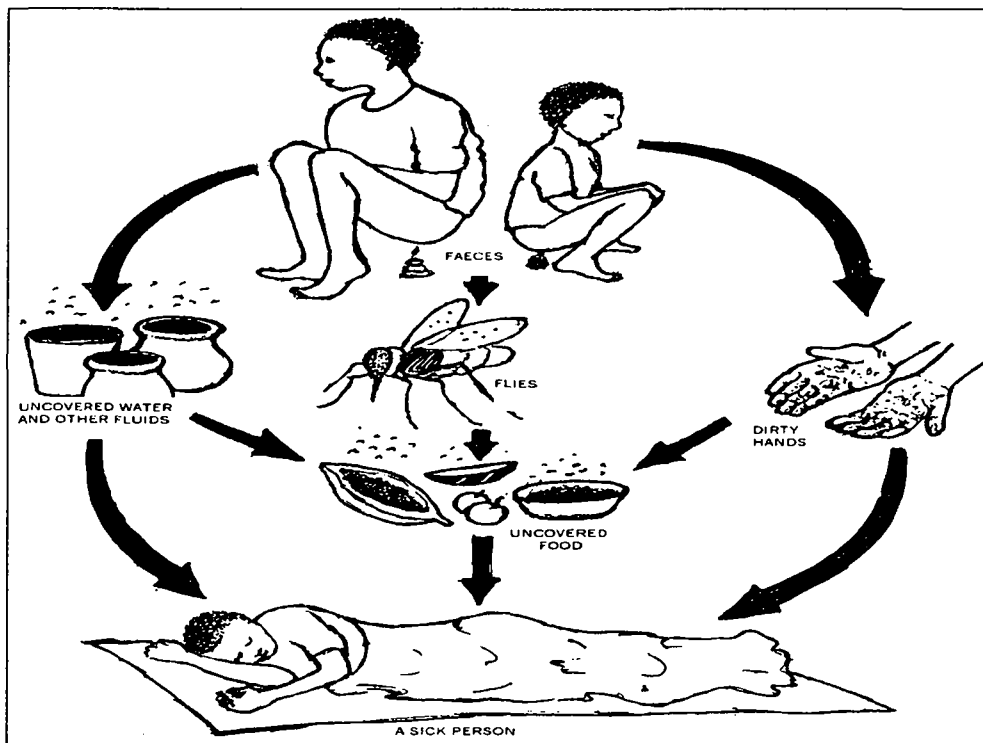
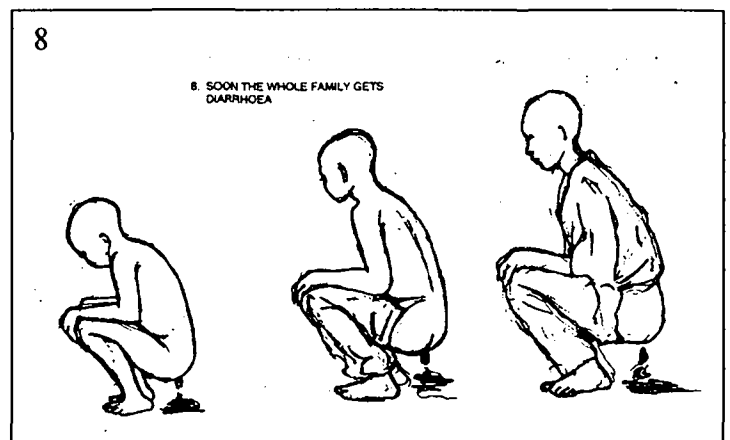
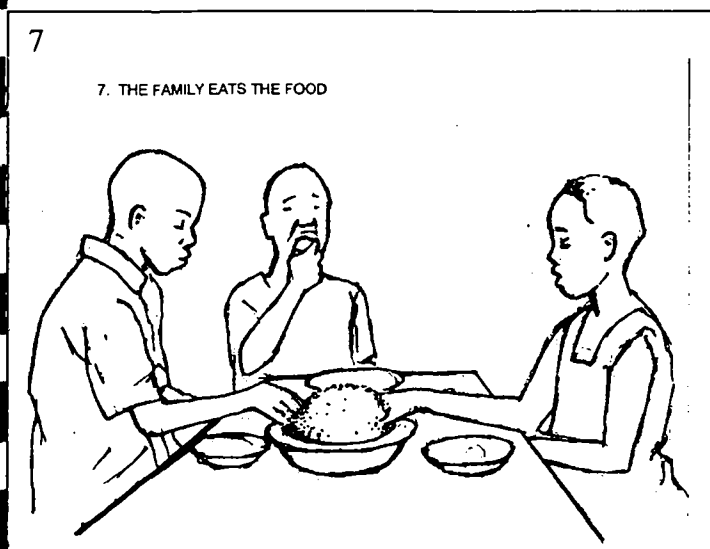
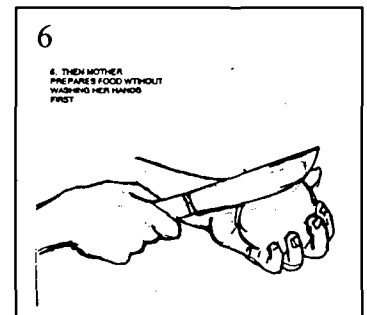
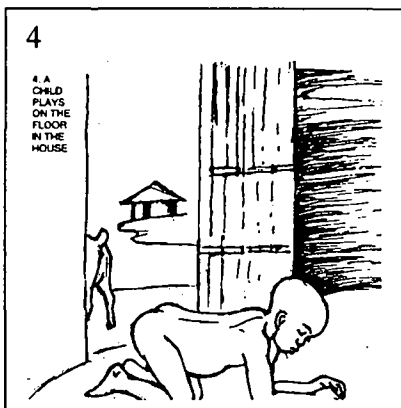
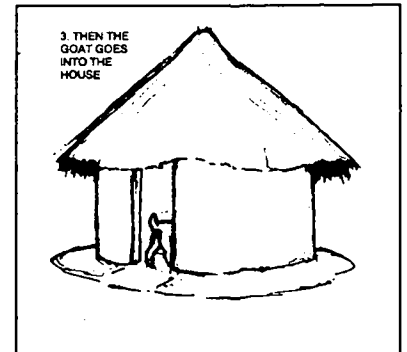
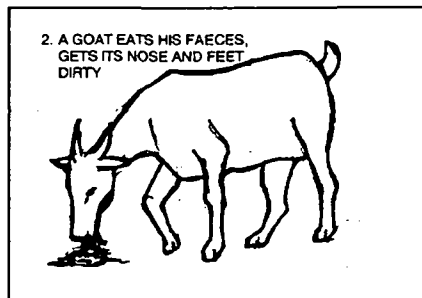
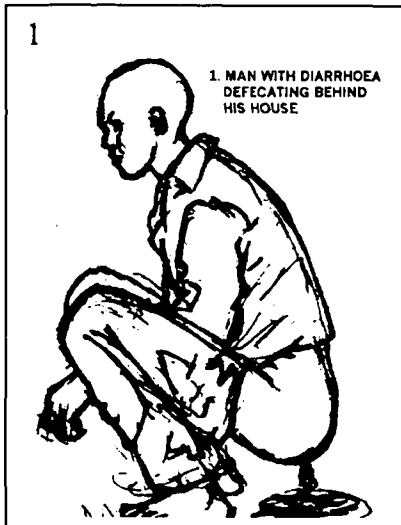


Figure 4:

An example of the role played by domestic animals in faecal - oral transmission of diseases.



### **General signs and symptoms of water-borne diseases.**

- Many watery stools per day, which is normally called **diarrhoea**. This is why these diseases are also called **diarrhoeal diseases**.
- The stools may or may not contain blood and mucus
- Vomiting
- Stomach cramps
- General body weakness
- Fever

Other signs include feeling like vomiting (nausea), stomach discomfort or pains, headache, fever, and generally feeling sick.

The sick person may show many of these signs together.

### **Diarrhoeal diseases**

Diarrhoea is to have many (at least three times) liquid or watery stools in a day.

#### **Types of diarrhoea**

- Ordinary diarrhoea (liquid stools)
- Diarrhoea with blood and mucus (**Dysentery**)
- Diarrhoea with watery stools that look like rice water (**cholera**)

#### **How does a person get diarrhoeal diseases like cholera?**

- By the **faecal-oral routes** as described above.

#### **Effects of diarrhoea on the human body**

Diarrhoea results in the body losing a lot of fluids, leaving the body dry or **dehydrated**. If the lost fluids are not replaced very quickly, this **dehydration could result in death**.

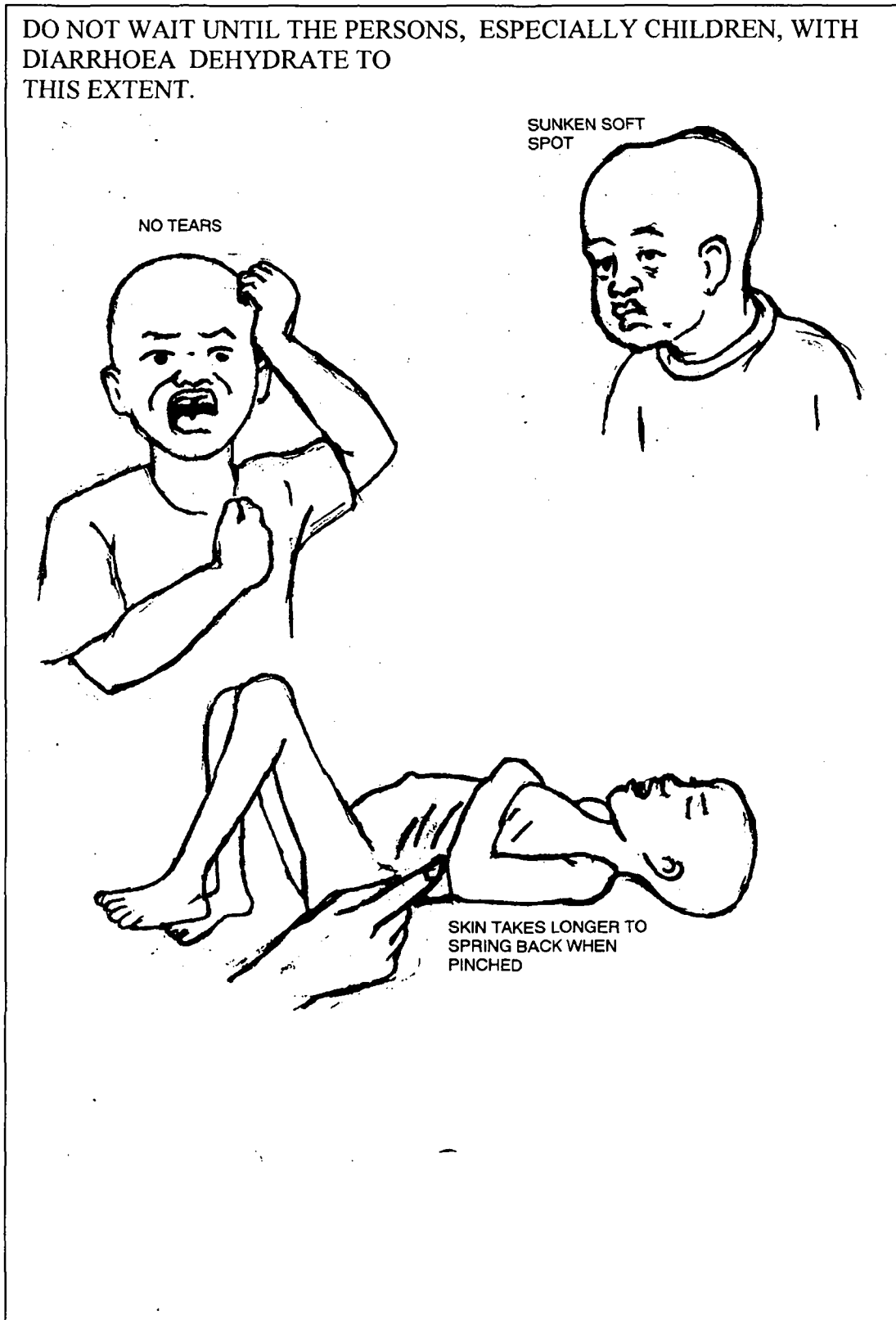
#### **Why does severe dehydration cause death?**

- Over 70 percent of the human body is made up of water. Most of the body functions that keep us alive use or need water.

#### **Signs of Dehydration (See Figure 5)**

- Eyes are sunken (but no tears)
- Sunken soft spot in skull of children
- Dry lips, mouth and tongue
- Feeling very thirsty all the time
- If skin is pinched, it will take longer than usual to return to its position
- Very little urine or no urine at all.

Figure 5: Signs of dehydration



### Treatment for dehydration

- Drink a lot of fluids or liquids to replace what the body is losing as soon as diarrhoea begins, and continue until the diarrhoea stops.
- Continue breast-feeding babies. (Note! This may not be advisable if mother is HIV positive. Please check at the health centre)
- Patients must be encouraged to eat food they can tolerate,
- If the diarrhoea is very severe and does not stop, it is important to go to the nearest Rural Health Centre immediately for help.

### Examples of fluids to drink

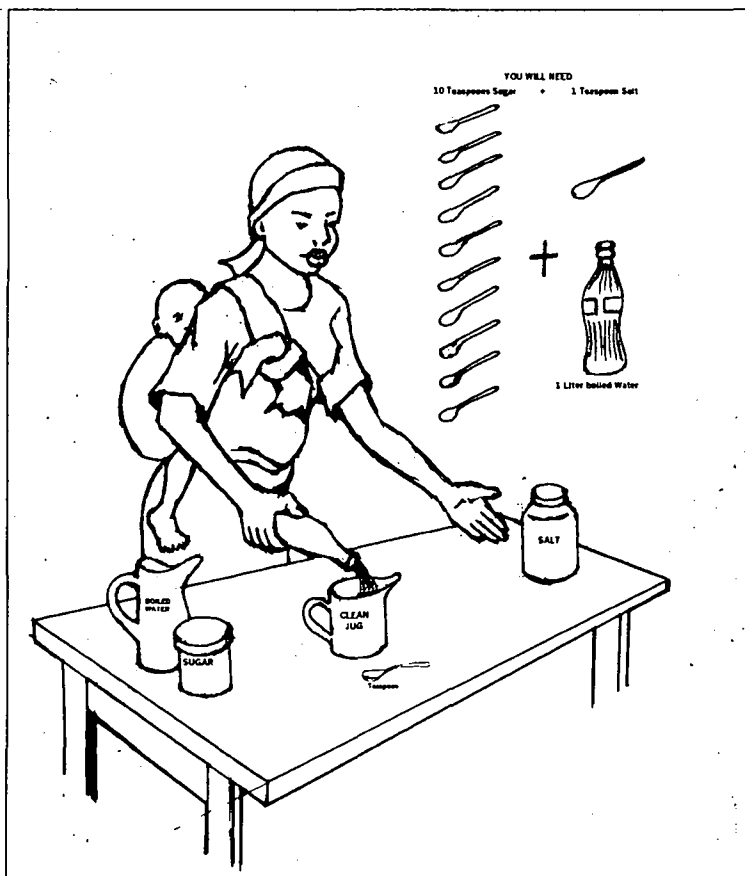
Oral Rehydration Solution (ORS) - a sugar and salt solution, which can either be bought from the pharmacy shop, or obtained from clinics, health workers or prepared at home. (See instructions for preparing ORS at home in Figure 6 below)

Home-made fluids like, boiled rice water, soup, samp water, weak tea corn flour or mealie meal porridge can also be taken.

(Are there any other examples of home-made fluids used in the communities?)

### How to prepare ORS at home.

Figure 6: How to prepare ORS at home



1. Boil and cool one (1) litre of water.
2. Add 10 teaspoons of granulated sugar (white spoon sugar)
3. Add one (1) teaspoon of salt.
4. Mix well with a very clean spoon.

Give this to the sick person as often as he/she can tolerate

## UNIT 2

### CONTROL MEASURES FOR FAECAL-ORAL TRANSMITTED DISEASES

#### Introduction

Unit 2 is a continuation of Unit 1 in which the transmission of faecal-oral diseases is discussed. Unit 1, therefore is a pre-requisite for Unit 2. Unit 2 examines the possible control measures that can be taken to fight these diseases. Greater emphasis is placed on Hygiene Education to improve on Hygiene and Sanitation Practices, which in turn will lead to the reduction, if not the elimination, of faecal oral transmission of diseases.

#### Intervention in the faecal-oral transmission of diseases.

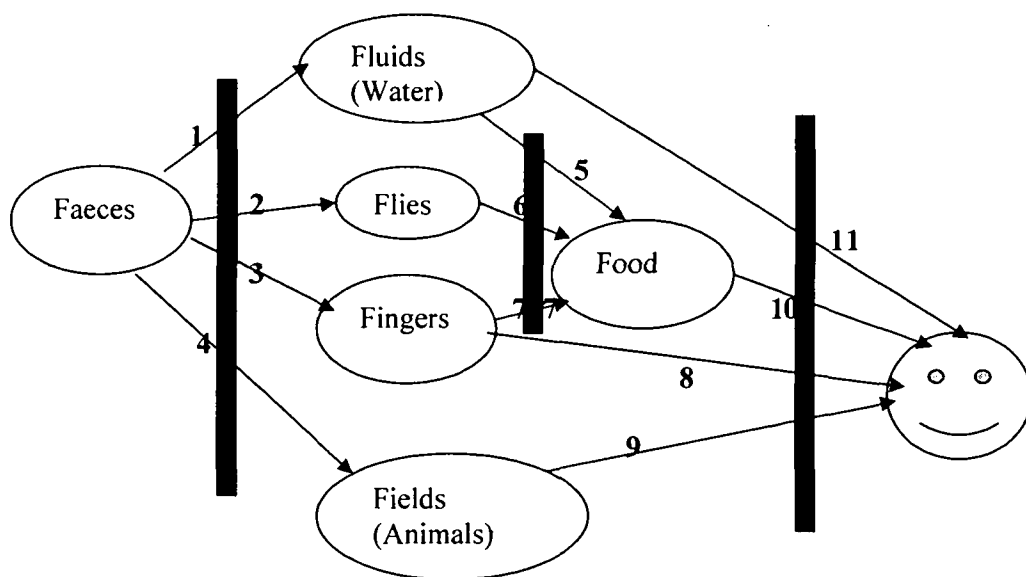
Faecal-oral diseases, including the water-borne diseases, are spread from person to person because of poor drinking water quality, and poor personal hygiene and sanitation practices.

Preventive measures must therefore include:

- Protecting sources and ultimately the quality of drinking water
- Improving and practising good personal hygiene
- Improving and practising good environmental sanitation.

**Figure 7: Intervention in the faecal-oral transmission of disease**

The person in the illustration below, Figure 7, is healthy and happy, because barriers or control measures have been erected to block or cut the paths of transmission. These paths are represented by the arrows numbered 1 to 11 in figure 7 and illustrated in figure 8.

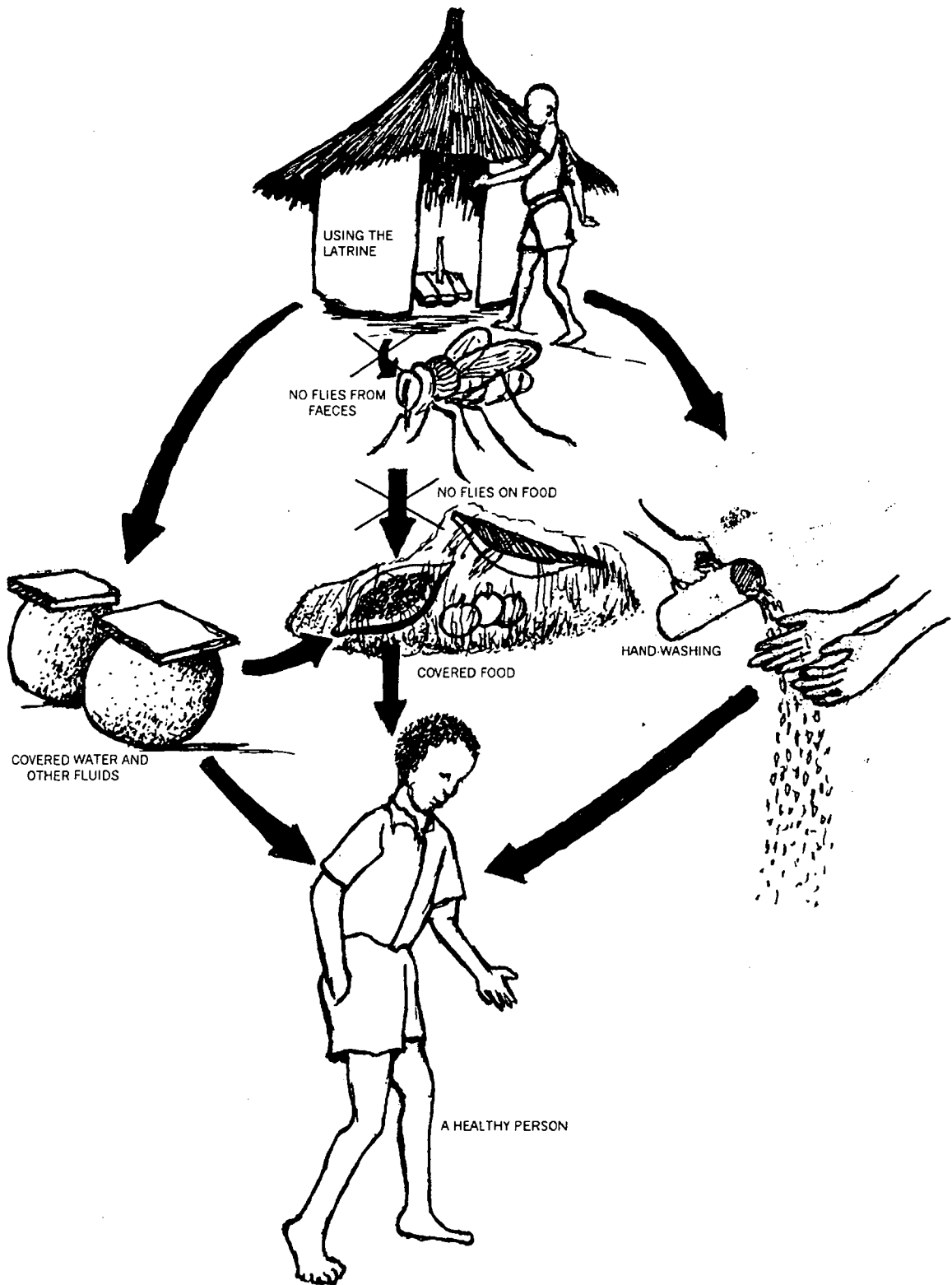




**Table 3: Control measures:  
How each of the numbered transmission routes in figure 7 can be blocked or cut.**

| Route of transmission to be blocked | Preventive or control measures.  |
|-------------------------------------|--|
| 1, 3,7,8,9                          | <ul style="list-style-type: none"> <li>• <b>Hands are washed properly with water and soap/ash</b> after using the latrine or after cleaning the anal area of a child.</li> <li>• Hands are washed properly before eating, cooking or handling food.</li> <li>• Hands are washed properly after handling animals.</li> <li>• Dirty fingers are not sucked by children.</li> </ul>   |
| 2,4,9                               | <ul style="list-style-type: none"> <li>• <b>Constructing latrines and using them properly and at all times.</b></li> <li>• Faeces, including that of children are disposed of properly in latrines in order that flies do not get to them.</li> <li>• Faeces are disposed of properly, in order that domestic animals are not exposed to them.</li> <li>• Faeces are disposed of properly in latrines in they are not washed into water sources.</li> </ul>  |
| 5,6,10,11                           | <ul style="list-style-type: none"> <li>• <b>Drinking-water and food should be stored properly by covering them;</b> drinking-water is stored in clean containers and covered.</li> <li>• Drinking-water is kept in storage containers reserved for that purpose only.</li> <li>• Drinking-water is removed from its storage container with the same cup or ladle without the hand touching the water.</li> <li>• Do not drink from the cup or ladle directly –it should be kept clean and only used for transferring water to another cup.</li> <li>• Food, cooking utensils, plates and cups are covered at all times so that flies do not land on them.</li> <li>• Food is prepared with water, which is not from a source contaminated with faecal matter.</li> <li>• Raw fruits and vegetables are washed properly and/or peeled before eating.</li> <li>• Food is cooked well to kill any germs that may be in them.</li> </ul> |
| 4                                   | <ul style="list-style-type: none"> <li>• Domestic animals are kept away from living area or kept in dens.</li> </ul>   |
| 2,6                                 | <ul style="list-style-type: none"> <li>• Refuse is disposed of properly in order that flies do not breed in them.</li> </ul>   |

Figure 8: Barriers in the routes of faecal-oral transmission of diseases



### UNIT 3

## WATER-WASHED, WATER-BASED, AND INSECT VECTOR DISEASES

Their mode of transmission and control.

