World Health Organization

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Fact sheets on environmental sanitation

Presentation

This document is intended for those dealing with the difficult task of identifying priorities and promoting and implementing programmes in environmental sanitation at the country level.

It covers four major areas: planning; water supply; sanitation; and hygiene education. However, considering the current urgency fact sheets on water are made available as a priority. The fact sheets on other topics will follow.

Introduction to fact sheets on water

The quantity and quality of the water that we drink is directly linked to health. If the water is contaminated with germs or chemicals, health will be affected. Outbreaks of diseases transmitted by water have a major impact on human health. Examples of diseases which can be transmitted by water include cholera, typhoid, hepatitis Aand many diarrhoea1 diseases. All of these diseases can also be spread by other means, but the quality of public water supplies is particularly important because such supplies are capable of transmitting contaminated water to many people.

The diseases mentioned above are transmitted through water when it is contaminated by human faeces. For this reason, water quality monitoring should include testing for indicators of faecal contamination such as thermotolerant (faecal) coliforms.

Water sources

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Water sources can include rainwater, surface water (rivers, streams, lakes) and groundwater (from wells and springs). In general, it is cheaper to protect good quality groundwater supplies from contamination than to apply extensive treatment to sources that are already contaminated.

Groundwater sources are often of good quality and may only require source protection and disinfection in order to provide agood quality source of water for drinking. Surface waters are often contaminated and will require treatment before being used. Where treatment of water sources is required, it is important to select the best source available for the supply.

Fact Sheet 2.1 describes how to carry out on-site inspections of water supplies to identify actual and potential sources of contamination, while Fact Sheets 2.2 to 2.7 deal with the upgrading of specific types of water sources.

Water treatment

The purpose of water treatment is to remove substances which may be dangerous to human health, such as pathogens (disease causing microbes). Treatment also removes substances which may provoke consumers to reject the water in favour of a different source (which may in fact be a health risk). Where water has to be treated, it is important to select the best quality water source available. This will make the treatment processes much more efficient, which will reduce treatment costs.

Fact Sheets 2.8 to 2.15 deal with the different stages in a treatment process, highlighting key aspeck of relevance to improved treatment.

Disinfection

The purpose of disinfection is to kill or inactivate pathogenic (disease causing) microbes. Disinfection of water is therefore an important step in the control of water-borne diseases such as cholera, typhoid, hepatitis A and many diarrhoeal diseases, although as mentioned above, all of these diseases may be transmitted in other ways as well. Any programme to control the spread of cholera or other water-borne diseases should include improved water supply, improved sanitation and hygiene education.

Disinfected water is not necessarily sterile. Bacteria dangerous to health are killed by disinfection but others not dangerous to health may survive. Water may be disinfected by chemical or physical means. Disinfection should be constant and should not be relied upon as the sole treatment for poor quality water for public distribution. This is because even a short-term fault with disinfection may lead to wide distribution of contaminated water. It is therefore important that disinfection is combined with source protection and, where appropriate, water treatment.

Fact Sheets 2.16 to 2.28 cover various aspects of disinfection.

Water quality monitoring

In any water supply, there is always a risk that water may become contaminated with pathogens (disease causing micro-organisms) either at the source or during treatment and distribution. In all water supplies, especially where there are epidemic diseases such as cholera and typhoid, it is important to test water supplies regularly to make sure that the water is safe to use. Where regular water quality testing is carried out, contaminated water supplies can be quickly identified and remedial measures taken to improve the supply. Water quality monitoring should not only include water quality tests but also sanitary inspections.

A sanitary inspection is an assessment of potential sources of contamination of a water supply in its immediate environment. The key observations to make for each type of water supply are shown in Fact Sheets 2.1 to 2.15. Detailed descriptions of how to undertake sanitary inspections and examples of inspection forms are given in WHO Guidelines for drinking water quality, Volume I (Geneva, 1993) which also provides information on the monitoring of small water supplies.

In general, the risk of contamination of water supplies with pathogens, particularly if they are from excreta, is far greater than the risk associated with chemical contamination. As this series of Fact Sheets concentrates on environmental sanitation for the control of infectious diarrhoeal disease, the health effects of chemical contamination of water are not covered. For further information on the health effects of all contaminants of water, refer to WHO Guidelines for drinking water quality, Volumes I (Geneva, 1995).

Water quality monitoring should be carried out at set intervals depending on the number of people served by the water supply. In many countries, water quality monitoring is not carried out as often as it should be, because there are few laboratories, costs of transport are high, and samples may deteriorate during prolonged transport. Even where laboratories are close by, there is always some delay before the results of water testing are available at the site of the test.

