COMMUNITY TOOLKIT

KEEPING YOUR DRINKING WATER SAFE

AN INTRODUCTORY GUIDE

Acknowledgements

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Keeping Your Drinking Water Safe: A Community Toolkit

The *Keeping Your Drinking Water Safe Community Toolkit* has been designed to be used by Community Trainers, Health Officers, Community Workers, and Facilitators, to raise awareness about the need to keep water clean and promote responsible attitudes, behaviour and actions to ensure safe and lasting drinking water supplies.

The ***Keeping Your Drinking Water Safe Community Toolkit*** contains:

- An Introductory Guide containing background information and annexes
- Tool for Conducting a Water Audit
- Tool for Conducting Sanitary Surveys
- Tool on Snapshots to Monitoring Water Sources
- Tool For Water Quality Monitoring Using The Hydrogen-Sulphide (H_2S) Paper-Strip Test
- Tool on Water Awareness and Education
- Tool for Water Management Actions
- Comic and Paper-strip test Instruction Flipchart

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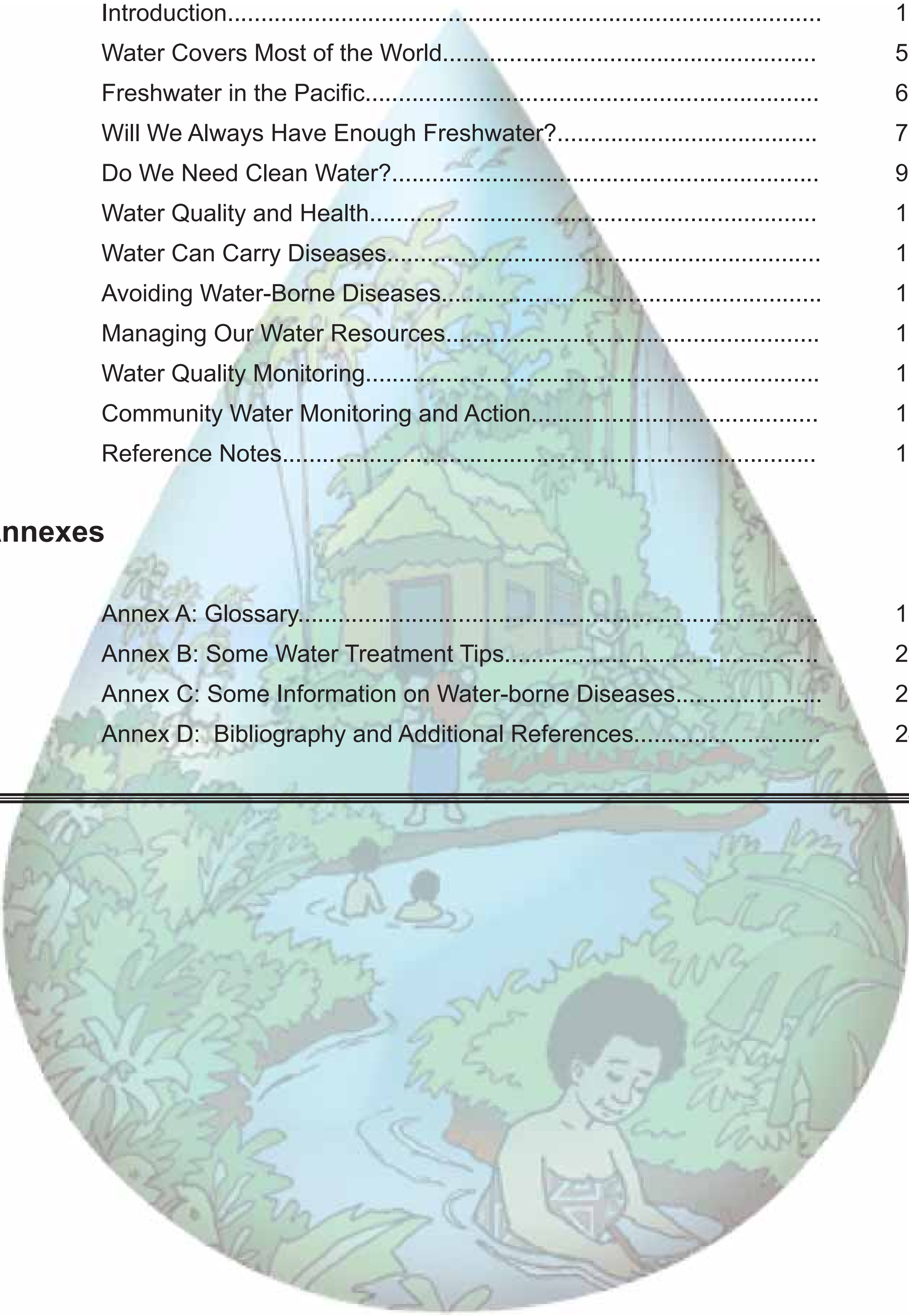
Annexes