### I. WATER-WASHED DISEASES

Table 4: Examples of water-washed diseases.

| Name of disease                | Name of disease in the <b>Zambian languages</b> |
|--------------------------------|---|
| Scabies (mites)                |   |
| Yaws                           |   |
| Leprosy                        |   |
| Head lice infestation          |   |
| Typhus (Body lice infestation) |   |
| Ascariasis (round worms)       |   |
| Whipworm                       |   |
| Trachoma eye infection         |   |
| Conjunctivitis (eye infection) |   |
| Fungal skin diseases           |   |
|                                |   |

#### How water-washed diseases are spread

These diseases are spread:

- From one person to another or
- From an animal to a person because of **lack of sufficient quantity of water.**

This could be due to the fact that **a greater effort is needed to get water**, because:

- The water point is dried up
- The water source is too far away.

**People therefore, in trying to manage and save water, neglect some aspects of personal hygiene.** For example:

- Bathe less often
- Wash clothes less often.

**Under these unhygienic conditions**, the agents or germs of infectious skin diseases (e.g. scabies, yaws), infectious eye diseases (e.g. conjunctivitis), and infections carried by lice flourish or increase.

- In fact, all water-borne diseases or diseases transmitted by the faecal-oral route could technically be classified as water-washed as well. This is because without sufficient quantities of water, it will be difficult to carry out most of the control measures as discussed in Unit 2.

**Control measures for water-washed diseases.**

- Increase use of water for bathing and washing. It is better to use water of lower quality to wash than not to wash at all, provided the water is not used for drinking.
- Improve access to water source to encourage people to collect more water easily.
- Practise good personal hygiene and environmental sanitation. (See Module 3 on Hygiene Education)

**II WATER-BASED DISEASES**

- These are the diseases people get when they walk through or swim in water containing the disease worms.
- The worms are found in the faeces, urine or the skin of the sick person and get into water when they defecate, urinate or walk through rivers and streams.
- The worms have to spend part of their lives inside some animals (intermediate hosts) that live in water (water snails and shrimps) before they can finish growing into mature worms in humans.

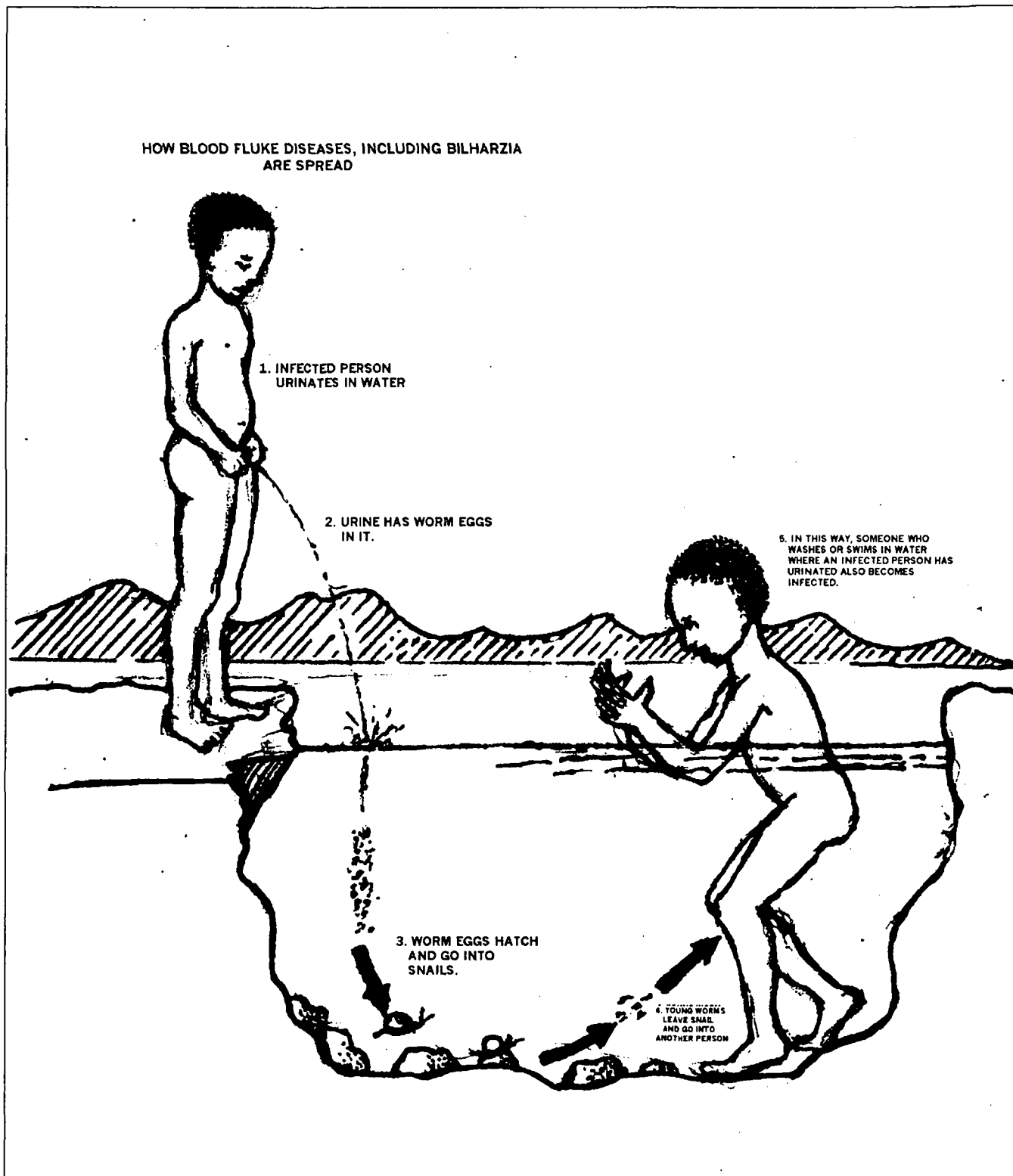
**Table 5: Examples of Water-based diseases**

| <b>Name of disease</b>  | <b>Name of disease in the Zambian languages</b> |
|---|---|
| Urinary Schistosomiasis or <b>Bilharzia</b> (blood fluke disease) |   |
| Rectal Schistosomiasis (liver fluke disease)                      |   |
| Guinea worm   |   |
|   |   |

**How water-based diseases are spread using Bilharzia as an example**

- The disease organism that causes bilharzia is commonly called the **blood fluke**.
- In humans it lives in the wall of the urinary bladder.
- The female worm, full of eggs, penetrates the wall of the urinary bladder to lay its eggs into the bladder.
- This normally causes some bleeding hence **one of the symptoms of bilharzia is blood in the urine**.

Figure 9: The steps involved in the spread of bilharzia



### The steps involved in the spread of bilharzia. (See Figure 9)

1. An infected person whose **urine contains the eggs of the worms**, urinates into water (a stream/river)
2. The eggs hatch and the tiny **immature worms (larvae) enter special snails** that live in the water.
3. **While inside the snail**, the worms go through some changes and multiply into many, young immature worms.
4. Later, the new immature **worms are discharged into the water**, ready to infest another person.
5. When a person goes into the water to swim or wash, the **immature worms enter that person by piercing through his or her skin**.
6. Once inside the person, **the worms grow or develop into maturity**, and the person becomes sick with bilharzia.

### How bilharzia and other water-based diseases can be controlled

- Practise good hygiene practices -do not defecate or urinate into or near streams and rivers.
- Do not swim or walk in rivers, **stand at the edge and fetch water with a bucket on a rope**.
- Destroy the intermediate hosts, the snails and shrimps in the stream and rivers, that the worms need to complete their life cycle. For example: Introduce other organisms into the water to eat the snails and shrimps (**biological control**).

#### **For guinea worm:**

- Strain drinking water through clean cotton cloth to remove the copepods or the tiny shrimps that contain the disease germs.

### **III WATER-RELATED INSECT -VECTORS**

This refers to diseases, that are spread by **insects that breed in surface water**. The insects carry the germs of the disease from person to person.

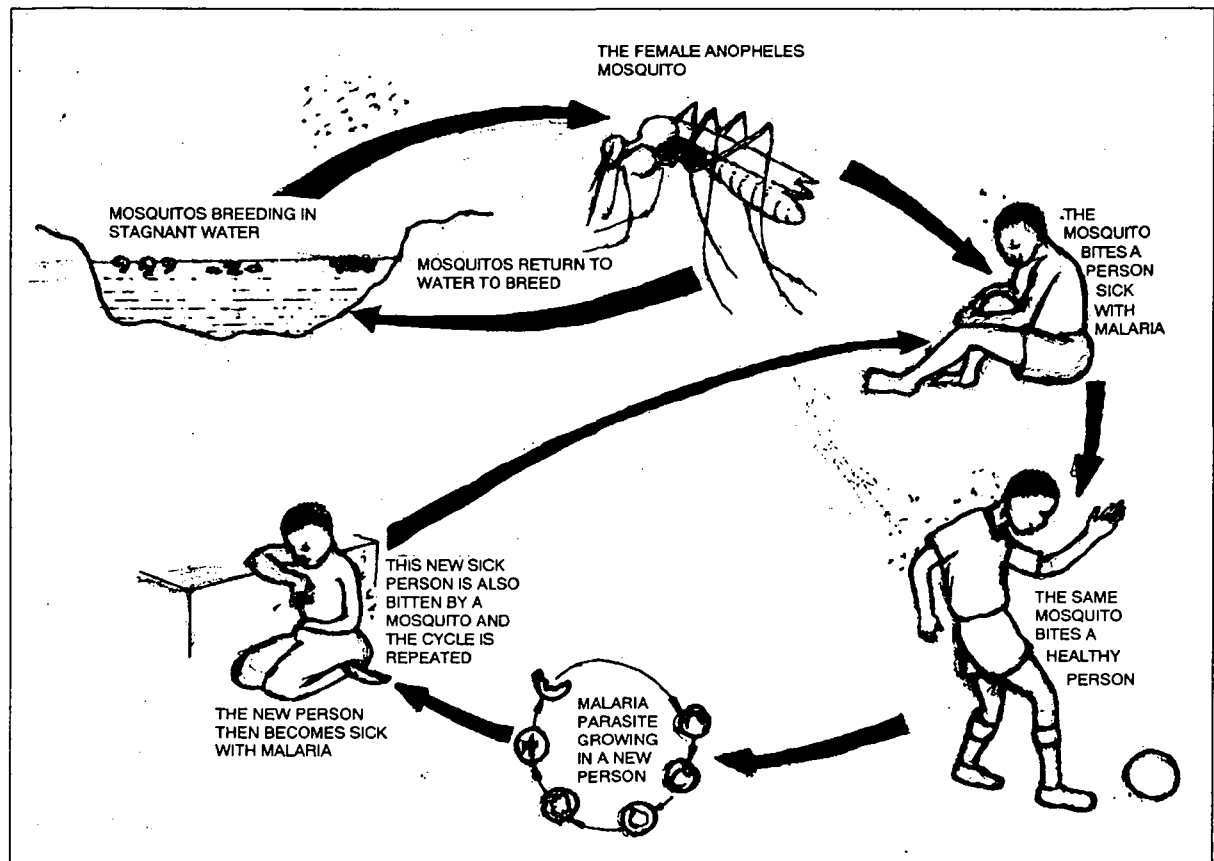
**Example: Malaria**, which is spread by the **female Anopheles mosquito**.

#### **The life-cycle of the mosquito.**

- The mosquito lays its eggs in standing water, that collects in empty cans, empty bottles, old tyres, gutters, and weeds. The eggs then hatch and develop there into adult mosquitoes.

(egg → larva → pupa → adult mosquito).

**Figure 10: How the mosquito spreads malaria.**



**Steps involved in the spread of malaria.** (See figure 10 above)

1. The adult female mosquito bites a person and sucks blood for a meal. If the person is sick with malaria, the blood meal will contain **tiny germs called malaria parasites**.
2. These parasites go through some changes and multiply in the mosquito.
3. Next, the mosquito bites a healthy person and gives him/her the parasites.
4. The parasites, grows and multiplies further in the person's liver and blood cells.
5. The new person then becomes sick with malaria.
6. Another mosquito bites this new malaria patient and the cycle is repeated.

**How to prevent and control malaria.**

1. Do not create breeding grounds for the mosquito.
  - Do not leave empty cans, bottles, and old car tyres around to collect water.
  - Do not allow the environment to be overgrown with weeds.
  - Ensure good drainage around the home in order to avoid the formation of pools of stagnant water.
2. Destroy all existing breeding grounds.
  - Drain stagnant water from ponds, empty cans, bottles etc.
  - Clear weeds from around the home.

3. Kill adult mosquito by using insecticides.
4. Prevent the adult mosquito from biting you:
  - Sleep in impregnated mosquito nets.
  - Cover windows in the home with mosquito screens.

#### **Other diseases that can be spread through water**

- **Eating under-cooked fish.**

Fish and shellfish may contain disease parasites. These parasites get into the water bodies, and later into the fish, when faeces that contain them are discharged or washed into the water. An example is the **fish tapeworm**. If the fish is not cooked well (under-cooked) to kill the parasite before it is eaten, one could get sick.
  
- **Accumulation of (toxic) dangerous chemicals in fish.**

Sometimes industrial wastes containing poisonous chemicals (toxins) are discharged into water bodies. These toxins may find their way into fish so that when a person eats this fish, the toxic substances may get into the body and make him/her sick.

#### **NOTE!**

Please note that it is not only drinking or ingesting contaminated water that can make us ill, sometimes bathing in streams that contain some disease carriers. In addition, leaving stagnant water around for the development of mosquitoes can also make us sick.



## MODULE 2

### POTENTIALLY HARMFUL CHEMICALS IN DRINKING WATER

#### Introduction

##### Chemical contaminants:

Water naturally contains some chemicals that get into it from the following sources:

- Naturally washed into it from underlining rocks.
- Discharged into it from industrial wastes as pollutants
- Discharged into it from domestic wastes as pollutants
- Pesticides and fertilisers washed into it from farms as pollutants.

When these chemicals are in small quantities, (levels below the WHO guidelines) and do not affect the colour and taste of the water, it does not matter. However, some of them, even in small quantities are harmful to human health. Examples of such harmful chemical contaminants are **lead, arsenic, nitrites and nitrates**. Others are not necessarily harmful but may affect the water quality such as the taste and colour, if their concentrations are above certain levels. Consumers characteristically reject water that has taste and colour. Examples of such chemicals are listed in Table 1.

**Table 1: Chemicals that are not necessarily harmful and how they affect water quality.**

| Parameter         | Upper limits (mg/l) | Quality of water affected            |
|-------------------|---------------------|--------------------------------------|
| Aluminium         | 0.2                 | Depositions, discoloration           |
| Ammonia           | 1.5                 | Odour and taste                      |
| Chloride          | 250                 | Taste                                |
| Copper            | 1.0                 | Staining of clothes and utensils     |
| Total Hardness    | 500                 | Using too much soap, white deposits  |
| Hydrogen sulphide | 0.05                | Odour and taste                      |
| Iron              | 0.3                 | Staining of clothes and utensils     |
| Manganese         | 0.1                 | Staining of clothes and utensils     |
| Sodium            | 200                 | taste                                |
| sulphate          | 250                 | taste                                |
| pH                |                     | High pH gives a taste and soapy feel |
| Zinc              | 3.0                 | Taste and appearance                 |

**\*\* Iron and Manganese are mentioned again in Table 2 because of the problems they cause in water supply in rural areas.**

**Table 2: Common chemical contaminants, their sources and effects on Health**

| <b>Name of Chemical</b>                             | <b>WHO guidelines for drinking water</b> | <b>Sources of contamination</b>  | <b>Some of the effects on health</b>  |
|---|--|--|---|
| <b>Lead</b>   | Not to exceed 0.01mg/l                   | Leaching from soil, leaded fuel  | Nerve poison affecting children; damage brain, kidney, liver                            |
| <b>Arsenic</b>                                      | Not to exceed 0.01mg/l                   | Naturally from rocks; industrial(e.g. copper mining) and agricultural wastes | Bladder, lung and skin cancer.  |
| <b>Nitrites</b>                                     | 3.0mg/l                                  | In soil, manure, decaying organic matter, fertilisers                        | Methemoglobinemia (blue baby) disease in infants. May cause death                       |
| <b>Nitrates (convert into nitrites in the body)</b> | 50mg/l                                   | Same as nitrites   | Same as nitrites  |
| <b>Iron</b>   | 0.3mg/l                                  | Naturally in rocks and leach into ground water                               | No known health hazard but gives bad taste and colour (red brown) when changes to oxide |
| <b>Manganese</b>                                    | 0.1mg/l                                  | Same as for iron   | Same as for iron (colour blackish tint)   |

**LEAD**

**How does lead get into water?**

Lead can get into water, especially ground water:

- By leaching from soil polluted with petrol containing lead (leaded petrol),
- From crop irrigation and,
- From food processing factories.

**How can drinking water containing lead affect a person's health?**

Studies have shown that lead causes serious health hazards especially in children:

- Lead is a nerve poison (neurotoxin), which affects the mental development of millions of children and adults.
- In children, especially children under 6 years old, the effects include reading and learning disabilities and poor growth.
- If the amount of lead taken in is low, the brain, kidney, liver and nerves may be damaged, but if it is very high the person could die.

The highest limit of lead in water, according to the **WHO Guidelines** for drinking water, is **not to exceed 0.01 mg/l. (milligrams per litre)**

### **ARSENIC**

#### **How does arsenic get into water?**

Arsenic gets washed into water supplies from:

- Natural deposits (rocks) in the ground
- From industrial and agricultural waste products (pollution).
- Arsenic is a **by-product of copper smelting, mining and coal burning.**

**Arsenic, therefore, becomes important in Zambia due to the copper mining industry and so its concentration in water must be monitored carefully, especially in the Copper Belt.**

#### **How can drinking water containing arsenic affect a person's health?**

- Arsenic is known to cause cancer, especially cancer of the skin. It is suspected that it could cause other forms of cancer including cancer of the bladder and lungs. According to the **WHO Guidelines** for drinking water, the concentration of arsenic in water should **not exceed 0.01 mg/l.**

### **NITRATES AND NITRITES (nitrogen compounds)**

#### **How do nitrates and nitrites get into water?**

- These nitrogen compounds occur naturally in the soil and they are important food for plants.
- They are found in manure, decaying plants and fertilisers. They dissolve easily in water so they get leached into groundwater, especially shallow wells.
- This problem may be common, therefore, in the farming districts.
- Nitrates and nitrites do not give colour or taste to water so can only be detected by laboratory tests.

#### **How can drinking water containing nitrites and nitrates affect a person's health?**

- When nitrates contaminate drinking water in concentrations **higher than 10 mg/litre**, the water should not be given to children under 12 months old.
- In these infants, **nitrates are converted into nitrites**, which are absorbed into the blood.

- The nitrites in the blood interfere with the transport of oxygen in the blood, causing a disease condition called methemoglobinemia (Blue Baby)
- In this condition, the amount of oxygen in the blood is decreased so the skin turns blue. If this is severe, it could result in brain damage or death.

## **IRON AND MANGANESE**

### **How do iron and manganese get into drinking water?**

- Iron and manganese commonly occur in rocks in the ground and from there get washed into water sources. (Water sinking through soil and rock can dissolve minerals containing iron and manganese and hold them in solution).
- Occasionally, iron pipes may also be a source of iron in water.

### **How can drinking water containing iron and manganese affect a person's health?**

- Iron and manganese in drinking water are not very harmful to health.
- Iron and manganese are actually very good for the body.
- Iron and manganese are chemically similar and cause similar problems.
- Iron occurs in water more commonly than manganese.
- The **WHO Guidelines** for drinking water give the upper limits for the concentration of iron as **0.3mg/l** and that for manganese as **0.05mg/l**.