For these reasons, particularly in remote areas, it is better to carry out water quality monitoring using on-site testing methods. In addition, community motivation in protecting and improving their water supply is likely to be higher when they see the test being carried out and the results of the test. Fact Sheets 2.29 to 2.33 cover different types of on-site testing used in water quality monitoring.

Household water treatment and storage

The water that we drink can have a major impact on health and well-being. If the water is contaminated with germs or chemicals, health may be affected. Many people worldwide collect water from wells, streams, rivers or springs, which may contain germs, or receive contaminated water from pipe distribution systems or vendors. This contaminated water can transmit typhoid, cholera, hepatitis A and other diarrhoea1 diseases.

Water can very easily and quickly be contaminated during household storage. This presents an especially high health risk where members of a family or community do not all practice good hygiene. Good hygiene includes :

- having and using excreta disposal facilities, such as latrines or toilets ;
- regular handwashing especially after defecation and before preparing food or eating ;
- personal and domestic hygiene.

Water stored in the home may become contaminated during handling if it is not stored and protected properly. So even if water is purified or collected from a clean and properly protected water source, it may become contaminated. Fact Sheets 2.2 to 2.6 explain about protection of water sources. Fact Sheet 2.34 deals specifically with household water treatment and storage.

The water cycle

Water covers two-thirds of the earth's surface, however 97% of all water is in the oceans and is difficult and expensive to use in drinking water supplies.

Water evaporates from the oceans into the atmosphere, where it condenses to form clouds. The water held in clouds eventually falls as rain and snow. Some rain falls onto the land where it is either intercepted by vegetation, or it runs off to streams, or it infiltrates into the soil. Some of the water intercepted by vegetation evaporates back into the atmosphere. The water flowing into the streams flows back to the oceans. Some of the water infiltrating into the soil is held there and used by plants. Some seeps down into the earth and becomes groundwater. Figure 1 summarizes the water cycle.

Water sources

Sources of water for drinking water supplies fall into three broad categories :

- Groundwater sources, including dug wells, boreholes, infiltration galleries and springs ;
- Rainwater collection from roof and ground surfaces ;
- Surface water sources, including intakes from streams and rivers, lakes and small dams.

Groundwater sources

Groundwater is water which is held in pores, voids or fissures underground. Pores are the spaces between grains in rocks or loose sediments, such as gravel or sand. These rocks and loose sediments which hold water are called aquifers. The level at which groundwater is first found when digging from the surface is called the water table. The water table often varies seasonally, the lowest level being found at the end of the dry season.

Good aquifers are those which have many interconnected pores. Examples of good aquifers are : sand and gravel deposits, some sandstones and limestones. These deposits tend to produce water that has little or no faecal contamination. This is because the water passing through the soil and rock is naturally filtered. This water can still contain chemical pollutants, for instance iron, and so may require treatment.

Other rocks may contain available water only in joints and fissures. This is very common in hard limestone areas where rivers and streams flow underground. It is possible to use this water, but it is often difficult to find and, as it has received little natural filtering, it may not be free of faecal contamination. In some geologically active areas (e.g. African rift valley) water extracted from crystalline rocks such as granite may contain high concentrations of chemicals such as fluoride, which can be harmful to health.

In some rocks and sediments, particularly those rich in clay, there is water but it cannot be abstracted. This is because, although there are many pores, very few are connected. These are called impermeable layers and they can force groundwater to the surface as springs.

Groundwater can be tapped for drinking water supplies by sinking dug wells and boreholes, building infiltration galleries or by protecting springs. Wells and boreholes are shafts which are sunk directly down to the water table. Springs are where the water table crosses the land surface and water appears on the surface. Infiltration galleries are horizontal drains laid through aquifers.

Dug wells

These are one of the oldest and most common forms of water supply worldwide. In their most basic form, they are unlined holes in the ground which reach the water table. Such wells should be upgraded wherever possible, usually by lining with concrete and adding a hygienic cover. The well should be sunk at least 2 metres below the dry season water table and the intake surrounded by gravel to act as an extra filter. The water can be lifted from the well by a hand pump, a rope and bucket or windlass. Mateller method is used for water lifting it is important that the water is raised in a hygienic manner.

Dug wells are described in detail in Fact Sheet 2.2.