Introduction

Safe drinking water for health and development is an important international goal that has been reflected in many international, regional and national policies and strategies. In 2000, the Millennium Development Goals (MDGs) for sustainable development and international co-operation were adopted by the international community. Under the Millennium Development Goals, countries have committed themselves to achieving inter-related targets for sustainable access to safe drinking water, basic sanitation and reduction in child mortality by 2015.[1]

In December 2003, the United Nations General Assembly proclaimed the years 2005 to 2015 as the International Decade – Water for Life. The Water for Life Decade places a greater focus on water-related issues and the participation of women in water-related development efforts at all levels to achieve the water-related targets of the Millennium Development Goals:

- To reduce by half the proportion of people in the world without sustainable access to safe drinking water by 2015.
- To reduce by half the proportion of people in the world without access to sanitation by 2015.

Safe water supply and adequate sanitation to protect health are among the basic human rights. The first water decade from 1981 to1990 brought water to over a billion people and sanitation to almost 770 million. Much more still needs to be done!

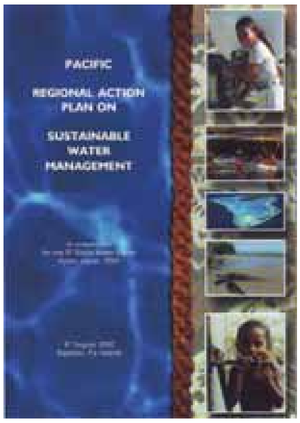
The Water for Life Decade encourages reflection and forethinking that each Pacific person is responsible to ensure that water is available for a clean, fresh, happy and healthy life for our current and future Pacific generations. Our challenge in the Pacific is to review our values, attitudes and behavior, and to develop responsible actions for using and managing our water.

Source: Live & Learn/ SOPAC: World Water Day 2005

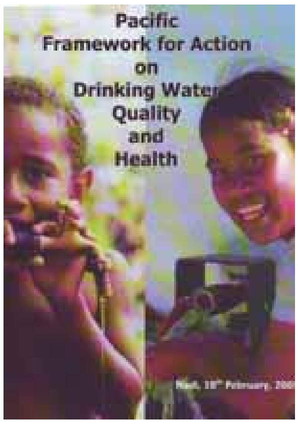
Pacific Drinking Water Quality Strategies

Since 2000, strategic documents to 'drive' regional water and sanitation development in the Pacific have been established. These include the *Pacific Regional Action Plan on Sustainable Water Management and Drinking Water Quality and Health Framework for Action.*

The **Pacific Regional Action Plan on Sustainable Water Management** (Pacific RAP) was completed in 2002, Sigatoka (Fiji Islands) in preparation for the Water in Small Island Countries session at the 3rd World Water Forum in 2003, Kyoto. The Pacific RAP outlines actions needed to achieve sustainable management of water resources and to improve water services through collaborative efforts by water sector authorities and stakeholders.[2]



The **Pacific Framework for Action on Drinking Water Quality and Health,** designed to complement and build on the Pacific RAP, was developed at the World Health Organization-facilitated workshop on Water Quality Standards and Monitoring in Pacific Island Countries (Nadi, 7-10 February 2005). The Framework outlines recommendations and actions for drinking water quality, such as developing community awareness and action-based programmes on safe water supply and sanitation, protecting water sources, household- level water treatment, community- based water testing and using Water Safety Plans.[3]



Keeping Your Drinking Water Safe: A Community Toolkit

Keeping Your Drinking Water Safe: A Community Toolkit was first developed and trialed in 2005 as 'A Guide to Community-based Water Monitoring Using the Hydrogen- Sulphide Paper-Strip Test'.[4] The community- based water monitoring guide has been used with many communities in Pacific Island Countries such as Fiji, Tonga, Papua New Guinea (PNG), and Vanuatu. As a result, many communities have developed Water Management Plans, elected Community Water Monitors, and have taken actions to protect and clean drinking water sources.

Water samples show that there is bacteria in the water. This is a simple, practical test that can easily be used in communities. Results are easily understood, and motivates community 'safe water' actions!
Source: Live & Learn Environmental Education

The Toolkit is designed to assist communities to maintain safe, clean and healthy drinking water. Quality of water is often reflected by quality of life. Water- related diseases from contaminated water cause misery for families. Actions are needed to fight water-related diseases; actions that control the amount of waste going into water sources and ensure safe and healthy water and sanitation.

By using this toolkit, you will be able to increase other peoples understanding of how water is managed, raise awareness about the need to keep water clean and make residents feel responsible about taking action and adopting the right attitudes and behaviour to ensure safe and lasting drinking water supplies.

Creating awareness in the community after testing the water in Nailega. After presenting water test results at the Village Council meeting, the Nailega community were motivated to take action in cleaning up their water sources the very next day!
Source: Live & Learn Environmental Education

Making a Difference in Nailega (Fiji Islands)!