### **Water quality problems caused by iron and manganese.**

- Even when underground water in deep wells and boreholes contain iron and manganese it remains clear and colourless. This is because there is very little air (oxygen) underground.
- However, when underground water is collected from the wells and boreholes and comes in contact with air, the oxygen in the air mixes with the iron and manganese and changes them into coloured substances called oxides.
- The new iron chemical (ferric oxide) is in the form of reddish-brown particles, that settle at the bottom of the water. Sometimes some of the particles are so small (colloidal iron) that they cannot settle at the bottom but remain in the water, giving the water a reddish-brown colour.
- In the case of manganese, the particles formed are black in colour.
- These coloured particles (sediments) are responsible for the staining properties of water containing high concentrations of iron and manganese.
- The content of iron and manganese in water higher than the WHO Guideline values may give taste and colour to food if used for cooking. They may give water an unpleasant taste, reddish or blackish colour and may also stain laundry and dishes.

### **Control measures for chemical contaminants.**

It is very difficult and expensive to remove these chemicals from water. In most cases, the affected water source, especially groundwater, is abandoned or used for purposes other than drinking.

- Iron however, could be removed using simple methods. The process involves mixing the water with air. This changes the iron in solution into the reddish precipitate (particles) as explained earlier. Then the water is filtered to remove the particles.
- Do not discharge industrial and domestic wastes into or near water sources.
- Treat industrial wastes to remove harmful chemicals before they are disposed of.

## MODULE 3

### HYGIENE EDUCATION: PERSONAL HYGIENE AND SANITATION

#### **Introduction:**

It has been made clear in Module I Units 2 and 3, that in order to effectively control the spread of water-related diseases, and sustain good health there should be:

- **Protection of water sources which will result in the improvement of the drinking-water quality**
- **Improvement in personal hygiene practices**
- **Improvement in environmental sanitation practices.**

**Module 3, on Hygiene Education**, is designed to ensure that community members have a basic understanding of what good personal hygiene and sanitation practices are so they can practise them effectively.

The module is sub-divided into the following Units:

- Unit 1: Hand-washing**
- Unit 2: Latrine usage and maintenance**
- Unit 3: Refuse and waste water disposal**
- Unit 4: Cleanliness in carrying water, storing water and in cooking food**
- Unit 5: A review of other personal hygiene practices**

## UNIT 1

### HAND-WASHING

#### **Why should we wash our hands?**

Because our hands become contaminated with the germs that cause diseases while:

- Working on the farm
- Cleaning our anal area or the anal area of a child after defecating
- Blowing our noses when we have a cold
- Playing in dirt on the ground
- Handling or playing with animals.

#### **Thus we wash our hands to:**

- Get rid of any disease germs that may be on the hands.
- Keep them clean, and smelling good.

#### **What do we need for hand-washing?**

- Adequate amount of water
- Soap or ash

**How do we make sure that water and soap are available by our latrines at all times?**

Some suggestions include:

**Ash:** put a container (a pot) by the latrine door for people to put in ash from their stove every morning.

**Soap:** keep soap by the container of water or people should bring their own, but if they forget then they could use the ash provided.

**Water:** Place a pot or other suitable container filled with water by the latrine alongside the soap or the pot of ash.

- Community members should meet and discuss how best they can organise themselves to ensure that there is water in the container at all times.
- It is also important to use or to design a system, that will prevent users from contaminating all the water in the container.

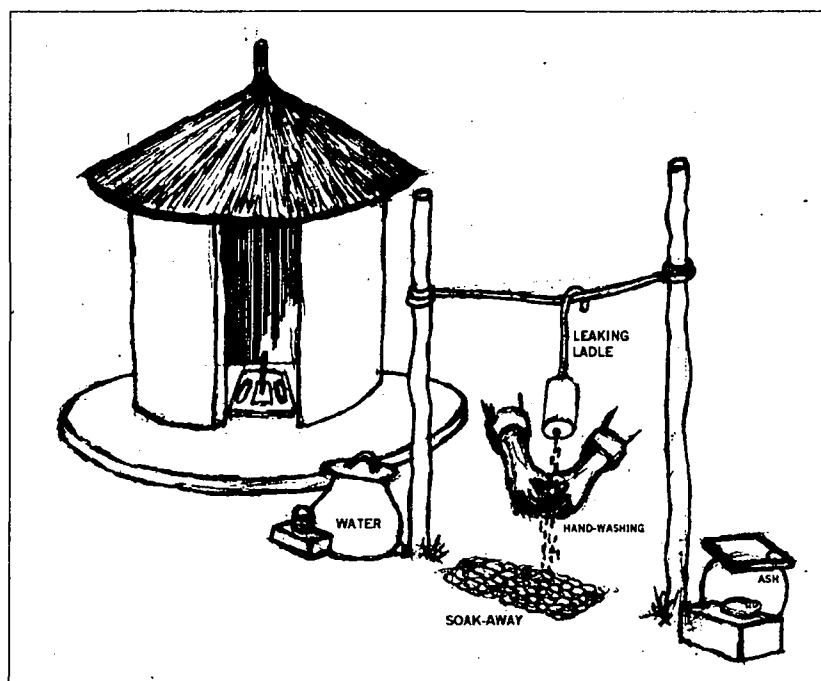
A good example is the “leaking ladle or water scoop”: (See Figure 1a)

1. The ladle has a small hole at the bottom.
2. It is used to collect water from the storage container and then hung over a soak-away.
3. The water leaks out slowly allowing the person to wash his/her hands in that slow stream of running water.

**Advantages:**

- The user does not touch the ladle again after washing his/her hands.
- Only a controlled amount of water is used at a time.
- The user’s hands do not touch the water to contaminate the water.

**Figure 1a: A latrine with hand-washing facilities using the leaking-ladle**



**Figure 1b:** A latrine with hand-washing facilities showing an alternative method of washing hands after using the latrine; having water poured over the hands.



**How should we wash our hands?**

1. Wet your hands slightly and apply soap or ash.
2. Then rub your hands together vigorously.
3. Rinse your hands under a running water from, for example, the leaking ladle (Figure 1a) or have water poured over your hands (Figure 1b) while still rubbing them together.
4. Dry your hands in the air or with a very clean towel.

**Question:**

**What about washing hands in a communal basin of water?**

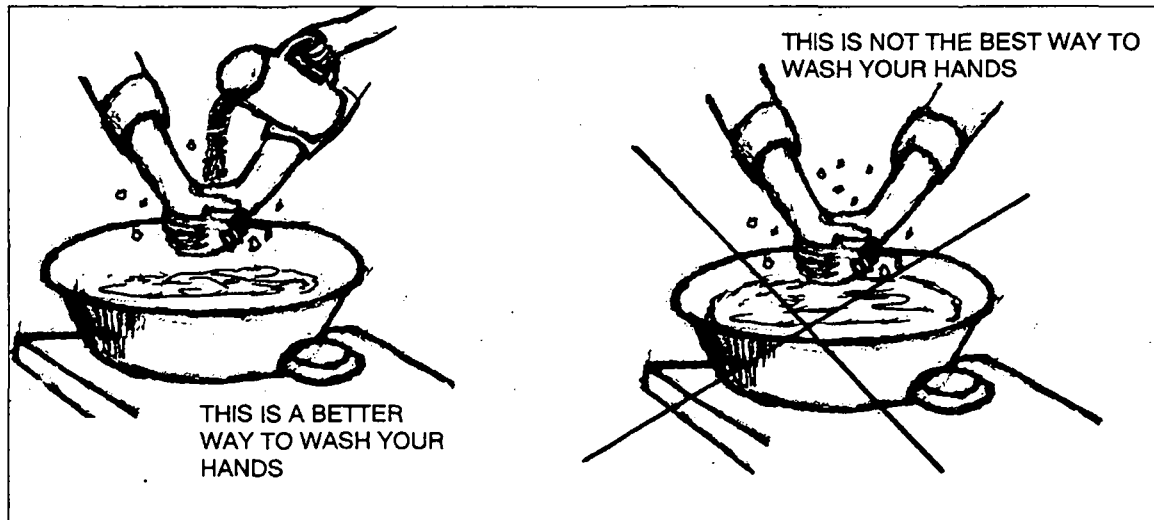
**Avoid washing your hands in a communal basin of water (See Figure 2 below). This is not the best way to wash your hands.**



**Why should you not wash your hands in a communal basin of water?**

Because the germs you wash off your hands remain in the bowl. This means that you will pick up not only some of your germs, but also those from the persons who washed their hands before you.

**Figure 2: Hand washing in a communal basin of water.**



**When should we wash our hands?**

**Before**

- Eating
- Feeding a child;
- Cooking or handling food

**After**

- Defecating;
- Handling a child's faeces or cleaning up a child;
- Playing in dirt (children);
- Returning from school, the farm, or other places of work;
- Handling domestic or farm animals.

## UNIT 2

### LATRINES: USAGE AND MAINTENANCE

#### **Why is it important for families or community members to have latrines?**

When latrines are constructed properly, and are used at all times to dispose of faeces, it protects the community from faecal-oral transmitted diseases.

#### **Where should a latrine be constructed?**

- It should be as close to the living quarters as possible, provided the following conditions are met:
  1. It is constructed at least 30 metres from the nearest water source.
  2. It is located on lower ground than the nearest water source.

#### **How should a latrine be constructed to make it safe, sanitary and convenient?**

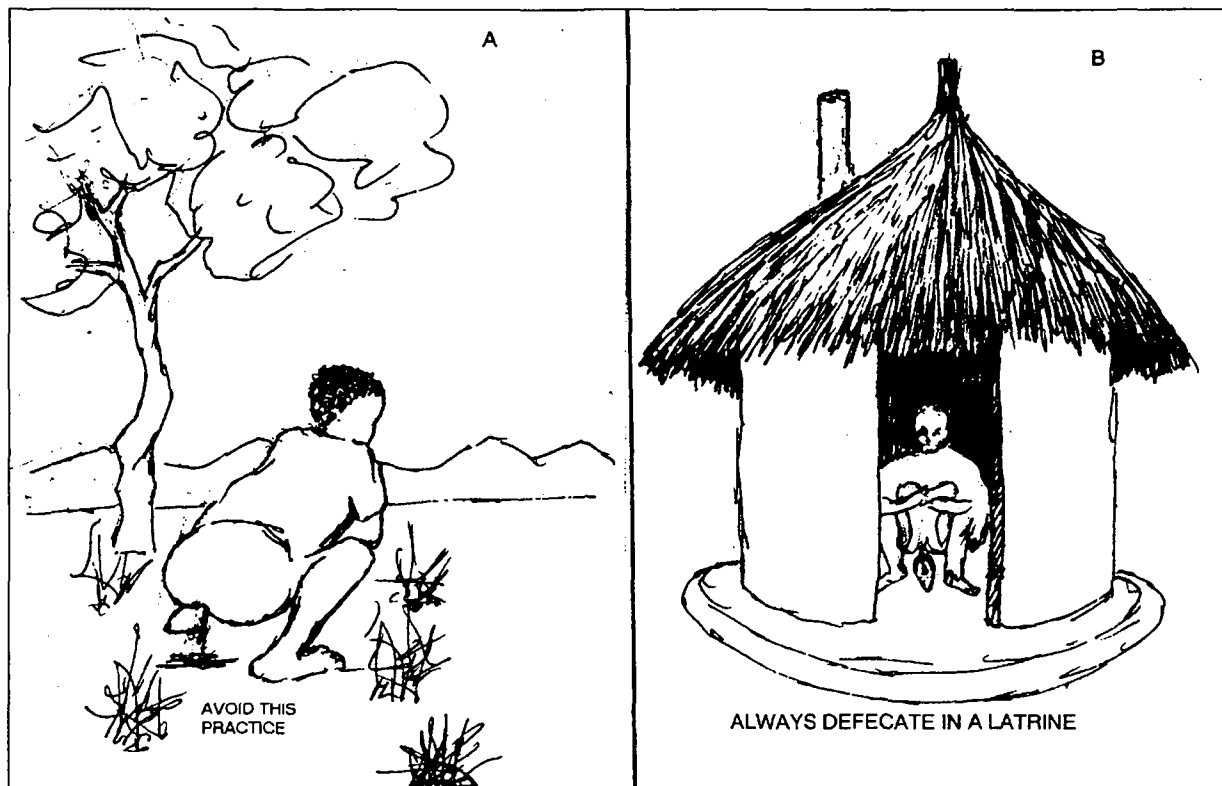
It should have:

- A properly constructed pit, which is lined in collapsing soil, and a proper foundation for the superstructure.
- A platform with a safe hole (key shaped) protecting small children and domestic animals from falling into the pit.
- Raised foot steps that guide people to squat properly, even at night
- A floor that slopes inwards towards the hole, so that water can easily flow into the hole when the platform is cleaned.
- Proper ventilation.

#### **How should latrines be used?**

- Use the latrine always when you need to defecate. (See Figure 3 below)
- Show older children how to use the latrine properly, and encourage them to use it all the time.
- Always throw the faeces of infants, and children into the latrine pit.
- Squat on the squat hole properly so that all faeces drop into the pit without soiling the platform around it.
- Make anal cleaning materials readily available for use when needed.
- Have water in a container at the entrance of the door to the latrine and ensure that there is always water in it. (see Module 3, Unit 1 on hand washing)
- Assign the responsibility of providing water in the container to some persons in the family or community.
- Make sure that there is always soap or ash next to the container of water.
- **Wash your hands always after defecating with clean water and soap or ash provided at the entrance to the latrine. (See Module 3, Unit 1)**

**Figure 3: A person NOT defecating in a latrine in Figure 3a, and in Figure 3b a person defecating in a latrine.**



**Maintenance of all latrines.**

- Keep the inside of the latrine, and its immediate surroundings clean at all times. **Assign the responsibility to specific persons.** (See Figure 4 below)
- Scrub the floor, especially the area around the squat-hole and foot rest, regularly even daily with lots of water.
- Do sanitary survey at regular intervals to ensure that good sanitation practices are being followed. (See Module 5 for Sanitary Surveys)
- Make sure that the squat-hole cover fits the hole properly and provide the cover with a handle for easy lifting.
- Cover the squat-hole properly after using the latrine, in order to avoid flies flying in and out. Remember that flies transmit diseases.
- Fit a door that shuts properly, and when you leave the latrine make sure that you close the door to prevent domestic animals from going in. (See Figure 4 below)

Figure 4: A well-maintained pit latrine.



**For VIP latrines:**

- **Do not cover the squat-hole.** This allows ventilation that will reduce bad odour formation.
- Make sure that the **screen net** on top of the vent is intact, and in place to trap flies.

## UNIT 3

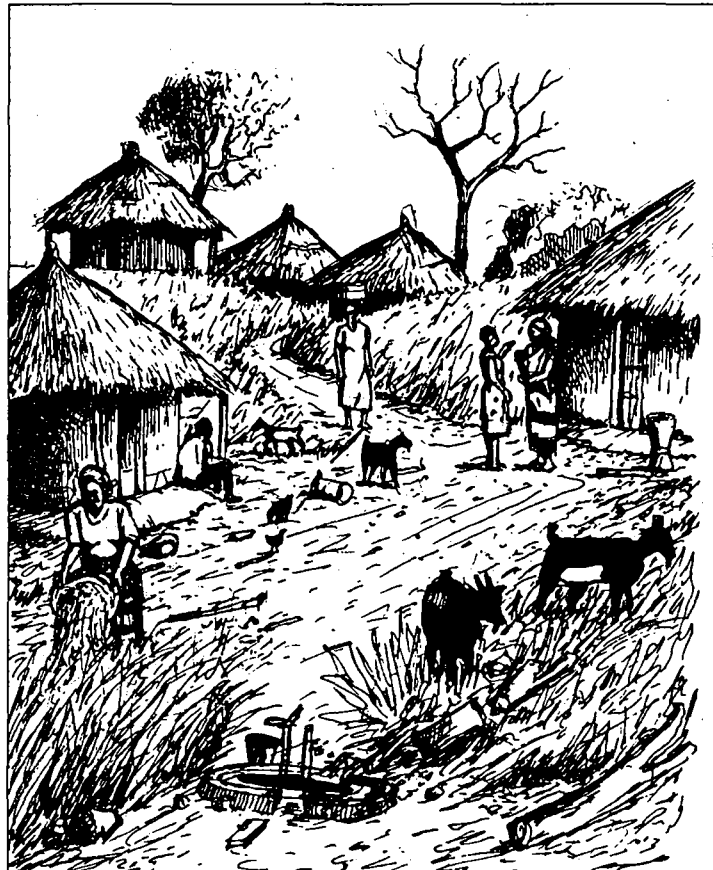
### REFUSE AND WASTE WATER DISPOSAL

As we go about our daily activities, we generate refuse, and waste water as by-products. If these are not disposed of quickly and properly, they accumulate and cause health problems in the environment.

#### Problems associated with the accumulation of refuse.

- It makes the environment dirty, untidy and reduces the quality of our environment. (See Figure 5 below)
- Decomposition of dead plants and animals give off bad odour that pollutes the air.
- It is used as feeding and breeding grounds for germs, mosquitoes, rats, mice, flies cockroaches, which invade our homes and spread diseases.
- Domestic animals such as dogs and goats, which are not kept in dens, go there to eat and bring germs to our homes.
- Empty cans and bottles collect water where the mosquitoes can breed.

**Figure 5:** A dirty and unhealthy environment.



**The proper way to dispose of refuse to ensure a clean and healthy environment** (See Figure 6)

- Select a good site away from the living areas, and just outside the community for refuse disposal.
- Reduce the volume of the refuse by:
  - **Recycling** valuable parts of the refuse – for example, bottles can be reused instead of throwing them away. Make sure that the bottles are cleaned thoroughly before reusing them.
  - Using plants or vegetable wastes to
    - **feed animals** like goats, sheep and cows
    - make **compost** that in turn can be used as **manure** in our farms.
- Bury the rest of the refuse in refuse pits and cover with soil or carry it to a place selected for refuse disposal.

**Figure 6: A clean and healthy environment**



### Waste water disposal

Waste water, if not disposed of properly, leaves ponds and stagnant water, in which

- **mosquitoes can breed** and spread malaria.

The proper way to dispose of waste water is to:

- Let it drain into a covered soak-away pit.
- Make sure that the soak-away is not too close to a water source to contaminate it.

**To construct a soak-away:**

- Dig a large pit, fill it with large stones and cover it.
- Construct a **drainage channel** to carry the waste water to the soak-away.
- Ensure that the drainage channel is not blocked so that the waste water flows freely always.

## UNIT 4

### CLEANLINESS IN CARRYING WATER, STORING WATER AND IN COOKING FOOD

Germs can re-enter water at all stages, from collection to storage, if control measures are not followed. Listed below are some of the steps to follow in order to minimize recontamination of water.

#### Care during collection of water from water point

- The container, bucket or jerry can, used to carry water must be very clean. If necessary, should be washed at the water point before filling it with water. Make sure that your hands are clean and do not play in the water.
- Use only one container (bucket) to draw water from wells.
- The container and the rope should not be allowed to come in contact with the ground since that will introduce germs into the water.
- If the container falls to the ground by accident, it should be washed well before being used to draw water again.
- If no windlass is installed, a short pole can be erected next to the well where the bucket for drawing water can be hung when not in use.

#### Care during transportation of water from water points to the home

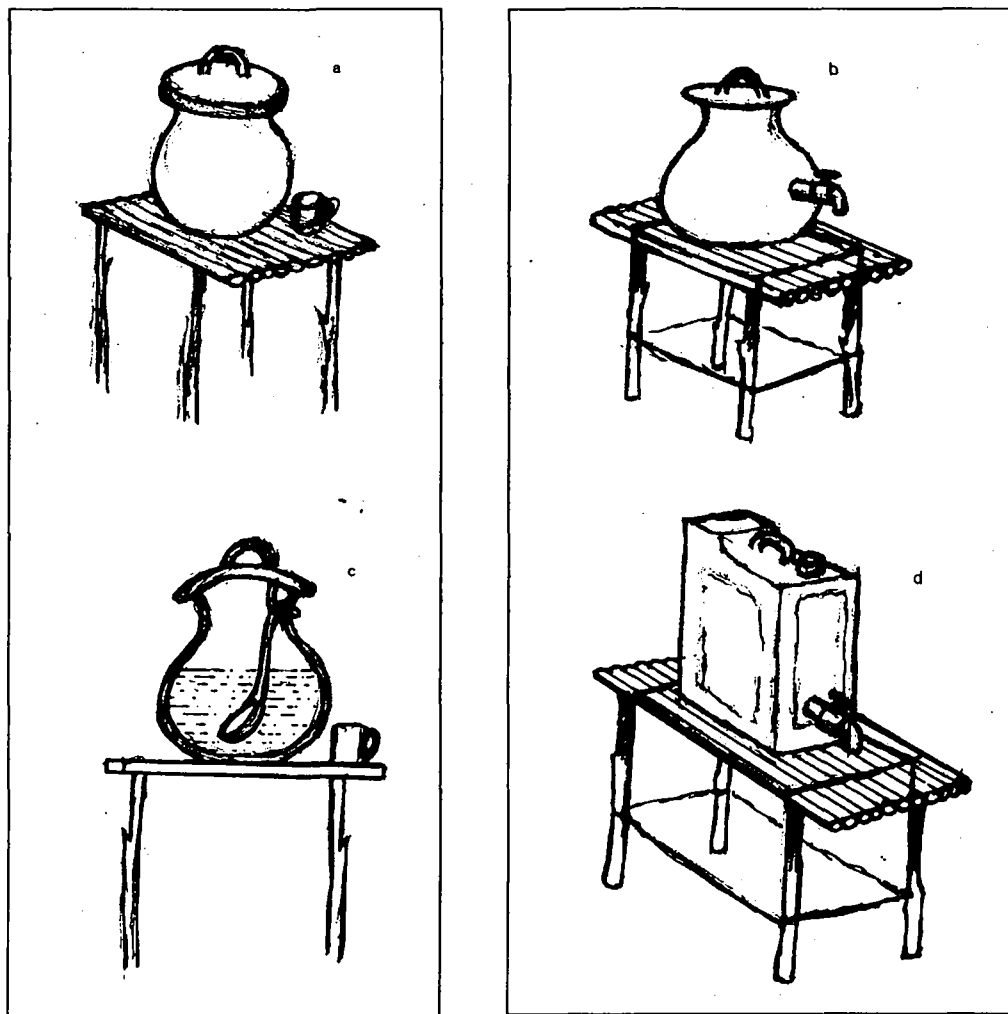
- If the container has a lid, then protect the water by covering it.
- Maintain good hygiene practices. For example, wash your hands before handling water, especially drinking water.