Boreholes and tubewells

These are narrow diameter wells which are usually fitted with either a hand pump or a powered pump. There are a number of ways to sink boreholes and tubewells. Shallow tubewells may be sunk using an auger, by driving a pipe into the ground or by jetting. Boreholes and deep tubewells are sunk using drilling rigs and can be up to 200 metres deep. Boreholes and tubewells are lined with pipe from the surface to the water table. The section of pipe under the water table is either slotted or perforated to allow water to enter. This is called the well screen. A gravel pack is developed around the well screen to provide extra filtering of the water and to remove any solids which could block the intake. Boreholes and tubewells are covered in more detail in Fact Sheet 2.3.

Tubewells can be used in many different situations. They have been commonly used in small rural communities as an alternative to dug wells. They can also be used in low to medium density urban communities and in refugee camps. Deeper tubewells tend to be sunk where a permanent water supply is required. Care should be taken, when siting wells, to ensure that adjacent wells are not so close together that they cause excessive lowering of the water table. Boreholes, or deep tubewells, are most appropriate where large quantities of water are required, for instance for medium sized towns. Boreholes are useful when the water table is deep and where the aquifer is rocky.

Infiltration galleries

These are horizontal or slightly sloping drains made from open-jointed pipes or tiles, which are laid below the water table to collect groundwater. They are used to tap spring lines, increase the yield of dug wells and are sometimes laid near rivers to collect the sub-surface flow of water. The drains should be surrounded with gravel to remove any suspended solids in the water. Infiltration galleries can vary in size from a few tens of metres to two kilometres or longer. Infiltration galleries are covered in greater detail in Fact Sheet 2.5.

Springs

A spring is the point at which groundwater appears on the surface. This can result from the water table intersecting the level of the land surface, or the release of groundwater from between two impermeable layers or from a rock fissure. Springs where the water has been filtered by moving through the aquifer often have water of high quality, which may only require protection and need no treatment. Springs from rock fissures may require treatment as well as protection.

Springs can be protected by surrounding the outlet, or" eye ", of the spring with a water-tight concrete box into which the spring water flows. This is called a spring box. The water is then allowed to overflow from the box through a pipe which may be connected to a distribution system.

Springs are favoured water sources as they often produce high quality water, are inexpensive to protect and do not require a pump to bring the water to the surface. If a spring occurs uphill of the community to be served, it can be connected to a gravity-fed piped distribution system. If the spring occurs downhill of the target community, the water can be pumped up to a storage tank. Springs close to small communities where a piped system is not feasible can be protected and allowed to overflow from the spring box permanently or be connected to a storage tank fitted with a low-lift hand pump.

Springs are dealt with in more detail in Fact Sheet 2.4.

Rainwater collection

This is most commonly a household-level activity, although rainwater can be, collected at schools to provide supplementary drinking water. Rainwater used for drinking is most commonly collected from roofs but it can also be collected from ground surfaces.

Rainwater supplies are often used as a supplement to other water sources, particularly in the period at the start of the dry season. Rainwater collection has many applications and. provided there is sufficient space for a storage tank, can be practised anywhere. It is particularly important in small, dispersed communities where other forms of water supply may be too expensive. Rainwater collection is covered in more detail in Fact Sheet 2.6.

Surface water sources

Surface water sources are rivers, streams, lakes and reservoirs. Surface water generally requires treatment before consumption as it is easily contaminated by faecal and organic matter and may carry silt. Water treatment is covered in Fact Sheets 2.1 1 to 2.34. Surface water sources are often used for large urban water supplies, as rivers and lakes can provide a large, regular volume of water. Where the surface water source is at a lower elevation than the treatment works or community, it will have to be pumped? thus increasing costs. Surface water can be abstracted in a number of ways and the method chosen will depend on cost, population to be served and technology available. Surface water abstraction is covered in more detail in Fact Sheet 2.7.

Rivers

A simple way to abstract water from a river is to sink a well on the river bank, up to 50 metres from the river. There must be sufficient permeable material, such as sand and gravel, between the river and the well.

A similar method requires the construction of infiltration galleries alongside or under the riverbank. Water obtained by these two methods has already been naturally filtered and may only require disinfection prior to consumption. Most commonly. however, water from rivers is taken directly from the river channel. This water will almost always require treatment prior to consumption. If this water is not treated it represents a major health hazard. Direct abstraction of water from rivers is a high cost solution as treatment works must be built. If the intake and treatment plant is upstream of the community, the water can run into a storage tank by gravity to supply the distribution network, otherwise it will have to be pumped. Direct river abstraction is most commonly used to supply urban areas where there is sufficient money to build and operate the system.