Nailega, a village community, has access to treated water that is stored in the main community tank before being distributed to households. Although having access to treated water, a series of water quality tests showed that the water contained in the main community tank was contaminated. The community members identified possible reasons for contamination and the probable source of pollutants using the sanitary survey. Branches were chopped from a breadfruit tree that was growing beside their water tank. According to the community members, leaves from the tree fall into the tank and decompose causing contamination. A cover for the tank was made to prevent bird waste and leaves from getting into their drinking water. After the clean up, the community tested the water again using the H_2S test-kit- this time the test results showed that the water was safe to drink!

Source: Live & Learn Environmental Education

Community Monitoring & Action in Veinuqa (Fiji Islands)!

The people of Veinuqa, Tailevu source their drinking water from the community well. It was only after carrying out the Water Quality Test, using the H_2S test that they realized how contaminated their drinking water had been.
Following a series of water tests the people of Veinuqa developed practical ways to help ensure their water source was safe and free from pollutants. They took the following steps to clean out their water sources:

- Drained out water from the well.
- Cleaned out the well, removing all debris and dirt.
- Cleaned and fixed all gutters and roofs that drained into water tanks.

According to the Village Headman,

"We never realised that the clear water we drink had bacteria that can be harmful to us. We thought that we don't need to boil the water if it was clear and our children drink straight out of the well.

The Village Headman then approached the staff from the Ministry of Health to present the results of their water test to the Ministry and seek their assistance in providing the village people with safe and treated water.

"This simple and practical the water testing activity has empowered and motivated the people and the chief that we must and we can do things ourselves to improve our own water source"

Source: Live & Learn Environmental Education

Water Covers Most Of The World!

If you were an astronaut gazing down from outer space, you would notice that most of the earth's surface is blue. About three quarters of the earth (70%) is covered by water.

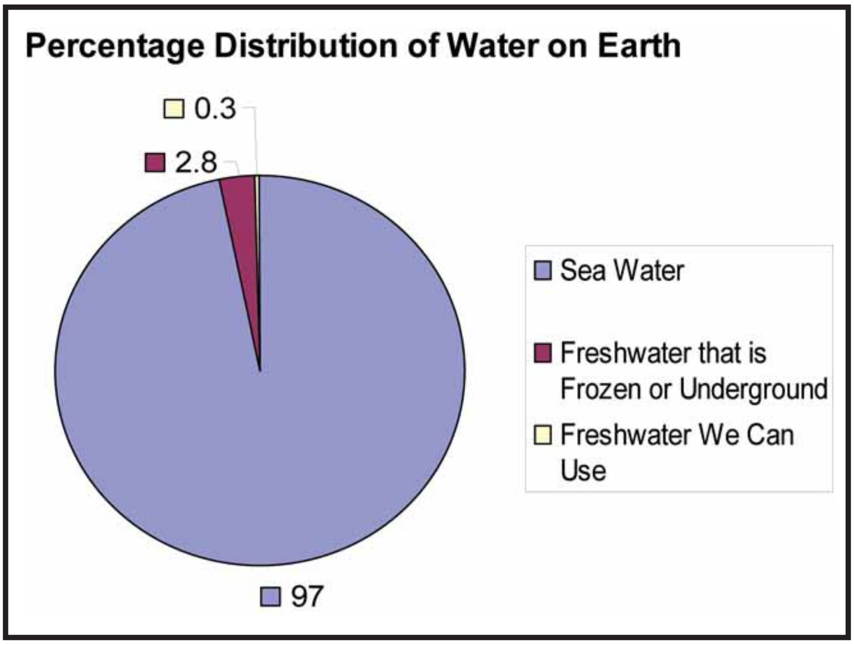
Source : Live & Learn Environmental Education

Almost all of the world's water (97%) is found in oceans and seas and is salty. We cannot easily use salt water for our daily needs. All animals and plants that live on land, including humans, need fresh water to drink.

Source : Live & Learn Environmental Education

A very small amount (about 2.8%) of the world's water is fresh water and most of it is not available for us to use. It is either frozen or trapped under the ground as ground water or found in the atmosphere or soil as water vapour.

A very, very small amount, about 0.3%, is found in rivers and lakes – this is freshwater we can use! Just a drop in the bucket!



Our limited water supplies are being threatened by human activities such as deforestation, pollution and the misuse of water resources.

Much water that is piped to towns and cities is lost before it reaches our taps through leakage.

In Fiji about 50% of water is lost through leakage before it reaches the taps.

Also in many cases water is taken from other areas through pipes to towns and cities, leaving people who live in those areas with little or nothing.

Did you know? We treat water as the world's rubbish bin- a dumping ground for all kinds of waste, from human body waste to radioactive materials.

Freshwater in the Pacific

Freshwater supplies are a critical issue for many Pacific Island countries. Not all islands within the Pacific region have the same sources of freshwater or equal access to freshwater. The soil and rock structure of each island or island group directly affects where freshwater will be found.