**Care during storage of water at home.**

Clean water can become contaminated again if not stored properly. To prevent recontamination, the following measures should be taken:

- Drinking-water storage containers should be kept separate from others.
- The container used for storage should be easy to fill, cleaned and have a tight fitting lid. Examples are a plastic bucket with a lid, a 20 litre jerry can with a lid, a pot with a lid. (See Figure 7 below)
- The container should always be covered.
- It should be kept in a safe place where younger children cannot play in the water, and the surroundings kept clean.
- The container should be cleaned regularly.
- If possible, use a container that has a tap fixed to it. (See Figure 7 below)

**Figure 7: Examples of drinking-water storage containers. (c is a cross-section)**





### **Care when removing water from the storage container.**

The best way to remove drinking water from storage containers which have no taps, is to pour it out from the container. However, most of the time that is not possible because the containers may be too heavy. Taking the measures listed below will help reduce the risk of contamination.

- Use only one vessel, a cup or ladle with a long handle, to remove water from the container.
- Do not drink directly from the cup; use it only to transfer water into another cup or container.
- Care should be taken that the hand does not come in contact with the water when removing water from the storage container.
- Practise good personal hygiene, such as making sure that your hands are clean, before drawing water from the container.

### **Cleanliness in cooking, eating and drinking**

- Water should always be treated, for example, boiled before drinking, especially when there is an outbreak (epidemic) of cholera and other diarrhoeal diseases.
- Use cooking pots and serving dishes that have covers.
- Cover all food and drinking-water containers properly to prevent flies and other insects, that transmit diseases, from crawling into them.
- Wash your hands very well before handling or cooking food and eating.
- Wash your hands with soap and clean water before serving food.
- Wash all fruits and vegetables very well before eating them or better still peel them if possible.
- Wash your dishes and pots well with soap and clean water.
- Wash your cutting board especially well with soap and water.
- There should be sufficient water available for washing the dishes, vegetables and cleaning.
- Serve food and drinks in clean dishes and cups.
- Thoroughly cook all meat and fish to kill all parasites such as tapeworms and eat them while hot.
- Erect simple platforms or dish racks in your kitchen for storing food and dishes. (See Figure 9b below).
- Keep your kitchen clean so that rats, mice and insects like cockroaches are not attracted to come there to breed. Avoid unhealthy kitchens as shown in Figure 9a below.

Figure 9:

a: An unhealthy kitchen

b: A clean and healthy kitchen



## UNIT 5

### A REVIEW OF GOOD PERSONAL HYGIENE PRACTICES

In order to make sure that we stay healthy, it is important for us to keep both ourselves, and our environment clean. Below is a list of some good personal hygiene practices to follow.

- Wash your hands with soap or ash and water after defecation and before handling food or eating.
- Always urinate and defecate in the latrine.
- Dispose of children and infants faeces in the latrine.
- Clean latrines regularly.
- Change and wash your clothing regularly in order to avoid unpleasant body odour.
- Wash your hair regularly to avoid head lice.
- Have at least one bath a day, especially after working hard and sweating in order to avoid unpleasant body odour.
- Brush your teeth everyday and after each time you eat sweets to prevent cavities developing in your teeth.
- Cut your finger nails, and especially those of children, regularly because germs that cause diseases, can be trapped in them.
- Do not spit on the floor because sputum can also spread diseases like tuberculosis.
- Cover your nose and mouth when you cough or sneeze in order not to spread diseases of the chest.
- Sweep, dust and air your home regularly.
- Air your bedding regularly so that disease vectors like fleas do not hide in them.

## MODULE 4

### SOURCES OF WATER

#### Introduction

Water is of great importance to man and all other living things because:

- **All living things, including humans, need water to survive.**
- **Over 70 percent of the human body is made up of water.**
- **Man needs water for drinking, cooking, cleaning and farming.**

For these reasons, man has always **explored all sources of water** available to him. In fact, in the early days, settlements were established around or near major sources of water.

- **Unfortunately this essential commodity can also be a source of water-borne diseases, (See Module 1) if the necessary preventive measures are not taken.**

Module 4 examines:

The different sources of water and:

- Methods of water collection,
- Sources of contamination, and
- How to protect the quality of the water.

The different sources of water are:

- **Rain water**
- **Surface water**
  - Streams and rivers
  - Lakes
- **Underground water**
  - springs
  - wells (shallow and deep)
  - boreholes

#### RAINWATER

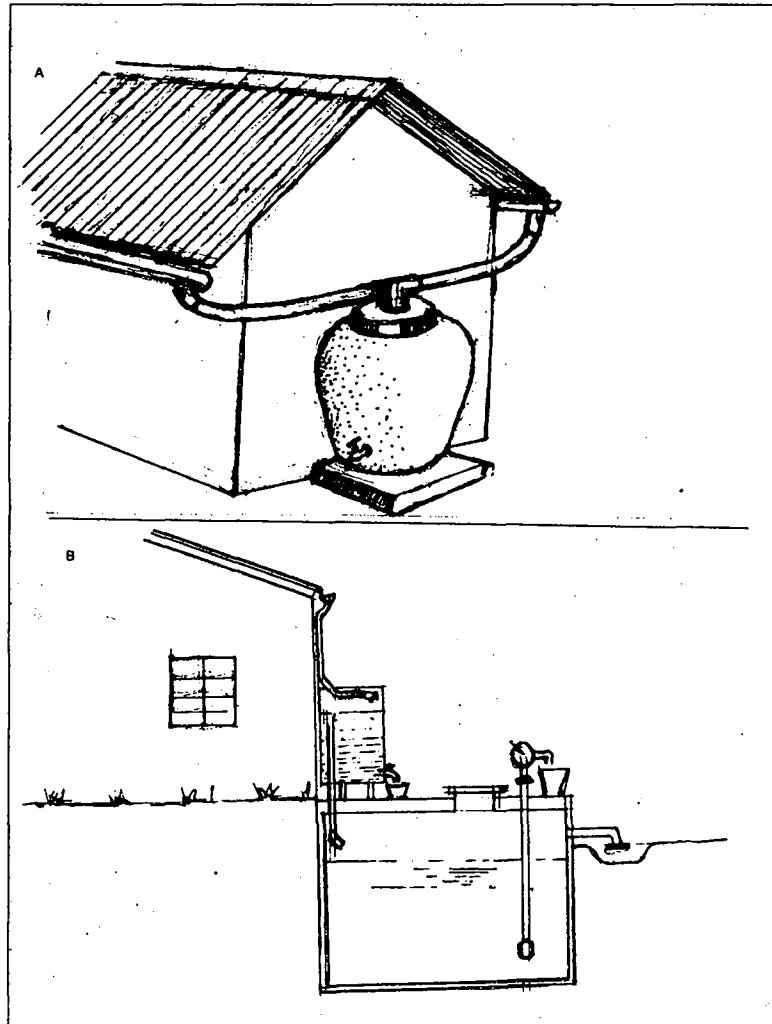
This can be the purest form of water, if it is collected properly and the air in the area is not heavily polluted, as it is in some industrial countries.

#### **Methods of collecting rain-water:**

The simplest way is to collect water draining from the roof of buildings through roof gutters, into

- Storage containers near the house or (see Figure 1a below)
- Underground storage tanks. (See Figure 1b below)

**Figure 1: Rainwater storage tanks**



**How does rain-water get dirty or contaminated with germs?**

Rain water gets contaminated by:

- Dust and animal droppings (faeces) especially birds droppings, that collect on the roofs of buildings.
- Pollutants in the air, for example carbon dioxide, that dissolves in the water to cause acid rain. (May not apply to Zambia at this present time)

**How to protect the quality of rain-water**

1. **Wash** the storage container properly and regularly if possible.
2. Let the **first rain wash away the dirt**, like dust and bird droppings off the roof before you start to collect the rain-water.
3. Put a **wire mesh** or screen over the top of the down-pipe for the roof gutter to prevent it from becoming clogged with leaves.
4. **Boil** the water before drinking, as an extra precaution.

**Question:** Do people in your community collect rain-water? What do they use it for?

## SURFACE WATER

### Streams, Rivers and Lakes

- These are the most abundant, common and most useful sources of water in some communities.
- Unfortunately, most of these sources, have been polluted and should be used only after adequate treatment. An example of a polluted river in Zambia is the Kafue River. (See Module 6 for water treatment methods).
- Sometimes, some rivers and lakes are polluted so much that even fish cannot live in them. In such cases, very extensive and expensive methods are needed to treat the water.

**How do these sources of water get dirty or contaminated by disease germs?**

1. Human, animal **faeces** and **urine** are deposited or washed into them.
  2. People **wash clothes** and other things and **swim** in them.
  3. **Fertilisers** and other farm wastes are discharged or washed into them.
  4. **Pesticides** that are used to spray crops on farms are washed into them.
  5. **Industrial and mining wastes** (chemicals) are discharged into them.
- These contaminants may be discharged directly into the water bodies or are washed by rain from the surrounding land into the water.

**Figure 2: Different ways in which river water gets contaminated**



- When these bad things (pollutants) are not too much, the rivers, streams and lakes can clean themselves (natural self-cleaning mechanisms).
- However, because population and industrial growth have increased, the level of pollution has also increased, so the water bodies are not able to clean themselves as well.

\*\*\*Remember that even if water looks clear to the eye it may contain many germs and harmful chemicals.

#### **What is the best way to collect water from a stream or river?**

- Water should always be **collected upstream** of any known point where any form of pollution is taking place. For example, if waste water is being discharged into a river, water should be collected at a point upstream to that point of discharge.

#### **How can the quality of surface water be protected?**

- **It is very difficult to protect surface water from contamination** because a river, for example, travels through a long distance. However, the extent of pollution can be reduced if people living along it practised good personal hygiene and environmental sanitation. (See Module 3)
- Water collected from rivers, streams and lakes should always be treated before drinking.
- There are many methods by which these sources of water can be treated to make them safe for drinking. (See Module 6 for simple methods of treating water at home).

### **UNDERGROUND WATER OR GROUNDWATER**

- This is water, mostly rain water, that has collected at different depths underground over many years. An area underground, where the water collects, is called an aquifer.
- Groundwater, under normal circumstances, should not contain any disease germs, because as rain-water seeps through the earth, the soil serves as a filter and removes the germs.

#### **Collection of groundwater**

- Groundwater becomes available to man when a **well** is dug, a **borehole** is drilled or when it comes out naturally as a **spring**.

#### **Sources of contamination**

- **Chemicals:**  
A problem with groundwater is the chemicals that are found in them. These are the naturally occurring chemicals in rocks or soil, that get washed along as water sinks towards the groundwater storage or aquifer. (See Module 2 for chemical contaminants in water).

- When dangerous chemicals, such as lead and arsenic, are found in groundwater, normally people are advised not to drink water from that source.
- Sometimes human activities also expose groundwater to contamination:
  - Mining
  - Latrines; pit latrines and septic tanks
  - Tombs
  - Disposal of wastes underground
  - When wells are not maintained properly

### Protecting groundwater from contamination

**At the community level, the protection will be limited to protecting the water points.**

- With respect to drinking-water quality, the risk to human health is mostly from contamination with disease germs found in faeces.  
Therefore, sources of such contamination, such as pit latrines, should be as far away as possible (minimum safe distance) from groundwater points - wells and boreholes.
- **In Zambia the minimum safe distance between a water point and a potential source of pollution is given as 30 metres.**
- These potential sources of pollution should **not be on ground higher than the water points.**

### Springs

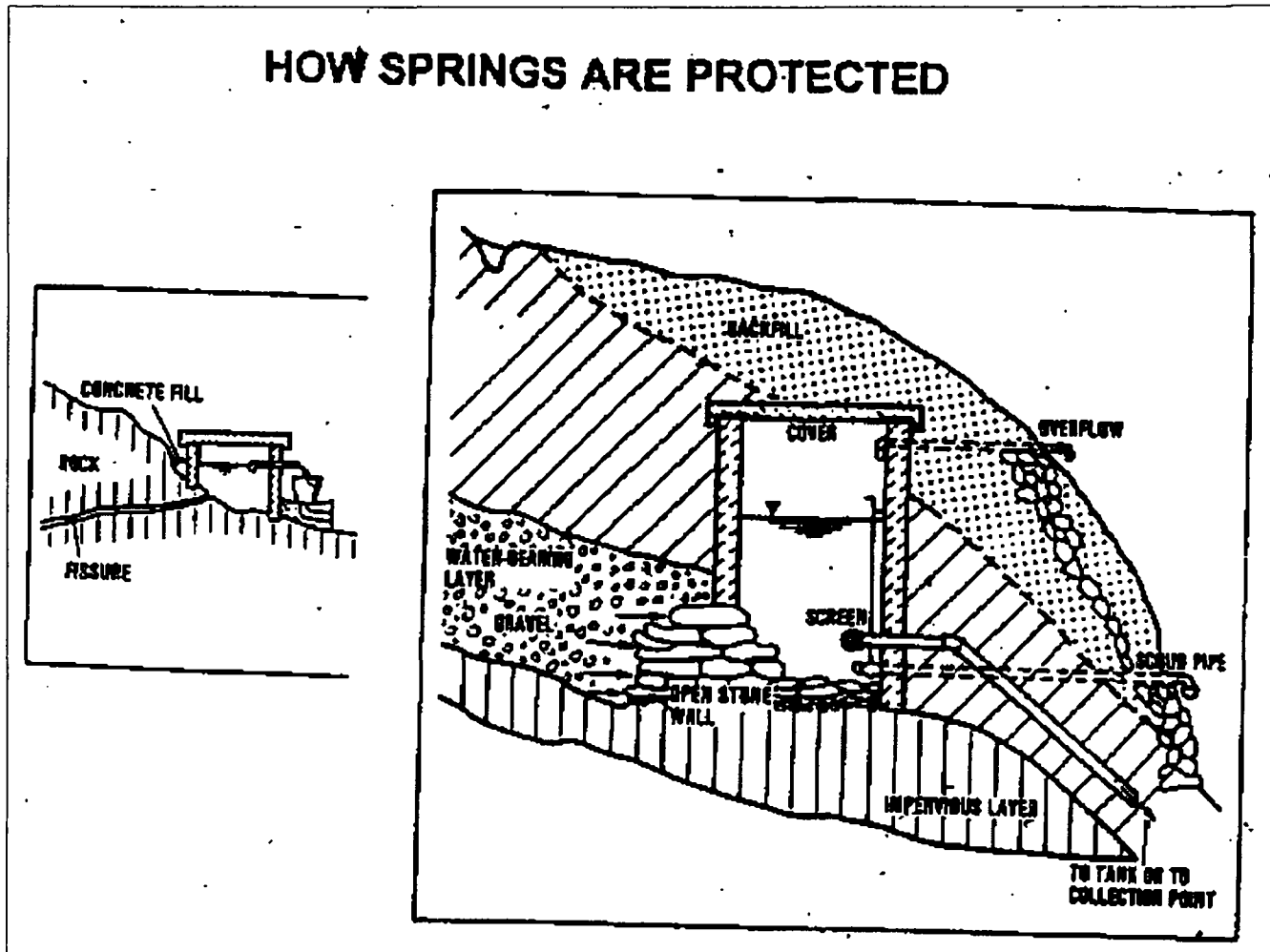
- A spring is underground water that flows out naturally, usually from the side of a hill.
- For this reason, spring water can be of very high quality, and used without treatment if some measures are taken to protect the outflow properly.
- Unprotected outflows could be contaminated by human and animal activities.

**How to protect and keep spring water safe for drinking:**

- Build a covered concrete structure (a spring box) around the edge so that the water flows directly into a pipe without ever being open to pollution from outside. ( See Figure 3)
- The box should be easy to clean.
- The cover must be securely locked to stop unauthorized personnel from contaminating the water.
- The box should have an overflow vent and an air vent.
- A fence should be constructed around it in order to prevent animals from getting too close to the source.
- A surface drainage ditch should be dug uphill to the source to direct surface water run-off away from the source.
- **If the spring is not protected, then the water should be treated before drinking.**



Figure 3: A spring box protecting the outflow of spring water



**Wells (shallow and deep including boreholes):**

Wells give access to underground water and are very common sources of water in many communities, especially rural communities.

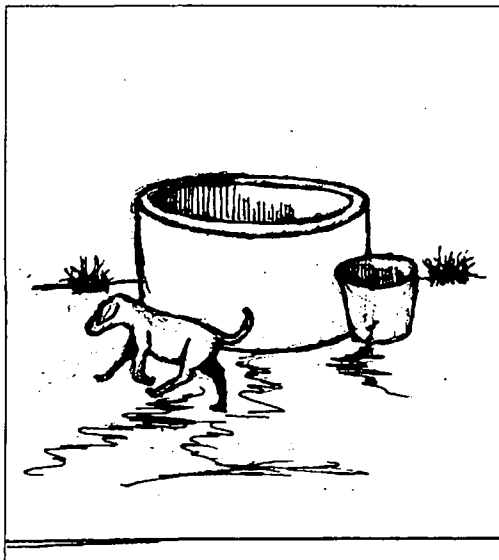
**Factors affecting the quality of well water:**

- The **Water table** determines the depth of the well. Normally, the deeper the well the better the bacteriological quality of the water, all other things being equal since the water is filtered through a longer column of soil.
- **Location**, for countries along the sea, distance from the sea determines whether the water will be salty or not. This does not apply to Zambia.
- **Distance from potential sources of pollution.** For example, pit latrines, tombs and refuse dumps etc.  
Such pollution may affect the bacteriological quality of the well water.
- The **type of rock formation** in the area affects the chemical quality.

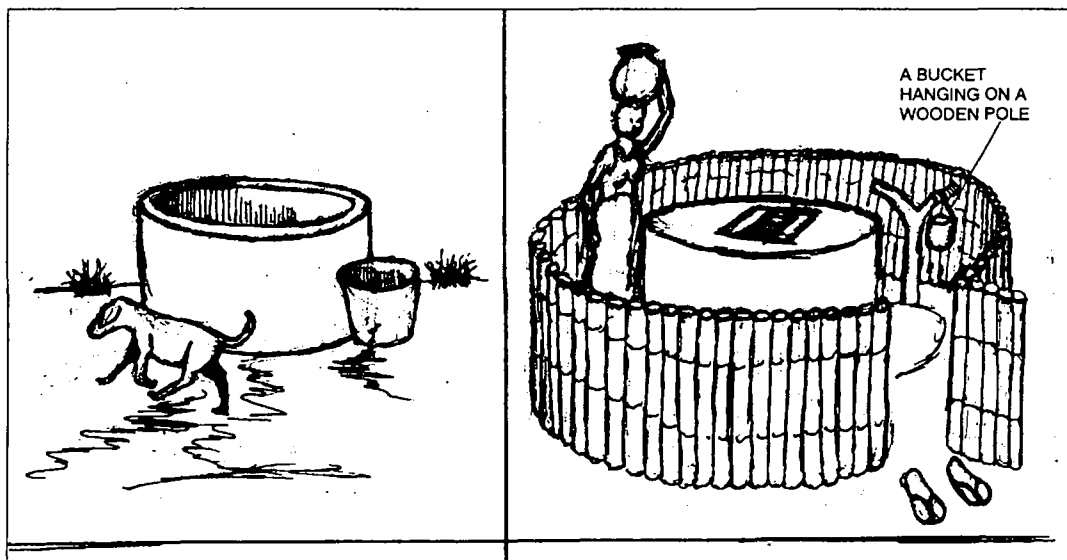
**Steps to take to protect the quality of well water:**

- Situate the well at least **30 metres** from possible pollution source, e.g. refuse dumps, latrines, tombs, animal pens, stagnant water etc.
- The well should also be **situated on higher ground** than possible pollution sources
- A well should be **lined** with either brick, stone, masonry (caisson) for several reasons:
  - It protects the well during construction against caving and collapse;
  - It prolongs the life of the well by retaining the walls after completion;
  - It prevents polluted surface water from entering the well;
  - It acts as foundation and support for the well top or headwall (parapet) and any pump or other mechanism, that may be fitted on completion.
- A **raised parapet** should be constructed around its outer rim to protect the well from the inflow of outside or surface dirty water. The wall should be high enough (50-75 cm) to prevent small children and animals from falling into the well. (See Figures 4 and 5a)
- A **concrete apron of 2 metres diameter or 2 metres square** should be constructed around the well, and it should slope so that water flows away from the well instead of collecting around it. (See Figure 5)
- A **concrete drainage channel at least 3 metres long** should be constructed to carry spilled water away from the well apron. (See Figure 5)
- All wells should have a **secure cover**, which should also slope, so that water is able to drain off it.
- **Dug wells** should have either a **windlass** (Figure 5a) or a **hand pump** (Figure 5b) for drawing water.

**Figure 4a: An unprotected well**



**Figure 4b: A protected well**

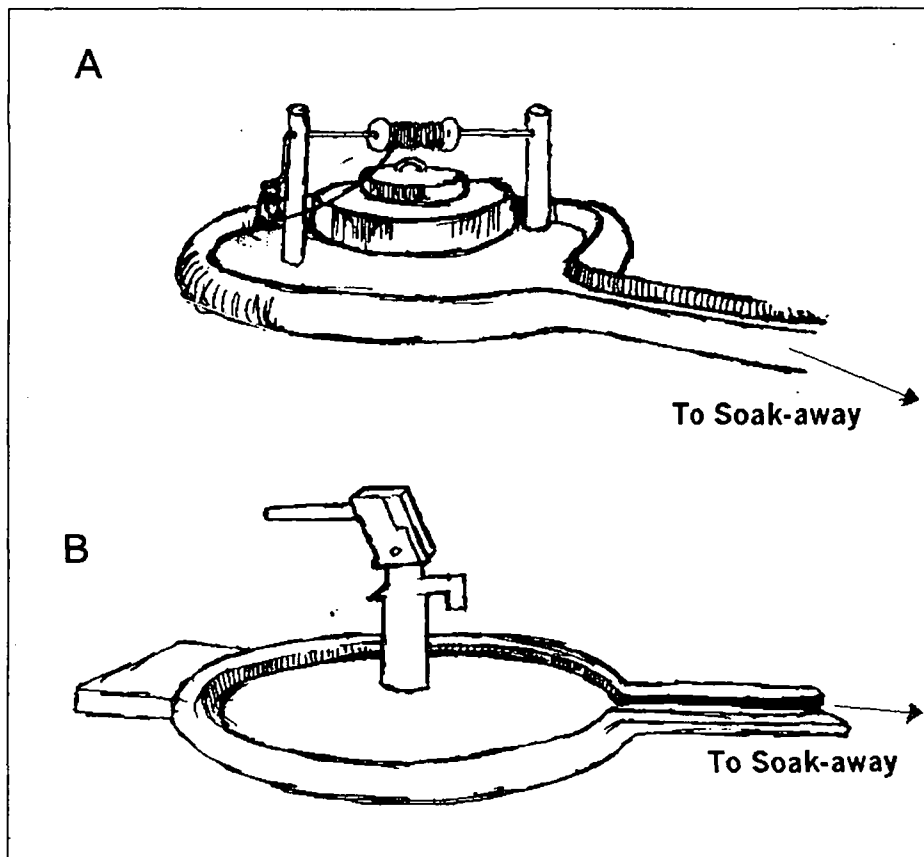


- For **dug wells**, the rope and bucket used for drawing water should not be left on the ground (See Figure 4a) where they could become contaminated by germs. Instead it

should be hung on a pole erected close to the well (See Figures 4b and 5a) **Only one container should be used to draw water.**

- A **fence** should be constructed around the water point to keep animals away from it. (See Figure 4b)
- There should be **good drainage** around the well to prevent stagnant water collecting around the immediate surroundings.