Lakes and dams

Water can be abstracted directly from natural lakes or reservoirs, or by means of a dam. Lake water quality varies widely, but there is always a high risk of human and animal faecal pollution near the shores. Small lakes and ponds have a high risk of pollution and all such sources should be treated prior to consumption. Water can either be abstracted directly from the lake or by means of a dam. Natural and dammed lakes, used as reservoirs, are often located above the community to be served, so gravity can be used to transport the water to a treatment plant and then to a storage tank prior to distribution. Lake water, like all surface water, should be treated unless it can be shown that the intake is not polluted. It is rare for lake water not to be polluted, and the additional costs of treatment make lake abstraction relatively expensive.

Introduction to fact sheets on sanitation

Excreta disposal

Human excreta always contain large numbers of germs, some of which may cause diarrhoea. When people become infected with diseases such as cholera, typhoid and hepatitis A, their excreta will contain large amounts of the germs which cause the disease. Fact Sheet 3.1 discusses excreta disposal options.

When people defecate in the open, flies will feed on the excreta and can carry small amounts of the excreta away on their bodies and feet. When they touch food, the excreta and the germs in the excreta are passed onto the food, which may later be eaten by another person. Some germs can grow on food and in a few hours their numbers can increase very quickly. Where there are germs there is always a risk of disease.

During the rainy season, excreta may be washed away by rain-water and can run into wells and streams. The germs in the excreta will then contaminate the water which may be used for drinking.

Many common diseases that can give diarrhoea can spread from one person to another when people defecate in the open air. Disposing of excreta safely, isolating excreta from flies and other insects, and preventing faecal contamination of water supplies would greatly reduce the spread of diseases. Fact Sheet 3.2 deals with open-air defecation, while Fact Sheet 3.3 covers cartage.

Download the fact sheets

Fact sheet 3.1: Excreta disposal options [pdf 230kb]
Fact sheet 3.2: Open-air defecation [pdf 157kb]
Fact sheet 3.3: Cartage [pdf 103kb]
Fact sheet 3.4: Simple pit latrines [pdf 472kb]
Fact sheet 3.5: VIP and ROEC latrines [pdf 389kb]
Fact sheet 3.6: Pour flush latrines [pdf 352kb]
Fact sheet 3.7: Composting latrines [pdf 375kb]
Fact sheet 3.8: Aquaprivies [pdf 388kb]
Fact sheet 3.9: Septic tanks [pdf 277kb]
Fact sheet 3.10: Disposal of sullage and drainage [pdf 188kb]
Fact sheet 3.11: Sewerage and sewage treatment [pdf 171kb]
Fact sheet 3.12: Solid waste disposal [pdf 141kb]
Fact sheet 3.13: Reuse of sewage in agriculture and aquaculture [pdf 171kb]
Fact sheet 3.14: Sanitation in public places [pdf 233kb]
Fact sheet 3.15: Sanitation in hospitals and health centres [pdf 128kb]

In many cultures it is believed that children's faeces are harmless and do not cause disease. This is not true. A child's faeces contain as many germs as an adult's, and it is very important to collect and dispose of children's faeces quickly and safely.

Fact Sheets 3.4 to 3.8 describe the construction of different types of latrines, and Fact Sheet 3.9 provides information on septic tanks.

The disposal of excreta alone is, however, not enough to control the spread of cholera and other diarrhoea1 diseases. Personal hygiene is very important, particularly washing hands after defecation and before eating and cooking.

Wastewater disposal and reuse

Wherever crops are grown, they always need nutrients and water. Wastewater is often used in agriculture as it contains water, minerals, nutrients and its disposal is often expensive. Where effluent is used for irrigation, good quality water can be reserved exclusively for drinking water. Wastewater can also be used as a fertilizer, thus minimizing the need for chemical fertilizers. This reduces costs, energy, expenditure and industrial pollution. Wastewater is also commonly used in aquaculture, or fish farming.

Fact Sheet 3.10 deals with disposal of sullage and drainage, while Fact Sheet 3.1 1 covers sewerage and sewage treatment. The reuse of sewage in agriculture and aquaculture is addressed in Fact Sheet 3.13.

Solid waste disposal

The disposal of refuse can have a significant effect on the health of communities. Where refuse is not disposed of properly, it can lead to pollution of surface water, as rain washes refuse into rivers and streams. There may also be a significant risk of groundwater contamination. Refuse disposed of in storm drains may cause blockages and encourage fly and mosquito breeding. It is therefore very important that household waste is disposed of properly.