Natural freshwater sources of high volcanic islands in Melanesia, including Vanuatu, Fiji, PNG, the Solomon Islands and New Caledonia, are:

- **Surface water:** These are water sources aboveground such as rivers, streams and ponds and lakes.
- **Ground water:** This is water stored underground in cracks, gaps or fissures in rocks.
- **Freshwater lens:** This is water that collects and floats above the heavier, salty seawater surrounding islands.
- **Rainwater** that is harvested or collected in rainwater tanks is also a major source of freshwater for many Pacific Island communities.

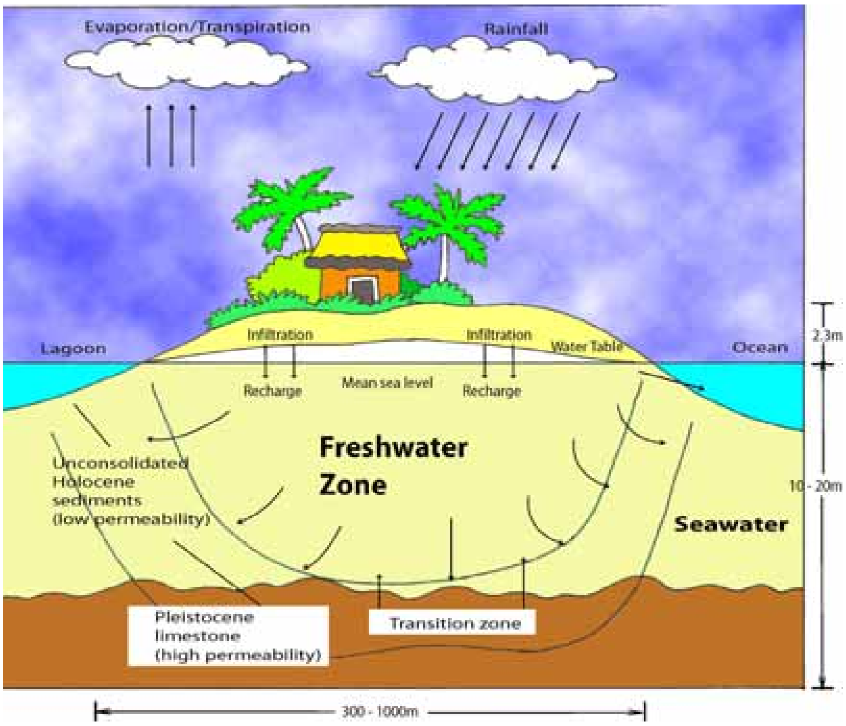
Islands with no surface water rely on rainwater tanks or groundwater. On the low-lying islands coral atolls or limestone islands, freshwater is available mainly from underground freshwater lens. This includes countries such as Kiribati, Marshall Islands and some of Polynesia including Tonga, Tokelau and Tuvalu. The limestone islands of Polynesia – such as Niue – also have a freshwater lens.

Freshwater collects under-ground and floats above the heavier, salty seawater surrounding the islands. This is called a freshwater lens.

The freshwater lens can be refilled by rainfall.

If there is excessive use of the water, or a drought, the freshwater lens will shrink or deteriorate!

Did you know? We treat water as the world's rubbish bin- a dumping ground for all kinds of waste, from human body waste to radioactive materials.



Source: Live & Learn Environmental Education

Will We Always Have Enough Freshwater?

It is easy to think that we have plenty of water in the Pacific – it rains often, sometimes for many days – so why do we need to worry about the quality and quantity of freshwater?

Not all islands or communities have access to the same amount or quality of freshwater. Not everyone has access to safe drinking water, or piped water. Some people can turn on a tap in their house and get drinking water immediately, some get water from community taps or wells, some carry water from rivers or lakes. Many islands face water supply shortages during the dry season and the springs, wells and rainwater tanks dry up.

Case study: Kiribati- Identifying Other Water Sources.

The people of Kiribati rely mostly on rainwater as their major water source. They also get water from shallow unconfined groundwater, imported water or desalination plants. Seawater is used by many for bathing.

The raised island of Banaba has fresh water pools in underwater caves that could serve as an emergency source of water in times of severe drought (Overmars and Butcher 2001). Also, during the British Phosphate Commission period water was imported in phosphate boats and stored in large 4.500m^3 storage tanks on the island. Water in these tanks is currently unused because of the presence of rust suspension in the water.

Source: Intergrated Water Resource Management - SOPAC

Where Does Freshwater In The Pacific Islands Come From?

Country	Surface	Ground	Rainwater (tanks)	Desalination
Cook Islands	•	•	•	
Federated States of Micronesia	•	•	•	
Fiji	•	•	•	• *in tourist resorts only*
Kiribati		•	•	• *for emergency use*
Marshall Islands		•	•	•
Nauru		• *limited use*	•	• *regular use*
Niue		•	•	
Papua New Guinea	•	•	•	
Samoa	•	•	•	
Solomon Islands	•	•	•	
Tonga	• *limited use*	•	•	
Tuvalu		• *limited use*	• *primary use*	• *for emergency use*
Vanuatu	•	•	•	
Wallis and Futuna		•	•	

Source: Intergrated Water Resource Management - SOPAC

Protecting and preserving freshwater sources is the best way to ensure there is enough clean, drinkable water for now and in the future. Water quality is affected by how people 'treat' and use water and the decisions that are made to govern or manage water.