**Figure 5:** A protected well with a windlass (a) and a protected borehole with a hand-pump (b).



**Maintenance of the water points:**

- After the wells have been built with all the facilities mentioned above, it is important to monitor them by periodically doing sanitary surveys. ( See Module 5)
- As soon as any risk factors are identified, they must be fixed immediately.
- Persons in the community should be trained and be responsible for routine maintenance and repairs to the water point facilities.
  - Tighten nuts and bolts of hand pump body once a month
  - Periodically (once a week) oil all movable parts like the hand pump, handle and chain
  - Clean your apron and drainage channel once a day.
  - Keep the water point surroundings (30 metres radius) clean. Protect it from animal and human faeces, refuse, and pools of stagnant water.

## MODULE 5

### SANITARY SURVEYS

#### Introduction

In order to protect communities, especially rural communities, from water-borne diseases, emphasis is placed on the promotion of better hygiene and sanitation practices. These include the provision of facilities such as a good water supply and latrines that have hand washing facilities next to them. (See Modules 3 and 4) However, it is equally important to maintain the infrastructure and keep the surroundings clean. These are achieved by:

- **Performing Sanitary Surveys and**
- **Monitoring the quality of the water supply, mostly the bacteriological quality.**

The results obtained from these analyses are combined to ensure that the community is supplied with water of safe quality.

#### What is a Sanitary Survey?

A Sanitary Survey is a tool, in the form of a list of questions, used to inspect facilities such as water points and latrines and their immediate surroundings to identify any potential risk factor(s). Risk factors are poor sanitary conditions that could lead to the contamination of the water supply, which could cause water-borne diseases.

- Note that all the questions are equally important and are therefore, given the same weighting.

#### Water points

There are two important aspects of water supply, the quantity and quality.

- The quality of water should be such that it is free from all disease-causing chemicals and biological agents (germs).
- To ensure the maintenance of safe water quality, the water source should be protected from factors, that could increase the risk of contamination. This means that good hygiene and sanitation practices are very important and have greater impact.

#### **Achieving safe water quality depends on the following:**

- Construct the water-point properly with protective features.  
For example, a dug-well should be fitted with protective features such as a headwall of 50centimeters high, a lining (at least 3 metres below ground level), and a cover. In addition, a dug-well as well as a borehole, should also have an apron (2 square metres wide or 2 metres in diameter) around it, and a drainage channel (3 metres long) that drains into a soak-away (1 metre deep and filled with stones).
- Maintain hygienic or sanitary conditions around the water point and its immediate surroundings.
- Undertake prompt and effective repairs of the protective structures of the water point and clear any unsanitary conditions around it or nearby.

## **Latrines should be constructed and maintained properly.**

### **VIP Latrines:**

- **VIP** latrines should have working **vents** to control odour and flies, that could land on faecal matter and transmit disease via the faecal-oral route.

*Odour control*-When the vent is working effectively and providing good ventilation, there will be no unpleasant odour in the VIP latrine. This can be checked by putting smoking material (for example, a burning piece of wood) by the squat hole, and observing if the smoke goes through the vent.

- The **squat-hole** should be left open to allow free passage of air through the pit to ventilate it.

*Flies control* -The inside of the pit should be dark enough so that flies that enter the pit will be attracted towards the vent by the light shining from the top of the vent.

It is also important to check to make sure that the **mesh** over the vent is not torn, otherwise flies will escape through the vent. The mesh is meant to serve as a trap for the flies that may enter the pit, and are attracted towards the light in the vent, and prevent them from escaping to contaminate food with faecal matter. The condition of the mesh could be investigated by climbing a ladder or by using a mirror tied to a pole to view it.

### **Pit latrines:**

- A pit latrine should have a sanplat with the following features
  - A pair of raised foot rests
  - A smooth floor sloping inwards towards the squat hole
  - A key-shaped squat hole with a well fitting squat-hole cover that has a handle, and the squat-hole must be covered when the latrine is not in use.

Sanplats are designed in such a way that when the latrine is used, excreta and urine fall directly into the drop hole without soiling the platform.

- A pit latrine is considered full when excreta in the pit is just half a metre (1/2 metre) below the platform/ground level. In this state, a pit latrine will be smelly and unsanitary and should not be used.

### **All latrines:**

- The latrine house floor, especially the sanplat and the area immediately around the squat-hole, should be clean and free of faecal matter.
- All latrines should have **hand-washing facilities**.

There should be **water** and **soap** or **ash** for washing hands after using the latrine, located at the entrance of all latrines. Washing hands gets rid of any faecal matter that may accidentally get on the hand while cleaning the anal area after using the toilet. This in turn breaks the cycle in the faecal-oral transmission of disease. (See Module 3)

### **When is a sanitary survey necessary?**

1. To monitor sanitary conditions as a routine exercise.
2. After severe weather changes like heavy rainfall; the sanitary conditions could be affected.
3. To identify the likely cause of contamination of a water point if water quality analysis results indicate so.
4. When there are complaints from users of noticeable changes in the water quality, such as colour, odour and taste.
5. To identify the likely cause of an outbreak of a water-borne disease.

### **Who should conduct a sanitary survey?**

- Ideally, this should be done by trained inspectors with knowledge of public health and sanitation like the Environmental Health Technicians (EHT). However, the Area Community Organizer (ACO) and any responsible members of the community could be trained to do so with the initial assistance of the EHT. The trainer from the Central Level, Central Board of Health, should ensure that the EHT and ACO understand the importance and the objectives of the survey. The EHT and ACO in turn should train the V-WASHE Committee members. **It is important for the person doing the sanitary survey to be thorough, professional, constructive, and honest.**
- It is recommended that initially where EHT and ACOs do the survey, they should always be assisted by some community members, especially the caretaker of the water facilities. This will serve as useful hands-on training to help them understand how to do the survey themselves and thus better protect their community.

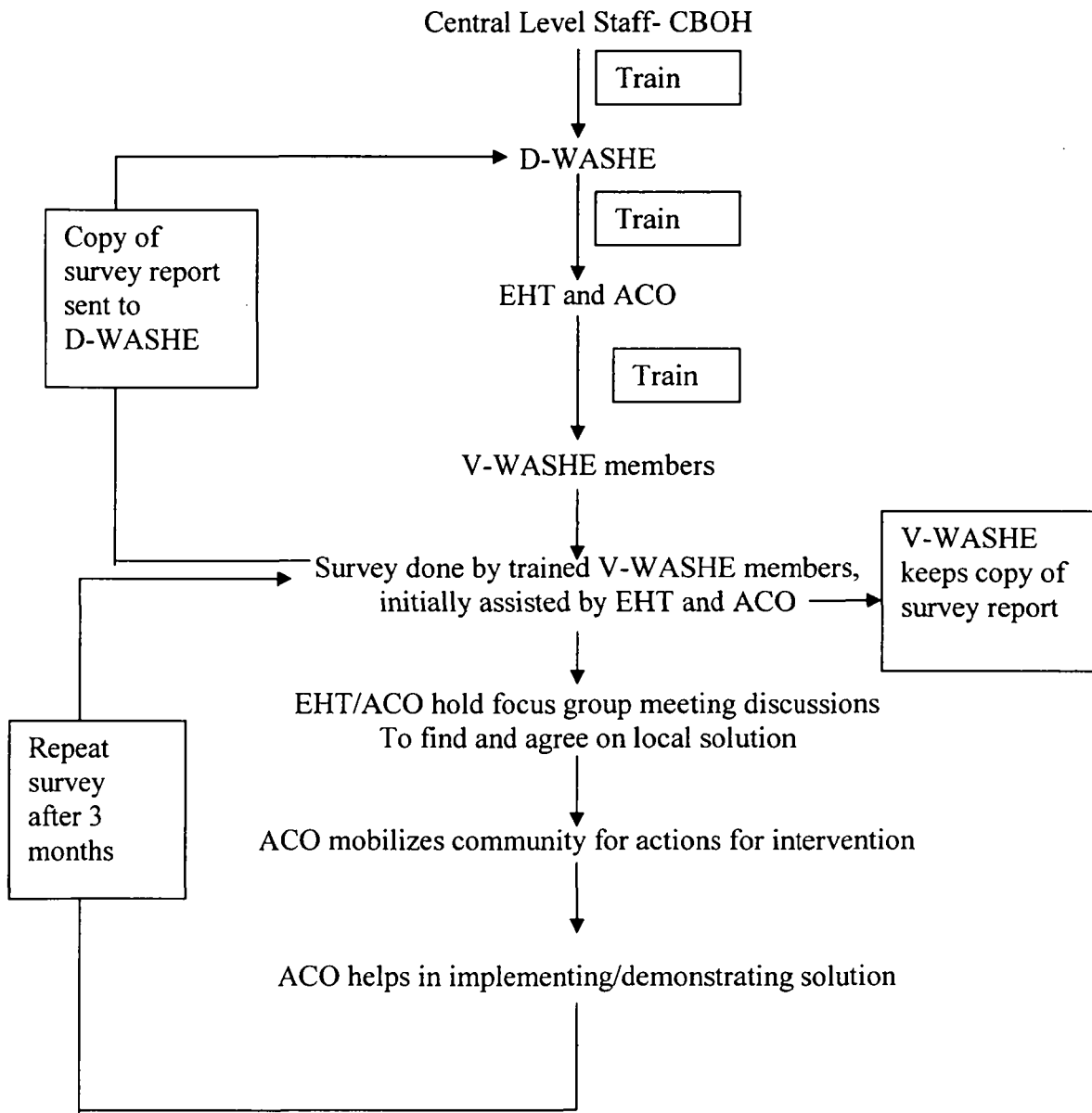
### **What are the steps involved in conducting a Sanitary Survey?**

- The community should have a map of the area showing all the water points and types of water points. The EHT should have knowledge of this in advance.
- **It is recommended that the inspector assisting to conduct the survey should try and notify the local community representatives in advance of the visit.**
- The sanitary survey questionnaire should be completed on site together with the community representative.
- On completion of the questionnaire, the inspector should clearly circle each of the risk factors observed on the diagram, detach the diagram from the survey form, and give it to the community representative.
- There should be clear discussions on the interventions necessary and a firm date scheduled for the next visit.

### **Who should be informed of the result of a Sanitary Survey?**

**Sanitary surveys are only useful and effective if action is taken immediately to repair or eliminate any risk factor(s) identified.** Therefore, all interested parties, users' representative, EHT, D- WASHE, V-WASHE should be given copies of the survey and a copy put on file for future reference. These people in turn should take all the necessary action to undertake prompt and effective repairs of the protective structures of the water-point and clear any unsanitary conditions around it.

## SUMMARY OF SANITARY SURVEY ACTIVITIES



### **Sanitary Survey Forms.**

These forms have been prepared for different water sources and latrines and below are explanations of the questions.

1. Distance between the nearest latrine and a water point:  
This should be at least 30 metres to ensure that some of the faeces does not drain into the water.
2. Nearby latrines should not be on higher ground or level than the water point.  
It is easier for faeces to drain from higher level down a slope to contaminate the water point below it.
3. Washing clothes, dishes etc. on the apron or within 10 metres of the water point will wear down the apron causing cracks, that will increase the risk of contamination.
4. Rubbish dump, animal faeces and other sources of pollution near the water point will increase the possibility of contamination of the water point, especially in shallow wells.
5. The area around the pump must slope away from the water source so that pools of stagnant water do not form. The stagnant water can breed mosquitoes which spread malaria.
6. It is important to make a concrete apron 2 metres in diameter or 2 square metres around the water point. This prevents dirty surface water from seeping into the well to contaminate the water.
7. The apron and the drainage channel should be constructed so that there is a gentle slope. This slope allows water that spills to flow away smoothly to the soak-away without forming stagnant water along it or around the water point.
8. If the concrete apron is cracked, it will no longer perform the function it was constructed for in the first place. (See No.6 above)
9. The length of the concrete drainage channel should be at least 3 metres long to take dirty water far away from the water point to prevent contamination.
10. Even if the drainage channel is well constructed but is not well kept, it cannot perform its function well. Accumulation of rubbish will block the flow of water and create pools of water. If it is broken, water will flow out at those joints, diverting the waste water away from the soak-away, thereby increasing the risk of contamination and the formation of pools of water.
11. If the fence around the water point is unable to keep animals away, they will come closer to the water point to drink water, defecate there and increase the risk of contamination.
12. If dirty surface water seeps down the sides of the pump, the risk of contamination is higher because there is no column of soil to strain or filter it.
13. If the pump is not able to pump the water properly, users may not be bothered to use it but use other sources which may be of poorer quality and expose them to water-related diseases.



## MODULE 6

### SIMPLE METHODS OF WATER TREATMENT FOR THE HOME

#### Introduction

*It is always better to protect and use a source of good quality water than to treat water from a contaminated source.* But we know now that it is difficult to protect all sources of water, especially surface water, (rivers and streams). If the only sources available are suspected to be contaminated, they should be treated before they are used for drinking or even for other domestic purposes.

*It is equally important to take necessary steps to protect the treated water from re-contamination.* (See Module 3 Unit 3)

#### When does water need to be treated?

- When consumers refuse to use it due to colour, odour or taste,
- When tests show that the water contains organisms (germs) and/or chemicals that could cause health problems to users,
- When a sanitary survey of a water point shows a very high risk of contamination score.
- When there is an outbreak of diarrhoeal diseases, such as cholera, in the community,

#### Factors that determine the suitability of any treatment method

- The quantity of the water to be treated.
- The physical quality (colour, odour, turbidity) of the raw or untreated water.
- The cost and convenience of treatment.

#### Methods of water treatment used:

##### **Filtration**

Simple filtration or straining  
Simple sand filtration  
Two or three pot filtration - sedimentation

##### **Disinfection**

Boiling  
Solar or sunlight disinfection  
Chemical disinfection, which is mostly chlorination

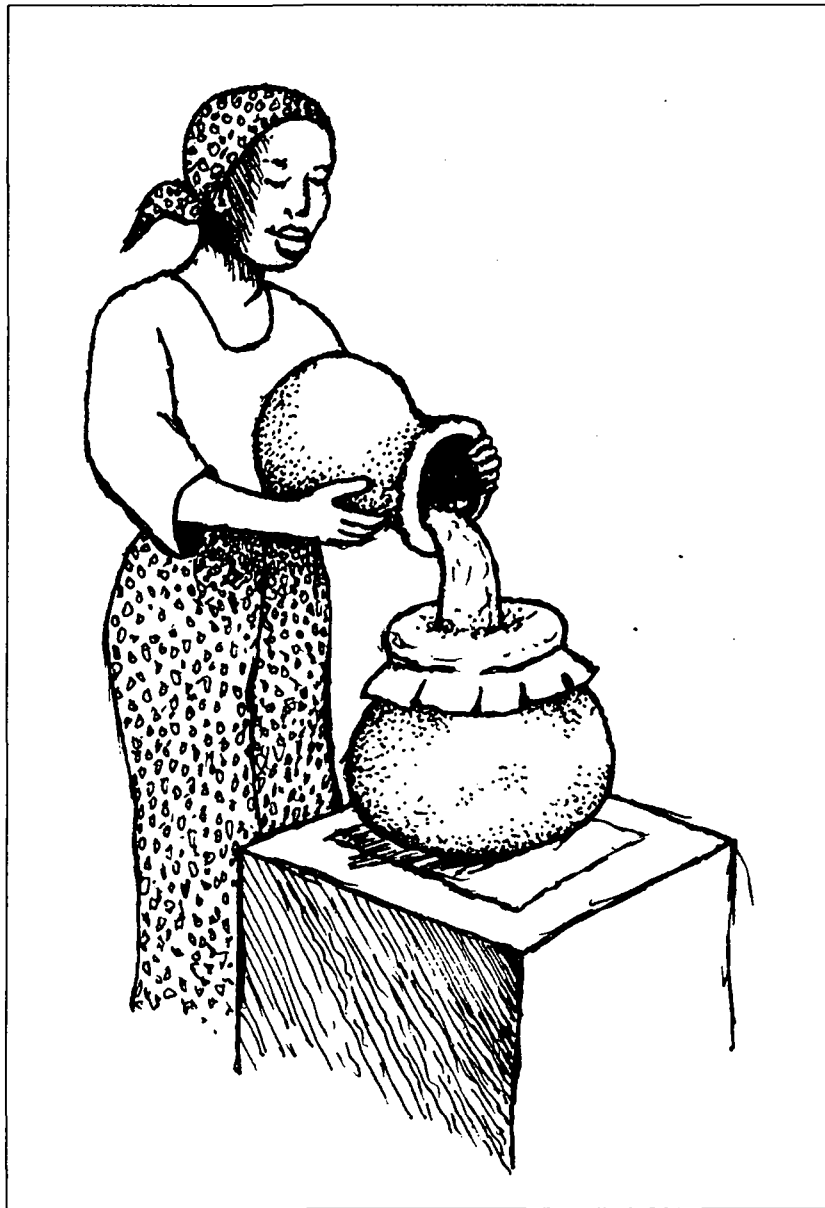
#### Filtration

Filtration is a method of physically separating or removing solid matter from fluids. There are many methods of filtration, and examples of simple methods that can be used at home are described below.

### Simple Filtration or straining

- In this method, a **piece of clean cotton cloth** is stretched over a pot, and the dirty water is poured through the cloth into the pot. The solid particles remain on the piece of cloth while cleaner water collects in the pot below. (See Figure 1).
- Thus the simple filtration gets rid of sand particles and some small animals in the water such as the water fleas (copepods), carrying the worms that cause Guinea-worm disease. These particles are too big to pass through the holes in the piece of cloth which serves as the filter.

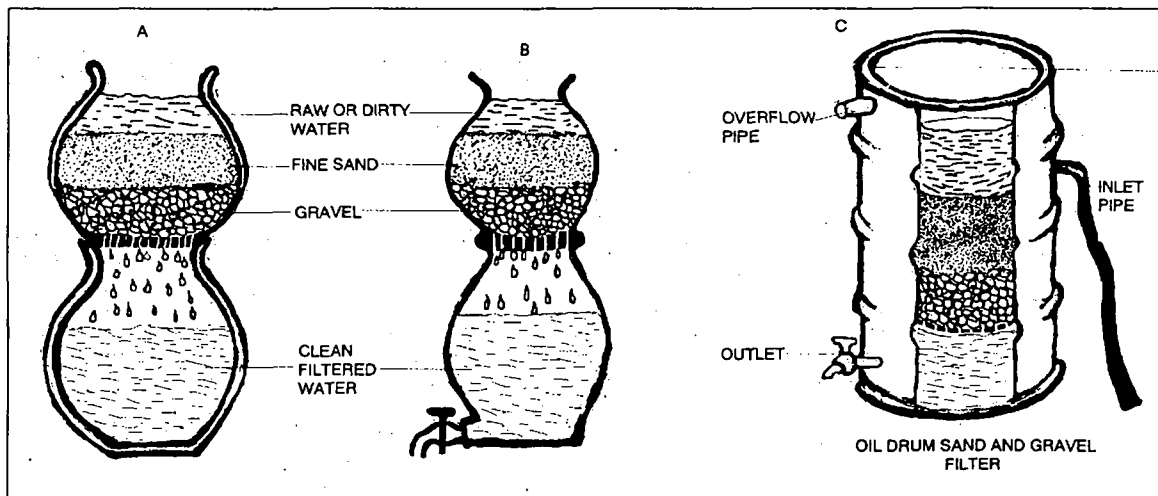
**Figure 1:** Simple filtration of water using a piece of cotton cloth.



### Simple sand and stone filters.

- This is a process where water is passed over a bed of fine sand, gravel and stones. **Dirt, including some of the germs,** remain at the top of the sand and cleaner safer water comes out from the bottom.
- This type of filter can be constructed in different types of containers and in different sizes. These could be clay pots, buckets or drums. (See Figure 2) In figure 2a, the top pot which is the filter should be removed before the filtered water can be poured. Figure 2b is fitted with a tap, which is an improvement over 2a, while c is on a larger scale.
- How well the filter cleans or treats the raw water depends on how the filter is constructed, in terms of the quality of the filtering materials and the depth of the layers, especially the fine sand. Filters with a longer column of fine sand clean raw water better.
- The sand and gravel bed should be changed from time to time, for example, every six months for the oil drum filter (Figure 2c). If the raw water is very turbid, (has a lot of clay particles) then the filter bed should be changed often, otherwise it will become clogged or blocked, and will not work properly.
- Sometimes, to be sure the water is safe, the filtered water could be chlorinated or boiled before drinking.