Fact Sheet 3.12 deals with solid waste disposal but does not cover industrial solid waste disposal, as this is complex and requires specialist techniques. It is, however, important that industrial waste is disposed of safely, as it is sometimes toxic and highly dangerous to human health.

Sanitation in public places

Where a large number of people are using one area, such as a bus station or school, especially when they are eating food from the same source, there is a greater risk of the spread of diseases such as cholera, hepatitis A, typhoid and other diarrhoea1 diseases.

These places vary in the number of people using them, the amount of time that people spend there and the type of activity that occurs in the area, but all public places need to have adequate sanitation and hygiene facilities. Fact Sheet 3.14 covers sanitation in public places.

Responsibility for the provision of sanitation facilities in public places is not always obvious, especially where these are informal gathering places. It is vital, however, that an agency monitors the sanitation facilities in public places on behalf of the users. Ideally, this should be part of the role of the ministry of health, or its equivalent. Special attention should be paid to the adequacy of facilities, their availability to the public, and the conditions of their operation.

There are several basic rules for sanitation in public places :

- There should be sufficient toilet facilities for the maximum number of people using the area during the day. This normally means one toilet compartment for every 25 users. The toilet facilities should be arranged in separate blocks for men and women. The men's toilet block should have urinals and toilet compartments ; the women's block, toilet compartments only. The total number of urinals plus compartments in the men's block should equal the total number of compartments in the women's block.
- Toilet facilities should not be connected directly to kitchens. This is in order to reduce the number of flies entering the kitchen and to reduce odours reaching the kitchen. It is important that people using the toilet facilities cannot pass directly through the kitchen.
- There must be a handwashing basin with clean water and soap close to the toilet facilities. There should be separate, similar facilities near to kitchens or where food is handled.
- There must be a clean and reliable water supply for handwashing, personal hygiene and flushing of toilet facilities. The water supply should meet quality standards and be regularly tested to ensure that any contamination is discovered quickly and that appropriate remedial action is taken.
- Refuse must be disposed of properly and not allowed to build up, as it will attract flies and vermin.

Responsibilities for cleaning sanitation facilities should be very clearly defined. Dirty facilities make it more likely that people will continue to use the facilities badly or not at all. Clean facilities set a good example to users.

It is important to make sure that information about health is available in public places. Such information should be displayed in an eye-catching, simple and accurate way. Where appropriate, large posters with bright colours and well chosen messages, put up in obvious places, are effective.

Health and hygiene messages may be passed on to the public using such posters in public places. These messages should include the promotion of :

- Handwashing.
- Use of refuse bins.
- Care of toilet facilities.
- Protection of water supplies.

Local school children and college students can be involved in preparing educational posters and notices for public places. Hygiene education is covered in Fact Sheets 4.1 to 4.12.

Introduction to fact sheets on hygiene education

Health education and communication are essential components for the success of any progamme to promote hygiene and prevent cholera. It is important to consider each stage of a programme to assess where uptake and effectiveness can be improved through a well chosen communication strategy. This series of Fact Sheets gives practical guidance on coping with health promotion issues within a cholera control programme.

Health promotion and hygiene education activities should be associated with measures aimed at providing a safe water supply, improving sanitation coverage, and enhancing food safety control.

The following fact sheets on hygiene education suggest activities to complement the overall planning and implementation of environmental sanitation, with particular emphasis on preventing and controlling cholera and other diarrhoeal diseases.

Download the fact sheets

Fact sheet 4.1: The role of hygiene education [pdf 168kb]
Fact sheet 4.2: Focusing on key behaviours [pdf 121kb]
Fact sheet 4.3: Collecting information about current hygiene practices [pdf 291kb]
Fact sheet 4.4: Planning and organization of an education programme [pdf 187kb]
Fact sheet 4.5: Selecting target groups for hygiene education [pdf 119kb]
Fact sheet 4.6: Setting objectives for hygiene education [pdf 96kb]
Fact sheet 4.7: Developing hygiene education messages [pdf 119kb]
Fact sheet 4.8: Selecting appropriate communication methods for hygiene education [pdf 159kb]
Fact sheet 4.9: Teaching and learning methods for hygiene education [pdf 130kb]
Fact sheet 4.10: Using the mass media for hygiene education [pdf 258kb]
Fact sheet 4.11: Using popular or people's media for hygiene education [pdf 128kb]
Fact sheet 4.12: Hygiene education for young people [pdf 181kb]
Fact sheet 4.13: Evaluation of a hygiene education programme [pdf 187kb]