Source: Youth Officer-Labasa

Many activities in urban and rural areas negatively affect water quality. Some of these are shown here. Can you think of any more?

Climate Change
The freshwater supplies of Pacific Islands are vulnerable to climate change.

Rising sea levels will probably affect the quality and quantity of water available for drinking and agriculture.

Low-lying atoll islands that rely almost completely on rainwater or freshwater lenses, for their water supply will be most affected.

Rainfall is likely to increase in some areas, leading to more storms. However, some areas will get less rain and experience more droughts.

Source: Live & Learn Environmental Education

Source: Youth Officer-Labasa

Source: Live & Learn Environmental Education

Case study: Tuvalu's Water Crisis!

Tuvalu is primarily dependent on rainwater. Although the majority of the islands have wells, many of the wells are not protected from contamination and pollution. Water quality is often very poor and well water is now seldom used for drinking. During period of low rainfalls the water quality deteriorates even further becoming more saline.
On many of the islands groundwater is available under the villages, which is probably why the villages were originally settled in that location. However because of the extensive use of pit latrines and septic tanks the water is contaminated.
Over-extraction of groundwater in 1999 and 2000 on the islands, resulted in groundwater becoming brackish or salty with the water level dropping. This has negative impacts on vegetation.
On the outer islands of Tuvalu, groundwater is only used as an emergency supply in times of drought. On Funafuti groundwater is only used for feeding pigs, washing pigpens and flushing toilets. During droughts the use of ground water sometimes extends to washing clothes, bathing and flushing toilets.

Source:Intergrated Water Resource Management - SOPAC

Do We Need Clean Water?

Living things cannot survive without water. Water is a necessity for life. An average person needs 8 glasses (about 2 litres) of clean water a day to survive – this is not surprising given that 75% of our bodies are actually made up of water!

Being such a necessity, not having enough safe drinking water or having contaminated drinking water, poses a threat to all living organisms and especially humans. We can survive for several weeks without food, but for only a few days without water. A constant supply of water is needed by each person to replace the fluids lost through normal daily activities, such as breathing, sweating and urinating.

Water of sufficient quality to serve as drinking water is called **potable water.** Ideally, potable water should contain no contamination such as harmful bacteria, viruses or dangerous chemicals.

Water is essential for life. A few organisms can survive without air, but none can live without water.

The quality of water can affect the life of people, plants and animals because all depend on water for survival. Clean, fresh, safe water is essential for our health and in our day- to- day living.
Equally important is having access to adequate sanitation and hygiene.

2.2 million people, mostly children, die from diarrhoea every year in developing countries.

Source: WHO

Contamination of water can occur when human and animal faeces enter the water source. The World Health Organization estimates that 80% of all sickness and disease in the world is a result of poor quality water and sanitation. Over one-third of deaths in developing countries, and on average, at least one- tenth of each person's productive time is sacrificed to water- related diseases. [5]

Women and Water

Two thirds of the world's households use a water source outside the home and the water carriers are traditionally women. In these areas women and children usually collect water from a standpipe in the village, a well or a muddy river.

A person needs 5 litres of water a day for drinking and cooking and 25 litres more to stay clean. The most a woman can comfortably carry is 15 litres. The work involved in collecting and carrying water uses up to 50 percent of a woman's energy.

If a supply of water were available in the village near their homes, women may have more time to participate in activities that support further development of their family and community.

Water Quality and Health

An established goal of the World Health Organization and Member States is that:

" All people, whatever their state of development, and social and economic conditions, have the right to have access to an adequate supply of safe- drinking water." [6]

'Safe water' refers to water that is not harmful for human beings, that is not contaminated to the extent of being unhealthy. Safe water also refers to a water supply that is of sufficient quantity to meet all domestic needs, is available continuously, is available to all and is affordable.

A big problem facing people is that although we all need water, unclean water can contain germs or microorganisms that cause disease. These nasty, often unseen organisms can make you very sick. They are especially dangerous for small children or the elderly and in some cases lead to death.