Figure 2: Simple sand and stone filters



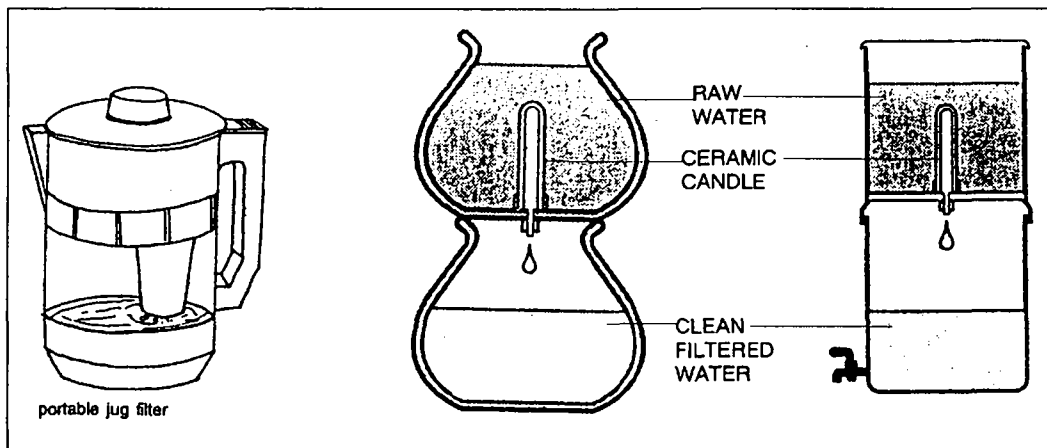
### Charcoal filters

- Compacted crushed charcoal is sometimes used in simple filters instead of sand. This type of filter is good for removing taste, odour and colour from water.
- The charcoal should be changed even more often than sand otherwise germs grow on the charcoal which may cause disease.

**Commercial filters –ceramic or candle filters**

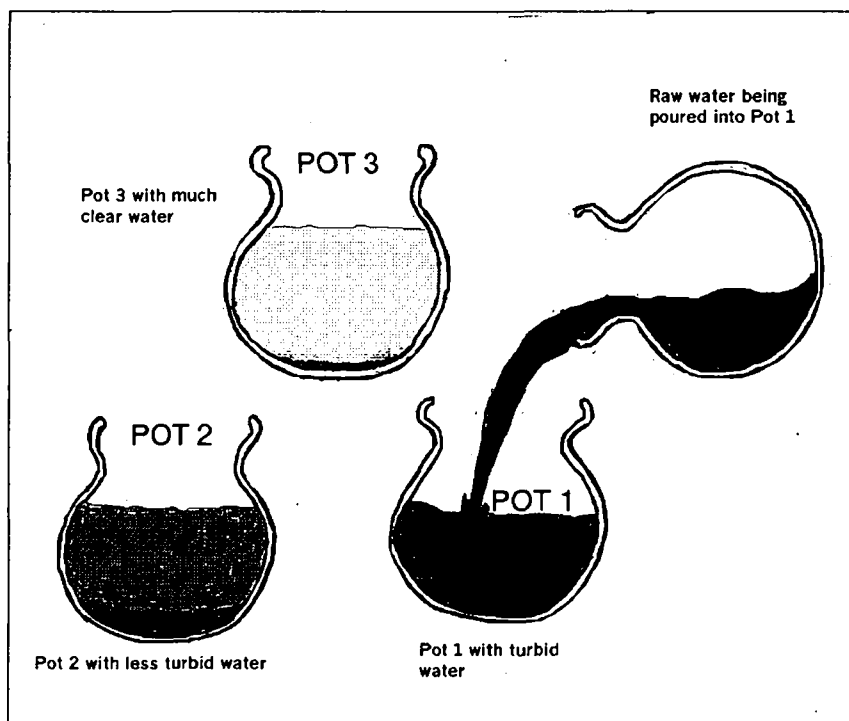
- In these filters, the part that filters the water which is also called the element, is made of baked clay or ceramic.
- The ceramic material is specially made to allow water to pass through (porous). They are usually made in the shape of candles (candle filters) and are produced in factories.
- These filters come in different set- ups ( See Figure 3)

**Figure 3: Commercial candle filters.**



**Sedimentation or two / three- pot filtration.**

**Figure 4: Three-pot filtration**



- In the sedimentation method, as illustrated in Figure 4, water that contains a lot of sand and other particles is allowed to stand in one pot (Pot 1) for a long time for the particles to settle to the bottom. The settled particles are then called **sediments**.
- The top clear water is carefully poured into a second pot (Pot 2). This water is also allowed to stand for particles to settle out again and the process can be repeated several times. The number of pots used depends on how dirty the raw water is and how easily the suspended particles in the water settle.

(The dirty water that is left at the bottom may be used for other things, for example to water plants).

- Finally, the clear water may be boiled or chlorinated to destroy germs before drinking.

#### **Addition of alum**

Alum is a type of chemical that is added to water. **It does not kill germs** instead it allows very small particles (such as clay particles) in the water to stick together to become heavy enough to sink to the bottom or float on the top of the water.

Addition of alum simply enhances the sedimentation of tiny particles in water.

The top clear water is then poured off and boiled or chlorinated to kill any germs in it.

#### **Disinfection of water**

Disinfection means destroying germs that cause diseases, and the different methods involved are as discussed below.

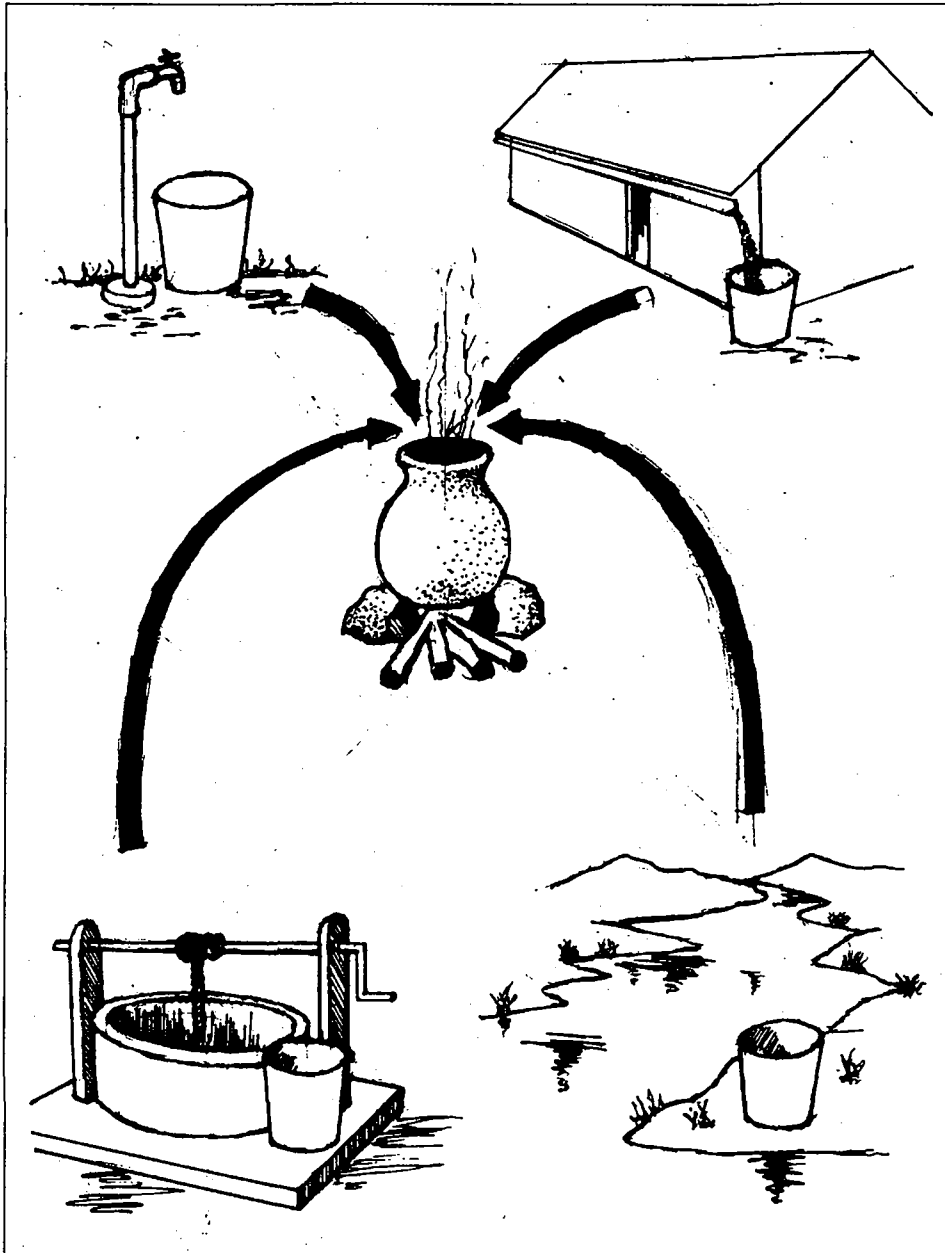
#### **Boiling**

- This is a very simple and reliable method of killing all germs present in water.
- The water should be **boiled for 5-10 minutes only. Please note that the timing starts after the water starts boiling – after the temperature of the water reaches 100<sup>0</sup> C.**
- Water from all sources can be boiled for drinking (See Figure 5 below)

#### **Disadvantages of boiling water.**

- High cost of fuel makes it expensive.
- Boiling drives air out of water and gives it a flat and an unpleasant taste.
- It is only practical to boil small quantities of water at a time.
- Boiled water needs time to cool before drinking.  
This, can, however, be overcome if water is boiled at the end of each day for drinking the next day.

**Figure 5: Boiling water from different sources for drinking.**



### **Solar disinfection**

- In this method, water is put into **clean, clear, colourless, and shallow** containers, even in clear plastic bags, and left in the **bright sun** for a long time, **at least five hours**.
- The best place to put the water is on the roof top of a house where there is no shade.
- Tests in the laboratory have shown that part of the sun called **ultraviolet radiation** is able to kill most of the germs in water that cause diseases.

## **Chemical disinfection: Chlorination**

Chemical disinfection of water is a method of adding a chemical to kill germs in water.

- **Chlorine** is the most common chemical that is added to water to **kill the germs in it**. It is the type of chemical that is found in household bleach. The process is called Chlorination.
- Chlorine comes in many forms. Like all chemicals, it is important to use chlorine with great care.
- **Sediments or small soil particles should be removed from the water first** before chlorine is added to it. **Water, if turbid (contains clay particles), should be filtered before chlorine is added.**
- The soil and clay particles, if left in the water, will use up some of the chlorine. This means that in order to have enough chlorine to kill the germs, more chlorine will have to be added. This will be a waste of chlorine and make the treatment expensive.
- The **amount of chlorine used is carefully measured**, based on the quantity of water to be treated and the type of chlorine chemical being used.

**In order to use chlorine properly it is important to:**

1. Know **the type and strength of chlorine compound** you are using.
2. Know **the amount of water you want to treat**, because more water will need more chlorine.
3. Make sure that the water is of very low turbidity.

### **Types of Chlorine:**

Chlorine is commonly available in the following forms:

1. **Sodium hypochloride**- supplied in liquid forms as household disinfectant (JIK, chlorox, parazone etc.), antiseptic solution(Milton).
2. **Bleaching powder** or chlorinated lime.
3. **Chlorine tablets**, (for example swimming pool tablets).
4. **High Test Hypochlorite (HTH)** which is also the powdered form and often supplied in big drums.

### ***Caution in Handling Chlorine chemicals***

It is important to note that chlorine chemicals are **very strong and powerful**. They should, therefore, be **handled and stored properly, and carefully**.

- They should always **be stored in plastic containers** that are dry and well sealed.
- Liquid solutions should be **kept in dark coloured bottles**.
- Do not let the chemical touch your skin - your skin will burn so **wear gloves always**.
- It should get into your eyes so **protect your eyes**.
- **Do not breathe in the fumes**, they will make you sick.

### Steps involved in the chlorination process

- The strength of chlorine sold on the market is very high so first a solution of **1% concentration** is prepared.
- Then a **known amount of the 1% chlorine solution** is added to a **known quantity of water** to be treated.

### Chlorine demand of water.

- When chlorine is added to water some of it reacts or is taken up by some of the chemicals and particles in water before what is left kills the germs.
- In order to make sure that **enough chlorine will be left to kill the germs, and leave a surplus (residual chlorine) to kill any germs that may come into the water later**, a test is performed. This test is called **the chlorine demand of the water**.

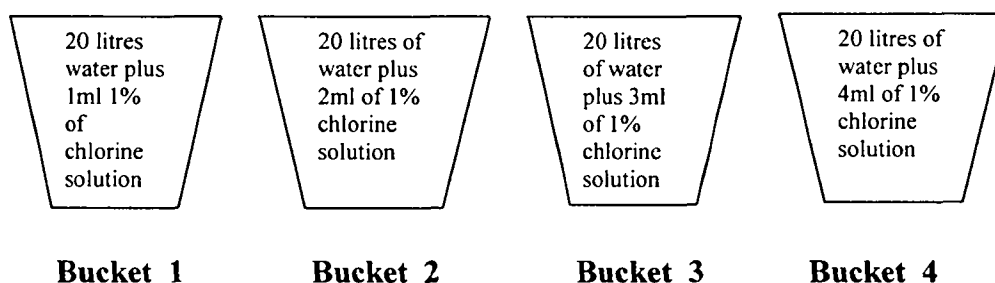
### How to do the chlorine-demand test (this test can be done once for the water point by the EHT)

You will need:

1. 1% chlorine solution
2. Four 25 litres plastic buckets each filled with 20 litres of water.
3. Four wooden stirrers
4. Residual chlorine test kit – a simple colour match comparator with its reagent, usually in the form of a tablet call DPD (*N,N*- diethyl-*p*-phenylenediamine)

### Method:

**Figure 6: Four buckets and their contents in residual chlorine test.**



- Add different amounts of 1% chlorine solution to the 20 litres of water in each bucket as shown in Figure 6
- Use the wooden stirrer to mix the chlorine with the water
- Wait for 30 minutes
- Test for residual chlorine in each of the buckets using the test kit



### Interpretation of results:

The WHO Guideline value for residual chlorine in drinking water is 0.2 to 0.5 mg/l.

If for example, the results obtained were as follows:

| <u>Bucket</u> | <u>Residual chlorine</u> |
|---------------|--------------------------|
| 1             | 0.2mg/l                  |
| 2             | 0.4mg/l                  |
| 3             | 0.6mg/l                  |
| 4             | 0.8mg/l                  |

The results obtained in this example mean that 20 litres of water from that particular source needs 2ml of 1% chlorine solution to disinfect it. The residual chlorine value of 4.0mg/l is within the WHO Guideline. Although the 0.2mg/l obtained with 1ml of chlorine in bucket 1 is also within the WHO range, 4.0mg/l is better.

- Therefore **the table below** gives different volumes of water from the same source and the amount of 1% chlorine solution that would be needed to disinfect it.

| Volume of water to be treated in litres | Volume of 1% chlorine solution needed |
|---|---------------------------------------|
| 5                                       | ½ ml                                  |
| 10                                      | 1ml                                   |
| 20                                      | 2ml                                   |
| 100                                     | 10ml                                  |
| 1000                                    | 100ml                                 |

### How to prepare 1 litres of 1% chlorine solution

Different chlorine chemicals (compounds) do not contain the same concentration, so different amounts are needed to make the same amount of 1% solution.

| Chlorine compound                                   | chlorine content (%)       | Amount required            | Approximate measure  | Amount of water required       |
|---|----------------------------|----------------------------|----------------------|--------------------------------|
| High Test Hypochlorite (HTH)                        | 70                         | 14gm                       | 1 heaped tablespoon  | add water to make 1000ml       |
| Bleaching powder                                    | 34                         | 30gm                       | 2 heaped tablespoons | add water to make 1000ml       |
| Bleaching powder                                    | 30                         | 33gm                       | 3 level tablespoons  | add water to make 1000ml       |
| Stabilized tropical bleach                          | 25                         | 40gm                       | 3 heaped tablespoons | add water to make 1000ml       |
| Sodium hypochloride (liquid household disinfectant) | 10                         | 100ml                      | 7 tablespoons        | Add 900ml water to make 1000ml |
| Liquid laundry bleach                               | 5                          | 200ml                      | 14 tablespoons       | Add 800ml water to make 1000ml |
| Milton (Antiseptic solution)                        | 1                          | 1000ml (1 litre)           | 0                    | No water should be added       |
| Chlorine tablets                                    | follow instructions on box | Follow instructions on box |                      |                                |

**Preparing 1% chlorine solution:**

- **Mix the chlorine and water well and let it stand for about one hour.**
- **All the powder will not dissolve. Only use the top clear part of the mixture to disinfect water for drinking.**
- **The 1% chlorine solution can be prepared and kept as a stock, but it should be used within one month. It should be kept in a dark bottle away from children.**

**Using 1% chlorine to treat or disinfect water**

1. To treat water with chlorine, the volume of the water should be known. This allows a specific amount of 1% solution to be added to it.
2. **The water should then be allowed to stand for about 30 minutes to allow the chlorine time to destroy the germs.**
3. Next, the water is tested to make sure that there is some chlorine (**residual chlorine of 0.2 - 0.5 mg/litre**) left in the water to kill any new germs that may enter the treated water later.

**If it is not possible to do a residual chlorine test then:**

- *For every litre of water add 3 drops of 1% chlorine solution and taste the water.*
- *You should just be able to taste the chlorine.*
- *Allow the water to stand for at least 30 minutes before drinking.*
- *Disinfect just enough drinking water needed for one day at a time.*

## MODULE 7

### WATER QUALITY MONITORING

#### Introduction

There are many important aspects to community water supply. These include the following:

- **Quantity**- there should be enough water to meet the needs of the people. The water source should be reliable.
- **Accessibility**- the water sources should be easily accessible and brought nearer to the community. This means that those who collect water, mainly women and girls, will spend less time and walk shorter distances to collect enough water for the home.
- **Quality** – The available water should be of an acceptable physical, chemical and bacteriological quality. This means that the water must be free of disease- causing germs and chemicals and the taste should meet the standards of the users.

Module 7 covers **Water Quality Monitoring**, a tool used to determine whether water is good, safe and acceptable for consumption.

The World Health Organisation (WHO) has produced guidelines for physical, chemical and bacteriological quality of drinking water. These guidelines may be used by countries or could be used as the framework on which countries could set their own standards to meet their own needs and conditions. It is important to avoid setting the national standard too high, if it is difficult to achieve it will be useless.

In Zambia, the WHO Guidelines are presently in use while one is being prepared to meet the requirements of the nation.

#### Why is water quality monitoring essential?

- The **objective of water quality monitoring** is to provide water for the community that meets the national standards for drinking water and is acceptable to the users.
- Water quality monitoring is a necessary and important part of the management of a water supply in a community.
- Water quality data gives information about the quality of water **at the time of sampling only. It is, therefore, necessary to do water quality analysis in combination with sanitary surveys, that give information on risk factors for faecal contamination.**
- It ensures that consumers are always well protected from water-borne diseases.

#### When is water quality monitoring necessary?

- When a **new source of water is established**, it is vital to know the water quality in order to determine if it is safe for drinking.

- If the water source is protected, sanitary surveys should be conducted to keep maintenance of the facility in check and to clear risk factors. It is also important to test samples of the water from time to time (**routine testing**) to make sure that the community is drinking safe water.
- If the result of the test shows that the quality is below standard then the source of the problem should be identified and corrected. But even more importantly, the community should be advised to treat the water before drinking until the problem is solved.
- **Routine Water Quality Monitoring** can also give an **early warning of an impending diarrhoeal disease outbreak or identify and confirm the source of an outbreak.**
- When there are **changes in the environmental conditions like heavy rainfall**, it is important to test the water to find out if the quality, especially the bacteriological quality, has been affected.

#### Logistics needed for Community Water Quality Monitoring

1. **A community map showing the location of water sources**, types of sources and what each water source is used for.
2. **Trained staff to do water sampling** – this could be done by trained Environmental Health Technicians (EHT)
3. **Trained staff to do the analysis**- Trained laboratory technicians instead of EHT for the sake of quality assurance, which includes quality control and validates the results of the analysis.
4. **Transportation** for water sampling in the field and to take the samples to a centre for analysis
5. **Laboratory facilities and /or field kits**  
This could be based at the Rural Health Centre, or District Hospital Laboratory with the Provincial Hospital Laboratory as a back-up for quality assurance. If there are field kits they should be used in the laboratory.
6. An established **method for reporting** information collected during sampling, and the results of the test.
7. A well designed water sampling report form to accompany each sample.
8. **Funds to ensure the sustainability of the laboratory facilities** in terms of replacement of consumables and **transportation costs**- purchase and maintenance of vehicle (motorbike) and purchase of fuel.
9. **The source of the funds should be clearly identified.** It is recommended that the importance of water quality monitoring should be recognised by the Ministry of Health and **included in their budget planning at both the district and provincial levels.**

#### WATER QUALITY

Water quality is divided into three parts:

1. **Physical**
2. **Chemical and**
3. **Biological or Microbiological / bacteriological**

### PHYSICAL QUALITY

It refers to the characteristics, for example taste, odour, colour, of the water that affect its immediate acceptability to the users. Some of these are usually assessed by observation without doing any complicated tests, while others are tested with metres which can be done at the site. These parameters are listed in Table 1 below.

**Table 1: Physical parameters and the WHO Guideline values or limits**

| Parameter               | WHO values             | Parameter                     | WHO values |
|-------------------------|------------------------|-------------------------------|------------|
| Colour (Hazel Units)    | 15 (20 for Zambia)     | pH                            | 6.5 – 8.5  |
| Appearance              | Clear                  |                               |            |
| Taste                   | Acceptable by consumer | Electrical Conductivity (EC)  | 3000       |
| Odour/smell             | Inoffensive            | Suspended Solids (SS)         | 1000 mg/l  |
| Turbidity or cloudiness | 5 NTU                  | Total Dissolved Solids (TDS). | 1000 mg/l  |

- If these qualities are not acceptable to the users, the water will not be used for drinking even if the values obtained are within the WHO limits.

### CHEMICAL QUALITY

As mentioned before, when a new water source is being developed for drinking purposes, ideally a sample should be sent for physico-chemical and bacteriological analysis. Usually a comprehensive chemical analysis is done. In Zambia, the following parameters listed in Table 2 are tested for:

(Ref: Government of Zambia, Ministry of Health, Food and Drugs Control laboratory)

**Table 2: Chemical parameters and WHO Guidelines values in mg/l**

| Parameter        | WHO   | Parameter         | WHO       |
|------------------|-------|-------------------|-----------|
| Sodium (Na)      | 200   | Total alkalinity  | 800       |
| Potassium (K)    | 12    | Chloride          | 250       |
| Calcium (Ca)     | 100   | Ammonia           | 1.5       |
| Magnesium (Mg)   | 30    | Nitrate           | 50        |
| Manganese (Mn)   | 0.5   | Nitrites          | 3         |
| Lead (Pb)        | 0.01  | Hydrogen (H)      | 0         |
| Zinc (Zn)        | 3     | Hydrogen Sulphide | 0.05      |
| Iron (Fe)        | 0.3   | Hydrocarbons      | 20        |
| Chromium (Cr)    | 0.05  | Dissolved Oxygen  | No effect |
| Arsenic (As)     | 0.01  | Phosphates        | 1.0       |
| Cadmium (Cd)     | 0.003 | Fluoride (F)      | 1.5       |
| Copper (Cu)      | 2.0   | Sulphate          | 250       |
| Calcium Hardness | 300   | Cyanide           | 0.07      |
| Total Hardness   | 500   |                   |           |

## **BACTERIOLOGICAL QUALITY**

- **Bacteriological quality is the most important aspect of water quality monitoring of a community water supply.**
- This is because the main health concern is the contamination of the community water supply with faecal matter, which cause water-borne diseases.