Diseases associated with water are heavily concentrated in the developing world, especially among the poorer urban and rural households of the poorer countries. Diseases such as cholera, typhoid, dysentery, hepatitis, giardiasis and guinea worm infection, arising from microbial pathogens (microscopic disease carrying agents) in contaminated water have the greatest impact worldwide.[7]

Water Can Carry Diseases

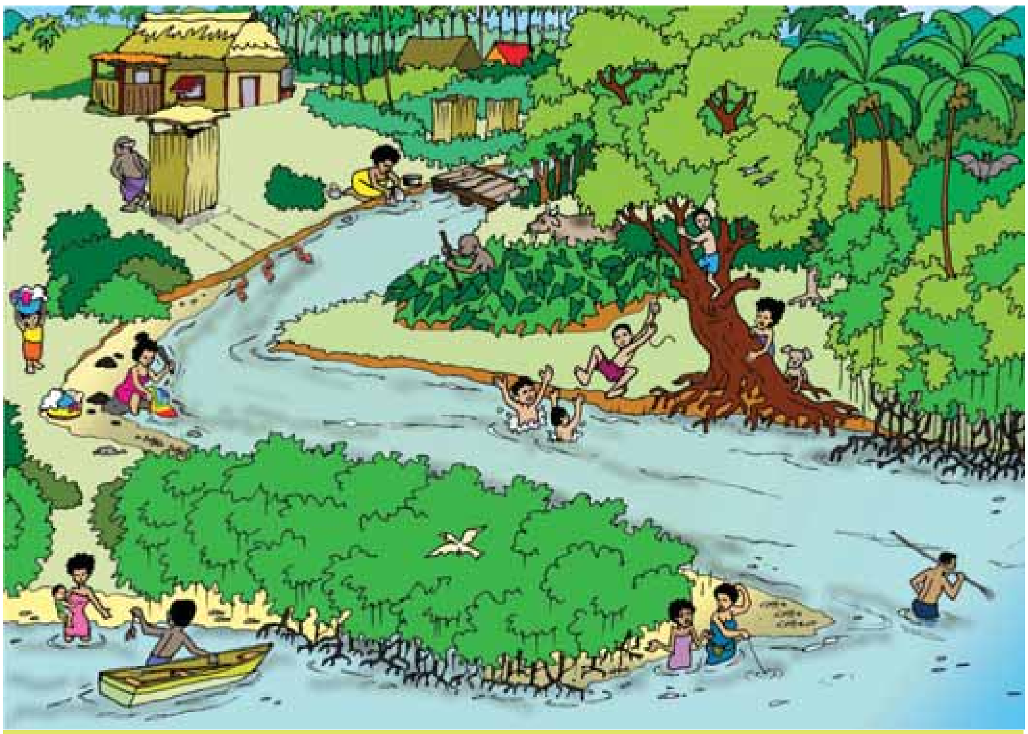
Water that looks clean is not always safe for humans to drink. Contamination of drinking water is sometimes hard to see because the germs and bacteria that cause diseases cannot be seen with the naked eye. So, you cannot assume that water is safe just because it looks clean!

If drinking water comes from a polluted source and is untreated it may contain germs and bacteria that can cause the spread of water-related diseases like diarrhoea, typhoid and cholera.

Treatment of water is a process of killing and removing dangerous microorganisms in the water. Water treatment involves filtering or adding chlorine in order to kill and remove dangerous bacteria, as well as to improve the colour, odour and taste of water. In small doses chlorine is safe for humans, but deadly for bacteria.[8]

Many people in developing countries know that the best way to avoid diarrhoea is by boiling water before use, yet in many areas of the developing world a lack of firewood and time means water is rarely boiled.

There are other ways of getting water borne diseases. Poor water storage and handling of food with dirty hands, or washing vegetables in contaminated water can cause water borne diseases. A main source of infection to other children is the poor disposal of children's faeces.



Source: *Pacific Islands Applied Geoscience Commission (SOPAC)*

Look at the picture, can you identify the different ways water can become contaminated?

We cannot assume water is safe just because it is clear. Many contaminants are either microscopic or dissolved in water, and we cannot see them unless we use a microscope.

Avoiding Water- Borne Diseases

Simple practices like washing of hands with clean water and soap after visiting the toilet, good disposal of wastewater and faeces, covering of food and boiling drinking water can help to protect us from diseases like typhoid and diarrhoea and can prevent the contamination of water. Wearing proper footwear when going outdoors and keeping any cuts covered should also help to prevent you from getting water- borne diseases.

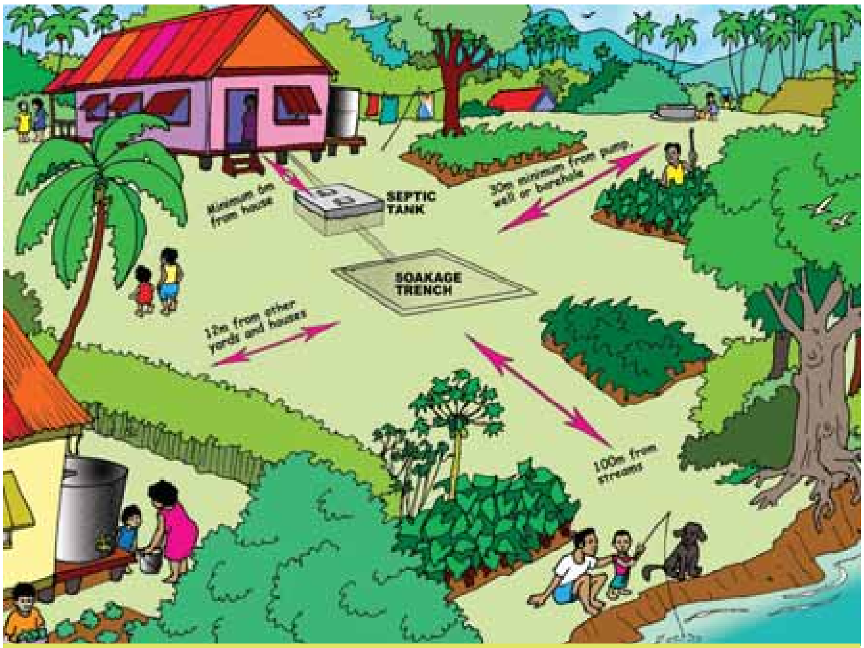
HAND WASHING: PROTECT HEALTH & PREVENT DISEASE:

Wet hands first. Use soap to lather your hands thoroughly, including wrist, palms, back of hands, fingers and under fingernails. Rub hands together for at least 15 – 20 seconds. Rinse your hands properly with clean water. Be sure not to touch side of sink. Dry hands completely using a clean hand towel or tissue.

ALWAYS WASH YOUR HANDS:

- *After using the toilet.*
- *After changing a diaper- wash the baby's hands too!*
- *After touching animals or animal waste.*
- *Before and after preparing food- especially when handling raw meat, poultry and fish.*
- *Before and after eating.*
- *After blowing your nose.*
- *After coughing or sneezing into your hands.*
- *Before and after treating wounds and cuts.*
- *After handling garbage or dirty equipment, rags, soiled clothes etc.*
- *Before and after handling money.*

To avoid water- borne diseases, ensure that your toilets are not placed uphill or close to water sources. Toilets should have a septic tank system and soakage trench, over 100 metres away from rivers or streams. Keep surroundings of water sources such as wells or rainwater tanks clean.



Source: Pacific Islands Applied Geoscience Commission (SOPAC)

WHEN SHOULD I BOIL MY DRINKING WATER?

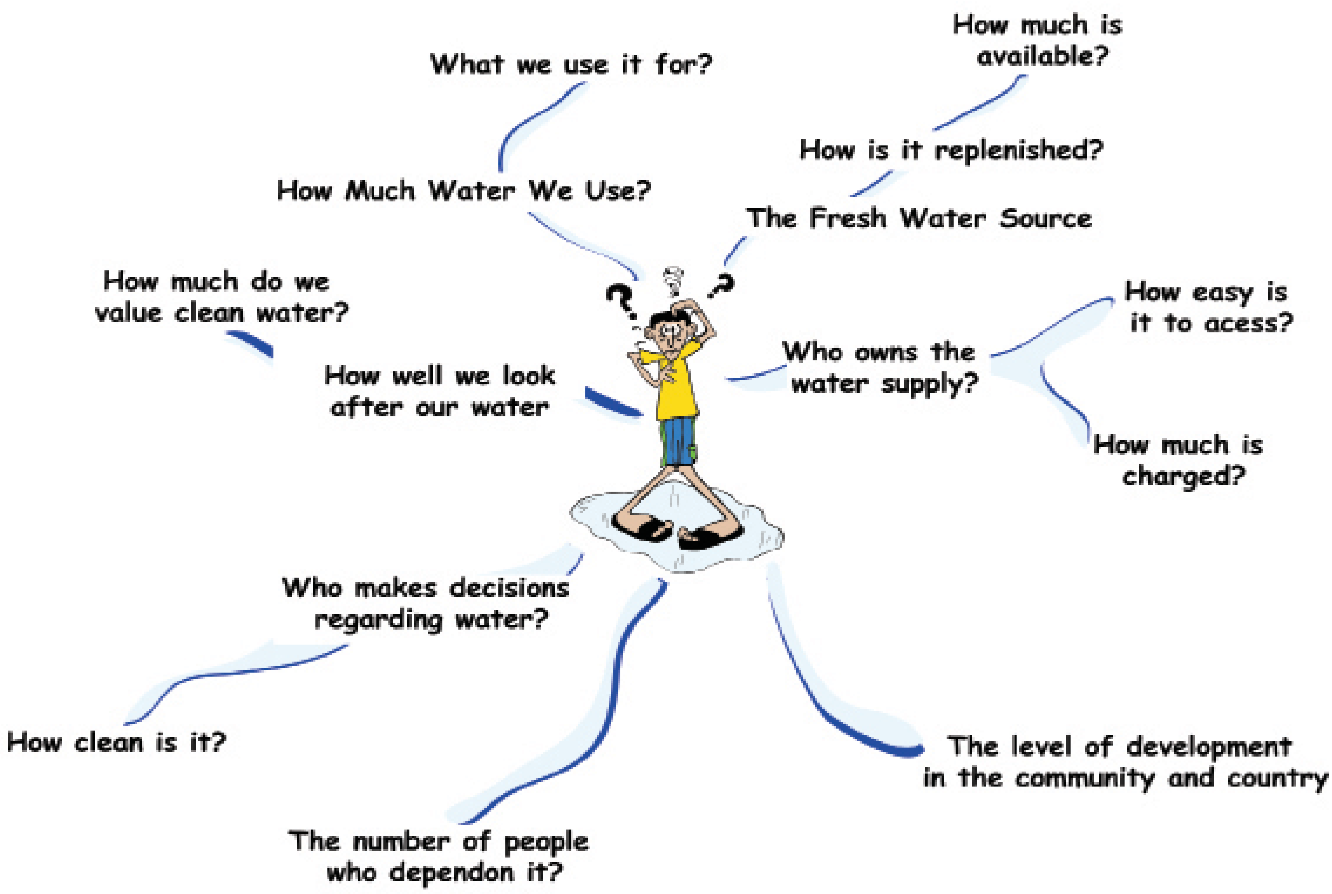
- Your community has been issued a boil water advisory;
- You are using water directly from a stream, lake or shallow well;
- Your water test results show it is contaminated.
- Your community water supply has been affected by disasters such as floods, earthquake or cyclone;
- You are traveling in an area where water is not treated;
- You have a weakened immune system, in which case you should disinfect all of your drinking water.