### **Testing for the presence of disease causing bacteria in water**

It is difficult, even in an established laboratory, to look or test for the presence of the germs that cause water-borne diseases in water directly. Thus the method used is indirect.

- Bacteriological tests look for special bacteria called **Coliforms** in water.
- This is an **indirect method** where the coliforms are considered to be **Indicators of faecal contamination**

### **What does “coliforms being indicators of faecal contamination” mean?**

- When tests done on water samples show that they contain coliform bacteria, it is assumed that the **water has recently been contaminated with human faeces.**

### **What are coliform bacteria, and why were they selected as “indicators of faecal contamination”?**

- **Coliforms** are a large group of bacteria (germs) that are found in great numbers in the faeces of both **humans and animals** like wildlife and birds and even in decaying plants.
- **Faecal coliforms:** Within this large group there are some that are **found only in the faeces of humans and other animals.** They are called faecal coliforms.
- ***Escherichia coli (E. coli):*** this is a kind of faecal coliform which is most common and most abundant in faeces of humans and other warm blooded animals. **Its presence in water points more to the contamination of water by human faeces.** *E. coli* can stand higher temperatures than other coliforms and this difference is used in the testing for their presence in water.

### **Coliforms were selected as “indicators of faecal contamination” in water analysis because:**

1. They are present in great numbers in faeces.
2. It is easy to isolate them from water samples using fairly simple methods and equipment. The methods are standardized and used internationally.

### **The bacteriological test, and the interpretation of the results**

The **objective** of the bacteriological tests is:

- To **detect the presence, and count the number** of coliform bacteria in a **known volume of water sample**.

If coliforms are detected in the water sample, **then the number per 100 ml of water is calculated or estimated**. The tests are done to determine:

1. The total coliform count in 100ml of water sample.
  2. The faecal coliform count in 100ml of water sample.
  3. *E. coli* count in 100ml of water sample.
- It is not enough to just determine total coliforms (see explanation below). It should always be done together with faecal coliforms particularly *E. coli*.
  - When resources are limited, the emphasis should be on the detection of *E. coli*.

### **Sampling and transporting the water samples for water quality testing**

The details of how water samples should be taken will be discussed and demonstrated in the field. However, some important issues are outlined below:

- **Water samples should be stored in cooler boxes at 4 degrees Celsius** (See sample bottle carriers below), and transported to the laboratory for analysis within the shortest time possible – ideally in 24 hours.
- Some parameters like pH could be tested at the water point using portable metres as their value may change during transportation.
- For physico-chemical analysis sampling bottles do not need to be sterile but they should be very clean and free from soap. It is advisable to rinse the bottle with some of the water to be tested first before filling it with the sample.
- **Sample bottle carriers** should be padded to protect the bottles and divided into compartments for individual bottles if possible.
  - There should also be room in the carrier for **frozen ice packs**.
  - It should have **straps** for easy carrying.
  - It should have **side pockets** for carrying **markers** and other materials.
- **The bottles with water samples should be labelled immediately at the water point.**

### **Sampling water for bacteriological analysis of water**

- Sterile sample bottles should be used always.
- Care should be taken not to introduce external bacteria into the sample other than those in the water, while sampling (strictly follow the sampling instructions given).
- If testing is not done at the water point, the sample should be kept in a cool box during transportation to the test centre.
- Testing should be done within the shortest time possible, ideally in less than 24 hours.

### **Methods used in the bacteriological analysis of water**

There are two main methods used:

1. The Membrane Filtration method (most field kits use this method)
2. The Multiple-tube method

### **Interpretation of the results of the bacteriological test**

The assumption is that since coliforms are found in faeces, if coliform bacteria are detected in water, it means that there is a possibility that the water source is contaminated with faeces.

#### **Total coliforms count**

Although the presence of these in water may not necessarily mean that there has been faecal contamination, the possibility should not be ignored.

#### **Faecal coliform / *E. coli* count**

When faecal coliforms, especially *E. coli* are detected in a water sample, that is a **strong indication** that the water sample **has recently been contaminated with faeces which could also contain the germs of water-borne diseases.**

- Table 3 below gives the WHO Guidelines for the bacteriological quality for drinking water which has been adopted by Zambia.

**Table 3: WHO Guideline values for bacteriological quality of drinking water**

| <b><i>Parameter</i></b>                         | <b><i>WHO</i></b> |
|---|-------------------|
| Total coliform count per 100ml of water sample  | 10                |
| Faecal coliform count per 100ml of water sample | 0                 |
| <i>E. coli</i> count per 100ml of water sample  | 0                 |

**The standard to aim for is that there should be no faecal coliform in 100ml of water intended for drinking.**

#### **Action to be taken when the result of the bacteriological analysis is not acceptable**

- The community should be advised immediately to treat the water before drinking it.
- A sanitary survey should be conducted to find out the source of the contamination.
- When the risk factor is identified, remedial action should be taken immediately.
- The bacteriological test should be repeated after the intervention to check whether it was effective.



**Selected parameters for routine water quality monitoring**

- After the initial testing of water, it is no longer necessary to test for all the above parameters during routine monitoring unless a particular parameter is a problem in the area.
- For most groundwater sources, most of the parameters do not change significantly with time. The following parameters listed in Table 4 below are recommended for water quality monitoring of community water supply.
- These indicate the hygienic state of the water and therefore any risk of water-borne infection.
- **It is better to test for a few parameters in conjunction with Sanitary Surveys more frequently than to attempt to do a lengthy costly testing less frequently.**

**Table 4**                      **Recommended parameters to be tested  
for Water Quality Monitoring**

| <b>Bacteriological quality</b> | <b>Physical quality</b> | <b>Chemical quality</b>                           |
|--------------------------------|-------------------------|---|
| Faecal coliforms count and or  | Turbidity               | Nitrates if in a farming community                |
| <i>E. coli</i> count           | pH                      | Chlorine residual if chlorination is practised    |
|                                |                         | Any parameters known to be a problem in the area. |

## REFERENCES

1. All India Institute of Hygiene and Public Health (AIIPH) and UNICEF: *Final Report on Evaluation of Community-Based Water Quality Surveillance Programme in Medinipur*. Calcutta, India, 1996.
  2. Central Board of Health, Republic of Zambia: *Integrated Technical Guidelines for Front Line Health Workers*, May 1997.
  3. Ofosu-Barko G., et al: *Water and Sanitation Training Manual For Water Vendors, Amukoko, Lagos, Nigeria*. Medecins Sans Frontieres (MSF) Holland, February 1999.
  4. Shaw R., Smout I.: *Running Water. More technical briefs on Health, Water and Sanitation*. The Water, Engineering, and Development Centre (WEDC) UK. Publication, 1999.
  5. United Nations Environmental Programme (UNEP), United Nations Children's Fund (UNICEF): *Childhood Lead Poisoning: Information for Advocacy and Action*, 1997.
  6. Werner D.: *Where There Is No Doctor: A Village Health Care Handbook for Africa*, Oxfam with Foundation For Teaching Aids At Low Cost (T.A.L.C.). Institute of Child Health, London UK. 1988.
  7. World Health Organization. Guidelines for Drinking Water Quality. Second Edition Volume 1: *Recommendations*, Geneva, 1996.
- World Health Organization. Guidelines for Drinking Water Quality. Second Edition Volume 3: *Surveillance and Control of Community Supplies*, Geneva, 1997.

# ANNEX 1

## Trainer's Guide

### Introduction to this trainer's manual

The materials in this manual will be introduced in modules that have basic information to be learnt. Information will also be provided through:

- **Brainstorming,**
- **Discussions,**
- **Instructions,**
- **Practical demonstrations,**
- **Field exercises, and role plays.**

### Structure of training

The training is divided into **modules** and is presented by a **Resource Person** or a **Facilitator**, using a variety of teaching methods as listed above.

**As a resource person or a facilitator, what are your responsibilities?**

- Help participants learn the skills presented in the training
- Hold discussions with the participants

This means that **YOU** should **know the material**, in order for you to be able to

- \$ Provide explanations
- \$ Give demonstrations
- \$ Answer questions
- \$ Help to conduct role plays
- \$ Organize and supervise any field work and
- \$ Give any other assistance to participants as needed to complete the training.

1. **YOU** instruct.

- Make sure that the participants understand the information in each module.
- Answer the participants' questions as they arise.
- Explain any information that participants find confusing and make them understand the main purpose of each exercise.
- Lead group activities, for example discussions, case studies, oral drill, role plays.
- Give guidance and feed back as needed.

2. **YOU** motivate

- Compliment the participant on his/her correct answers, improvement or progress.

3. **YOU** Manage

- Plan ahead and obtain all supplies and teaching materials required for the day
- Monitor the progress of each participant.

How do **YOU** do these things?

- Show enthusiasm for the topics covered in the training and for the work the participants are doing.

- Be attentive to each participant.
- Promote a friendly co-operative relationship.

What you should NOT do.

- Do not work on other projects or discuss unrelated issues.
- Avoid using facial expressions or comments that could embarrass participants.
- Avoid being too much of a showman.
- Do not treat them as if they are children.
- Do not talk too much; encourage participants to talk.
- Do not be shy, nervous or worried about what to say -- the manual will help you to remember what to say. Please use it.

#### **How to use the Training Manual**

Use it to help you prepare ahead and teach the topics in each of the modules.

- Most of the facts are presented in bullet form to make for easy reference.
- Most of the facts are also presented as answers to questions posed.
- Many of the illustrations are self explanatory, and can be copied or modified as necessary on large posters by an artist in the community ahead of the training. Such posters always serve as central points for discussions.
- After the training, the posters may be displayed in the community as a form of continuing education.

#### **How do YOU prepare yourself before you use each module?**

- Read the information for facilitators guide information.
- Read the module and work out exercises if there are any.
- Plan exactly how work will be done on the module.
- Collect necessary supplies for exercises in the module and prepare for any demonstration, field trip or role play.

#### Checklist for instructional materials.

| <b>Items needed by YOU</b>                          | <b>Items needed by participants</b> |
|---|-------------------------------------|
| Training Manual                                     | Name tag                            |
| Charts or posters                                   | Paper                               |
| Set of training aids; paper clips, pencil sharpener | Eraser, pencil                      |

#### Training Methods

- **Brainstorming:** To find out, in the first ten minutes, what participants know already about the topic to be discussed.
- **Visual aid:** Most of the concepts are best presented using illustrations on large posters or charts. The illustrations in the manual could be reproduced or modified as necessary.
- **Lecture/Discussions:** Must be participatory.
- **Field trips or exercises:** Whenever possible some topics, like sanitary surveys, must be done in the field, for example, at a water point.
- **Practical Demonstrations/  
Role plays:** Trainees must be encouraged to think of and to participate in role plays.

## MODULE 1

**Topic:** Water related diseases and their mode of transmission.

This topic is sub-divided into 3 Units.

Unit 1: Water-borne diseases and their mode of transmission – faecal-oral transmission.

Unit 2: Control measures for faecal-oral transmitted diseases.

Unit 3: A brief discussion on water-washed, water-based and insect–vector diseases.

**Delivery time:** 4 hours

### **Objectives**

At the end of this module participants should know:

- The examples of water-related diseases common in Zambia.
- The routes of faecal-oral transmission of diseases.
- The necessary intervention on each of the routes of faecal-oral transmission of diseases.
- Diarrhoea diseases, signs and treatment of dehydration.
- How to prepare Oral Rehydration Solution (ORS) at home.

### **Training Methods**

- Brainstorm
- Visual aid
- Demonstration

### **Content**

- Classification of water-related diseases.
- Water-borne diseases and their mode of transmission
- Diarrhoeal diseases
- Intervention in the faecal-oral transmission of diseases
- Water-washed, water-based, and insect-vector diseases, their mode of transmission and preventive methods.

## **MODULE 2**

**Topic:** Potentially harmful chemicals in drinking water

**Delivery time:** 1 hour

### **Objectives**

At the end of this module participants should know:

- Common examples of chemical contaminants and their sources
- How some chemical contaminants affect the physical quality of water
- Common examples of harmful chemical contaminants and the affects they have on health.

### **Training Methods**

- Brainstorming
- Lecture/Discussions

### **Content**

- Sources of chemical contaminants in water
- Effects of some common chemicals on the quality of water
- Common harmful chemicals and their effects on health
- World Health Organisation WHO Guideline values for chemical contaminants

## **MODULE 3**

**Topic:** Hygiene Education: Personal hygiene and sanitation.  
This topic is sub-divided into 5 Units

Unit 1: Hand-washing

Unit 2: Latrine usage and maintenance

Unit 3: Refuse and waste-water disposal

Unit 4: Cleanliness in carrying water, storing water, and cooking food.

Unit 5: A review of other personal hygiene practices.

**Delivery time:** 3 hours

### **Objectives**

At the end of the session, participants should know:

- How to wash hands properly
- How to use and maintain latrines properly
- The hygienic way to dispose of refuse and wastewater
- How to prevent stored water and food from contamination
- How to keep the home and surroundings clean

### **Training Methods**

- Brainstorming
- Discussions
- Demonstrations and field visits. (for example to a latrine)

### **Content**

- As listed above under the 5 Units

## **MODULE 4**

**Topic:** Sources of Water

**Delivery time:** 2 hours

### **Objectives**

At the end of this module participant should know:

- How different sources of water can be contaminated
- The best way to collect water from these sources
- How to protect water sources from contamination

### **Training Methods**

- Brainstorming
- Discussions
- Visual aids-illustrations

### **Content**

- Rainwater
- Surface water: Rivers, streams and lakes
- Underground water: Wells, boreholes and springs



## **MODULE 5**

**Topic:** Sanitary Survey

**Delivery time:** 4 hours

### **Objectives**

At the end of the training, participants should understand:

- What sanitary surveys are and why they are necessary.
- How to conduct sanitary surveys.
- How to use the results of sanitary surveys.

### **Training Methods**

- Discussions
- Field exercises

### **Content**

- The purpose of sanitary surveys
- Sanitary survey questionnaires for latrines and different water points
- Explanations for the questions
- When a sanitary survey is necessary
- Who should conduct the sanitary surveys
- The steps involved in conducting sanitary surveys

## **MODULE 6**

**Topic:** Simple methods of water treatment for the home

**Delivery time:** 2 hours

### **Objectives**

By the end of this module participants should know and appreciate:

- The importance of treating water for drinking.
- Different water treatment methods and their limitations.
- The processes involved in chlorinating water for drinking.

### **Training Methods**

- Discussions
- Demonstrations

### **Content**

- Simple water treatment methods
- Different methods of filtration
- Different methods of disinfecting water
- Chlorinating water for drinking purposes

## **MODULE 7**

**Topic:** Water Quality Monitoring

**Delivery time:** 4 hours

### **Objectives**

At the end of the training participants should understand:

- Why water quality needs to be monitored.
- The different aspects of water quality monitoring.
- The significance of the parameters tested for, both physical, chemical and bacteriological.
- How to use the field kit for water quality testing.
- How to interpret the test results using the WHO Guidelines.

### **Training Methods**

- Discussions
- Practical demonstrations

### **Content**

- The purpose of water quality monitoring.
- Logistics needed for community water quality monitoring.
- Water sampling for chemical and bacteriological testing
- Physical, chemical and bacteriological quality of water and the WHO Guideline Values of the parameters.
- Methods used for bacteriological testing of water and the interpretation of the results.

**SANITARY SURVEY FOR THE ASSESSMENT OF  
THE HYGIENIC STATE OF LATRINES**

**I Type of latrine : VIP**

**General information**

- 1. Location : Province .....
- : District .....
- : Village .....
- : School .....
- 2. Code No. ....
- 3. Date of visit .....
- 4. Who uses the toilet? Community / School / Family (Circle one)
- 5. How many people use the toilet. ....

**II Risk Assessment Questions.**

**Risk  
Yes No**

- 1. Is the area immediately around the latrine dirty with faecal matter and used anal cleansing materials?.....
- 2. Is the latrine and/or the area around full of house flies? ..... .....
- 3. Is the concrete slab and/or the area around the squat-hole soiled with faecal matter/urine?.....
- 4. Is the latrine giving off a bad odour? ..... .....
- 5. Is the squat hole covered preventing free passage of air to vent the pit?..... .....
- 6. Is the mesh on top of the vent damaged and therefore unable to trap flies?.....
- 7. Are hand-washing facilities (ash, or soap and water) unavailable for use at the entrance of the latrine? ..... .....
- 8. Is there any structural defect like a cracked slab unstable grounds or unstable superstructure?.....

**Total risk score (total number of "Yes" counted) ...../8**

**Contamination risk score:**            7-8 = Very High  
    5-6= High  
    3-4= Moderate  
    0-2= Low

**III Results and Recommendations:**

The following important points of risk (serially from the numbers 1-8 above) were noted.

|  |  |  |  |
|--|--|--|--|
|  |  |  |  |
|--|--|--|--|

Have the authorities / community been advised on intervention measures? . . . . Yes / No

**Investigator: Name..... Signature ..... Date.....**

**Position.....**

**SANITARY SURVEY FOR THE ASSESSMENT  
OF THE HYGIENIC STATE OF LATRINES**

**I**      **Type of latrine :**                         **Pit or Sealed Lid**

**General information**

1. Location                    : Province .....
- : District .....
- : Village .....
- : School .....
2. Code No. ....
3. Date of visit .....
4. Who uses the toilet? Community / School / Family (Circle one)
5. How many people use the toilet. ....

**II**      **Risk Assessment Questions.**

|  |             |           |
|--|-------------|-----------|
|  | <b>Risk</b> |           |
|  | <b>Yes</b>  | <b>No</b> |

1. Is the area immediately around the latrine dirty with faecal matter and used anal cleansing materials?.....
2. Is the latrine and/or the area around full of house flies? .....
3. Is the concrete slab or platform or the area around the squat-hole soiled with faecal matter? .....
4. Is the latrine giving off a bad odour? .....
5. Is the squat hole cover not closely fitting allowing flies to escape from the pit? .....
6. Are hand-washing facilities (ash, or soap and water) unavailable for use at the entrance or nearby the latrine? .....
7. Is there any structural defect like a cracked slab, unstable grounds or unstable superstructure? .....

**Total risk score (total number of "Yes" counted)...../7**

**Contamination risk score:**

|                 |
|-----------------|
| 6-7 = Very High |
| 4-5 = High      |
| 2-3 = Moderate  |
| 0-1 = Low       |

**III**      **Results and Recommendations:**

The following important points of risk (serially from the numbers 1-7 above) were noted.

|  |  |  |  |  |
|--|--|--|--|--|
|  |  |  |  |  |
|--|--|--|--|--|

Have the authorities / community been advised on intervention measures?... Yes / No

**Investigator:Name..... Signature ..... Date.....**

**Position.....**

**SANITARY SURVEY FOR THE ASSESSMENT OF RISK OF  
CONTAMINATION OF DRINKING WATER SOURCES**

**I Water Source: Protected Spring**

General information

1. Location : Province .....
- : District .....
- : Village .....
- : School .....
- 2 Code No. ....
- 3 Date of visit .....
- 4 Was water sample taken? Yes/No.....
- 5 Sample No. ....
- 6 Was water sample analysed? Yes/No .....
- 7 What is the water quality? Acceptable / unacceptable

**II Risk Assessment Questions.**

|  | <b>Risk</b> |           |
|--|-------------|-----------|
|  | <b>Yes</b>  | <b>No</b> |
| 1. Is the nearest latrine within 30 metres of the spring?  | .....       | .....     |
| 2. Is the nearest latrine on higher ground than the spring?  | .....       | .....     |
| 3. Is there a rubbish dump, or animals grazing or animal faeces within 30 metres of the spring?                              | .....       | .....     |
| 4. Is the spring source unprotected by a concrete wall or a spring box and therefore open to surface contamination?          | .....       | .....     |
| 5. Is the concrete wall or spring box protecting the source broken?  | .....       | .....     |
| 6. If there is a spring box, is the inspection cover unsanitary?   | .....       | .....     |
| 7. Does the spring box contain evidence of contamination such as animals and silt?   | .....       | .....     |
| 8. If there is an air vent, is it faulty or unsanitary?  | .....       | .....     |
| 9. Is the fence around the well unable to keep animals away?   | .....       | .....     |
| 10. Does the source lack a surface water diversion ditch above it, or if it is present is it dysfunctional or not effective? | .....       | .....     |

**Total risk score (total number of "Yes" counted)...../10**

**Contamination risk score:**    9-10 = Very High  
   6-8 = High  
   3-5 = Intermediate  
   0-3 = Low

**III Results and Recommendations:**

The following important points of risk (serially from the numbers 1-10 above) were noted.

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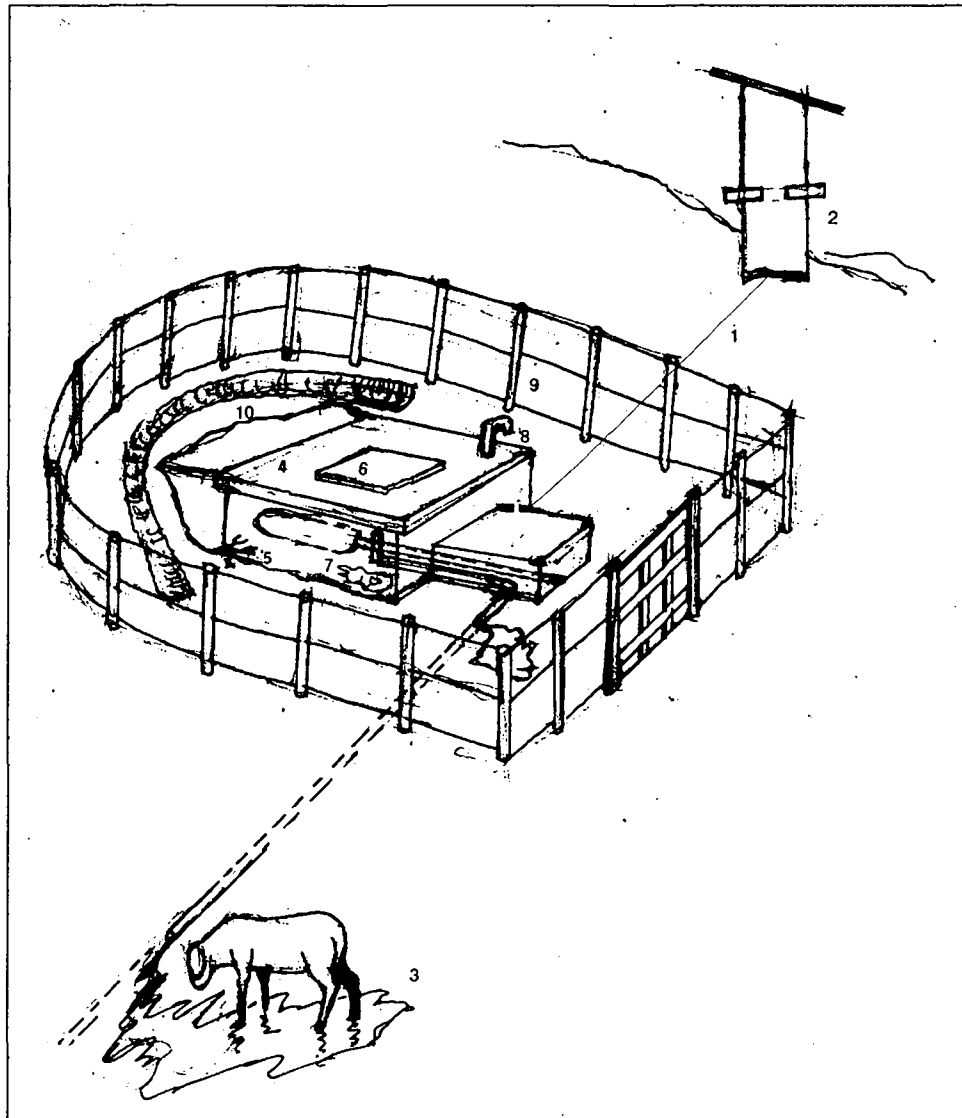
Have the authorities / community been advised on intervention measures?.....Yes / No

**Investigator: Name..... Signature .....**

**Date.....**

**Position.....**

**An illustration of a spring box used in conjunction with the sanitary survey questionnaire.**



**SANITARY SURVEY FOR THE ASSESSMENT OF RISK  
OF CONTAMINATION OF DRINKING WATER SOURCE**

**I Water Source: Borehole with Hand-pump**

General information

1. Location : Province .....
- : District .....
- : Village .....
- : School .....
2. Code No. ....
3. Date of visit .....
4. Was water sample taken? Yes/No.....
5. Sample No. ....
6. Was water sample analysed? Yes/No .....
7. What is the water quality? Acceptable / unacceptable

**II Risk Assessment Questions.**

**Risk**  
**Yes No**

- |   |       |       |
|---|-------|-------|
| 1. Is the nearest latrine within 30 metres of the borehole?   | ..... | ..... |
| 2. Is the nearest latrine on a higher ground than the borehole?   | ..... | ..... |
| 3. Are people washing clothes, dishes etc, on the apron, or within 10 metres around the hand-pump?                          | ..... | ..... |
| 4. Is there a rubbish dump, or animals grazing or animal faeces within 30m of the borehole?                                 | ..... | ..... |
| 5. Is the drainage within 3 metres of the water point poor, causing pools of stagnant water?                                | ..... | ..... |
| 6. Does the hand-pump have a concrete apron, less than 2 metres diameter /square around it?                                 | ..... | ..... |
| 7. Is the drainage on the apron and the drainage channel poor allowing pools of stagnant water to form?                     | ..... | ..... |
| 8. Is the concrete apron around the hand pump cracked?  | ..... | ..... |
| 9. Is there a concrete drainage channel less than 3 metres long?  | ..... | ..... |
| 10. Is the drainage channel unclean, cracked or broken allowing pools of water to form, or does not drain into a soak-away? | ..... | ..... |
| 11. Is the fence around the borehole unable to keep animals away?   | ..... | ..... |
| 12. Is the hand pump loose around the pump body, which could allow water to enter the casing?                               | ..... | ..... |
| 13. Is the hand pump unable to pump water properly?   | ..... | ..... |



Total risk score ( total number of “Yes” counted)...../13

Contamination risk score: 10-13 = Very High  
6-8 = High  
3-5 = Intermediate  
0-2 = Low

**III Results and Recommendations:**

The following important points of risk (serially from the numbers 1-13 above) were noted.

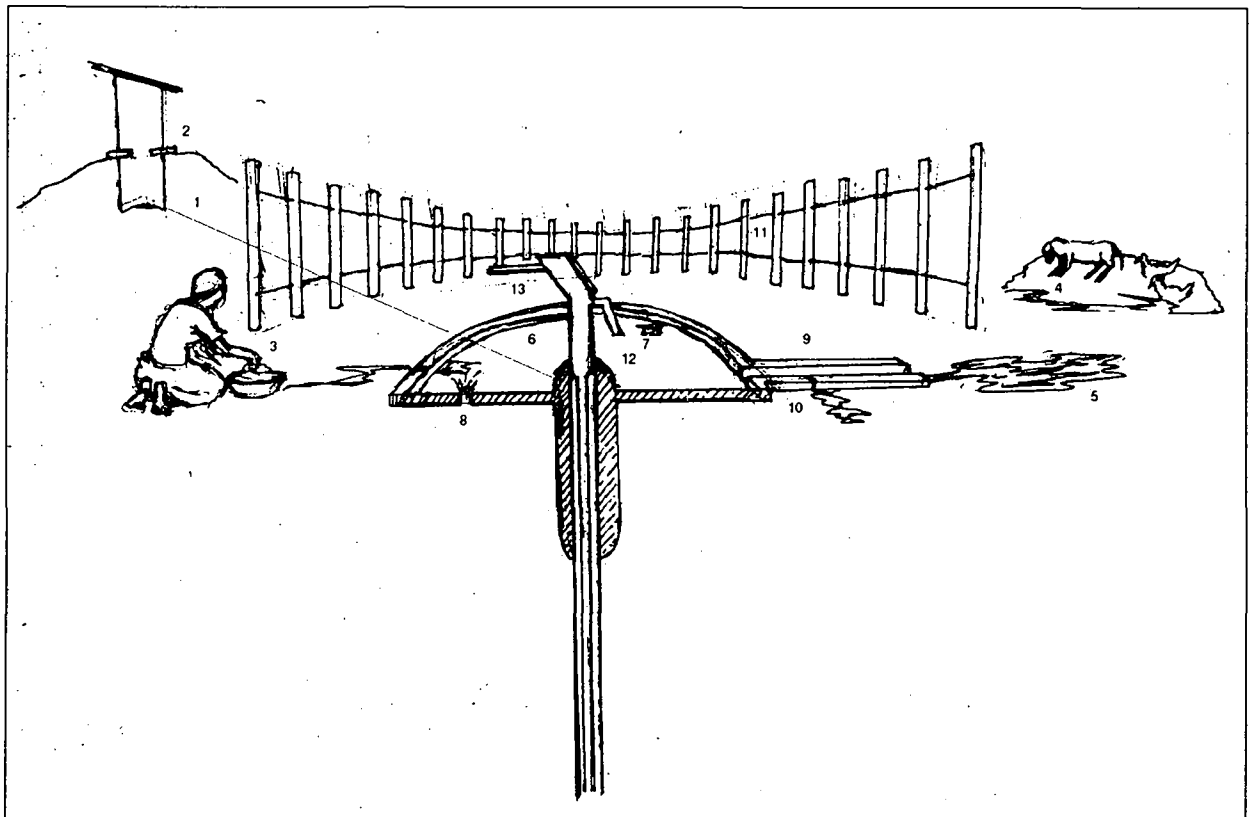
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Have the authorities /community been advised on intervention measures?... Yes / No

Investigator: Name.....Signature.....Date.....

Position.....

An illustration of a borehole with a hand-pump used in conjunction with the sanitary survey questionnaire.



**SANITARY SURVEY FOR THE ASSESSMENT OF RISK  
OF CONTAMINATION OF DRINKING WATER SOURCE**

**I Water Source: Dug well with Hand-pump**

**General information**

Location : Province .....  
 : District .....  
 : Village .....  
 : School .....

1. Code No. ....
2. Date of visit .....
3. Was water sample taken? Yes/No.....
4. Sample No. ....
5. Was water sample analysed? Yes/No .....
6. What is the water quality? Acceptable / unacceptable

**II Risk Assessment Questions.**

|   | <b>Risk</b> |           |
|---|-------------|-----------|
|   | <b>Yes</b>  | <b>No</b> |
| 1. Is the nearest latrine within 30 metres of the well? .....   | .....       | .....     |
| 2. Is the nearest latrine on a higher ground than the well? .....   | .....       | .....     |
| 3. Are people washing clothes, dishes etc on the apron, or within 10metres around the hand-pump? .....                            | .....       | .....     |
| 4. Is there a rubbish dump, or animals grazing or animal faeces within 30 metres of the well? .....                               | .....       | .....     |
| 5. Is there poor drainage within 3 metres of the water point, causing pools of stagnant water? .....                              | .....       | .....     |
| 6. Does the hand pump have a concrete apron, less than 2 metres diameter /square around it? .....                                 | .....       | .....     |
| 7. Is the drainage on the apron and the drainage channel poor allowing pools of stagnant water to form? .....                     | .....       | .....     |
| 8. Is the concrete apron around the hand pump cracked? .....  | .....       | .....     |
| 9. Is there a concrete drainage channel less than 3 metres long? .....  | .....       | .....     |
| 10. Is the drainage channel unclean, cracked or broken allowing pools of water to form, or does not drain into a soak-away? ..... | .....       | .....     |
| 11. Is the fence around the well unable to keep animals away? .....   | .....       | .....     |
| 12. Is the hand pump loose around the point of attachment, which could allow water to enter the casing? .....                     | .....       | .....     |
| 13. Is the hand pump unable to pump water properly? .....   | .....       | .....     |
| 14. Is the well cover unsanitary? .....   | .....       | .....     |

**Total risk score ( total number of "Yes" counted)...../14**

**Contamination risk score:** 10-14 = Very High  
 3-5 = High  
 3-5 = Intermediate  
 0-2 = Low

**III Results and Recommendations:**

The following important points of risk (serially from the numbers 1-13 above) were noted.

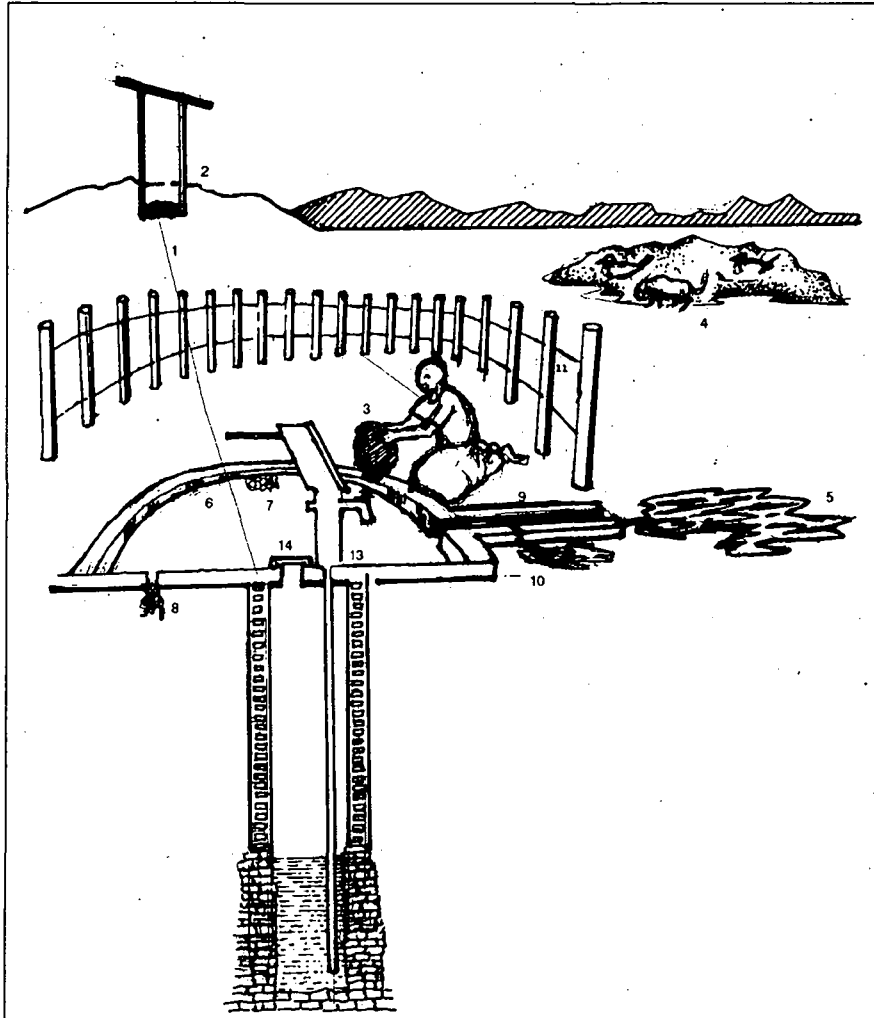
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Have the authorities /community been advised on intervention measures?... Yes / No

Investigator:Name.....Signature..... Date.....

Position.....

An illustration of a dug well with a hand-pump used in conjunction with the sanitary survey questionnaire.



## SANITARY SURVEY FOR THE ASSESSMENT OF RISK OF CONTAMINATION OF DRINKING WATER SOURCES

- I Water Source: Open Dug Well**
- General information
1. Location : Province .....
  - : District .....
  - : Village .....
  - : School .....
  2. Code No. ....
  3. Date of visit .....
  4. Was water sample taken? Yes/No.....
  5. Sample No. ....
  6. Was water sample analysed? Yes/No .....
  7. What is the water quality? Acceptable / unacceptable

| II Risk Assessment Questions.  | Risk  |       |
|--|-------|-------|
|  | Yes   | No    |
| 1. Is the nearest latrine within 30 metres of the well?  | ..... | ..... |
| 2. Is the nearest latrine on a higher ground than the well?  | ..... | ..... |
| 3. Are people washing clothes, dishes etc. on the apron or within 10m of the well?   | ..... | ..... |
| 4. Is there a rubbish dump, or animals grazing or animal faeces within 30 metres of the well?                                | ..... | ..... |
| 5. Is there poor drainage within 3 metres of the well, allowing pools of stagnant water to form?                             | ..... | ..... |
| 6. Does the well have a concrete apron, less than 2m diameter/square around it?  | ..... | ..... |
| 7. Is there poor drainage on the apron, allowing pools of stagnant water to form?  | ..... | ..... |
| 8. Is the concrete apron around the well cracked, which could allow surface water to enter the well?                         | ..... | ..... |
| 9. Is the well lining properly sealed for at least the first 3 metres below ground level?                                    | ..... | ..... |
| 10. Is the drainage channel unclean, cracked or broken, allowing pools of water to form, or does not drain into a soak-away? | ..... | ..... |
| 11. Is the fence around the well unable to keep animals away?  | ..... | ..... |
| 12. Does the well have a headwall (parapet) less than 50 centimetres high?   | ..... | ..... |
| 13. Is the headwall broken or inadequate which could allow surface water to enter the well?                                  | ..... | ..... |
| 14. Is the cover of the well in poor unsanitary condition?   | ..... | ..... |
| 15. Are the bucket and rope used to draw water left on the floor where they could become contaminated?                       | ..... | ..... |

**Total score of risk (total number of "Yes" counted)...../15**

Contamination risk score:            11-15 = Very High  
     7-10 = High  
     4-6 = Low  
     0-3 = Intermediate

**III Results and Recommendations:**

The following important points of risk (serially from the numbers 1-15 above) were noted.

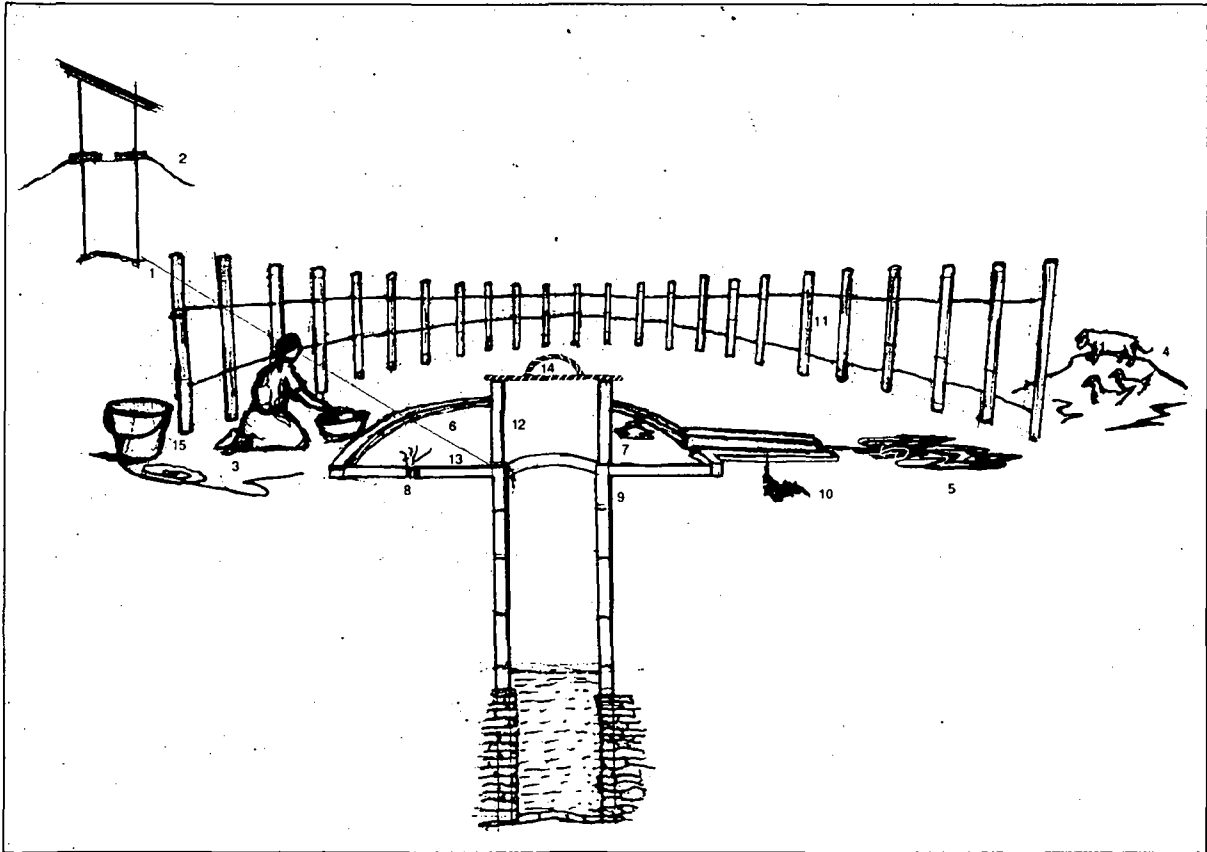
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|  |  |  |  |  |
|--|--|--|--|--|

Have the authorities / community been advised on intervention measures?.....Yes / No

Investigator: Name..... Signature ..... Date.....

Position.....

An illustration of an open dug well used in conjunction with the sanitary survey questionnaire.



**SANITARY SURVEY FOR THE ASSESSMENT OF RISK OF CONTAMINATION OF DRINKING WATER SOURCE**

**I Water Source: Dug wells with windlass**

General information

1. Location : Province .....
- : District .....
- : Village .....
- : School .....
2. Code No. ....
3. Date of visit .....
4. Was water sample taken? Yes/No.....
5. Sample No. ....
6. Was water sample analysed? Yes/No .....
7. What is the water quality? Acceptable / unacceptable

**II Risk Assessment Questions.**

|   | <b>Risk</b> |           |
|---|-------------|-----------|
|   | <b>Yes</b>  | <b>No</b> |
| 1. Is the nearest latrine within 30 metres of the well? .....   | .....       |           |
| 2. Is the nearest latrine on a higher ground than the well? .....   | .....       | .....     |
| 3. Are people washing clothes, dishes etc. on the apron, or within 10 metres around the well? .....                               | .....       |           |
| 4. Is there a rubbish dump, or animals grazing or animal faeces within 30 metres of the well? .....                               | .....       |           |
| 5. Is there poor drainage within 3 metres of the well, causing pools of stagnant water? .....                                     | .....       | .....     |
| 6. Does the well have a concrete apron, less than 2 metres diameter /square around it? .....                                      | .....       |           |
| 7. Is there poor drainage on the apron, allowing pools of stagnant water to form? .....   | .....       | .....     |
| 8. Is the concrete apron around the well cracked? .....   | .....       | .....     |
| 9. Is there a concrete drainage channel less than 3 metres long? .....  | .....       |           |
| 10. Is the drainage channel unclean, cracked or broken, allowing pools of water to form or does not drain into a soak-away? ..... | .....       |           |
| 11. Is the fence around the well unable to keep animals away? .....   | .....       |           |
| 12. Does the well have a headwall (parapet) less than 50cm high .....   | .....       |           |
| 13. Is the headwall or the lining 3 metres below ground level broken, which could allow surface water to enter the well? .....    | .....       |           |
| 14. Is the cover of the well in poor unsanitary condition? .....  | .....       |           |
| 15. Is the bucket and rope used to draw water left on the floor where they could become contaminated? .....                       | .....       |           |

**Total Risk Score (total number of "Yes" counted)...../15**

**Contamination Risk Score:**            11 -15 = Very High  
     7 -10 = High  
     4 - 6 = Moderate  
     0 - 3 = Low

**III Results and Recommendations:**

The following important points of risk (serially from the numbers 1-15 above) were noted.

|  |  |  |  |  |
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|  |  |  |  |  |
|--|--|--|--|--|

Have the authorities / community been advised on intervention measures? Yes/ No

**Investigator: Name..... Signature ..... Date.....**

**Position.....**

**An illustration of a dug well with windlass used in conjunction with the sanitary survey questionnaire.**