Managing Our Water Resources

Over the past years, water issues in the Pacific have become more intense with increasing competition for available water resources, and increasing water pollution. Water shortages, water quality degradation and destruction of the aquatic ecosystem are problems facing many communities in the Pacific.

In order to meet basic human needs and services, communities must address several serious water challenges. The question 'What can we do to address our water challenges?' is largely a question of good governance or good management of our water resources.[9]

Many factors influence how we use and manage our water resources.



These factors also shape our attitudes to water. Do you think you would value water more if you had to collect it from the river, or if you could just turn on a tap? Do you think water would seem more valuable, and you would use it more wisely, if you had to pay for it?

Case Study: Community Participatory Planning for Rain Water Harvesting in Tonga

The Pacific Islands Applied Geoscience Commission (SOPAC) has been working with FSPI Affiliate Tonga Community Development Trust (TCDT) to facilitate the implementation of a review of a Rainwater Harvesting Project within two Tongan communities- Matamaka, an isolated island, and Utugake, an urban village. In 2003- 2004, thirty cement tanks were installed with technical assistance from SOPAC

In 2005 SOPAC funded TCDT to review the status of the cement tanks through a participatory learning in action (PLA) approach. TCDT undertook a Training of Trainers using the 'Harvesting the Heavens' handbook, developed by SOPAC.

The tools in the handbook were used to assist communities identify the problems they faced and to develop community action plans to address the causes of the problems. Some of the key issues identified by the communities included:

- *The quality of the water was poor in most of the tanks and ran the risk of ill health of those who drink it*
- *Branches and shrubs hung over the gutters and above the tanks*
- *No fences around the cement tanks to protect from animals*
- *No net to cover the guttering at the joint to the tank*
- *No 'first flush devices' to prevent the first water to 'run off' after a 'no rain' period. The intention is to stop the dirty water from the first 'run off' contaminating the whole water supply*
- *Some tanks started to crack, and poor maintenance resulted in leaking and wastage of water*
- *Water committees were primarily focused on the testing and maintaining tap and ground water supplies, but neglected to monitor the rainwater harvesting systems*
- *Communities could not afford the costs associated with the use of chlorinated tap water, so the only access to drinking water supply is the rainwater harvesting system, therefore the standard of rainwater harvesting management needed to be improved.*

As a result some actions in the community were taken to improve their water quality.

- *Each family with the cement tank, recognized their responsibility, and set a timeframe with actions to be taken to improve the cement tanks.*
- *Water Committees were also established to improve the water resource management of rainwater harvesting systems.*
- *The Tongan Princess's 'beautification contest' in Vava'u, funded by the Princess Pilolevu Tuita, were requested to consider extending the recognition of 'beautification' to the cement tanks and 'rainwater harvesting systems'. The Princess agreed to recognise and fund a prize for those who would undertake to improve the water tanks.*

TCDT has gone on to translate the 'Rainwater Harvesting' manuals into Tongan for future training in the Tonga communities.

Source: Pacific Islands Applied Geoscience Commission (SOPAC)
Foundation of the Peoples of the South Pacific International (FSPI)

Water Quality Monitoring

There is a need for comprehensive and accurate assessments of trends in water quality, in order to raise awareness of the urgent need to address the consequences of present and future threats of water contamination, and to provide a basis for action at all levels.

Monitoring is the programmed process of sampling, measurement and recording of various water characteristics with the aim of ensuring that the quality of water meets certain standards.[10]

The overall purpose of a water quality monitoring programme is to improve the use and management of water resources. Monitoring provides the information that assists communities, individuals, and organizations to:

- Describe water resources and identify actual and emerging problems of water pollution;
- Formulate plans and set priorities for water quality management;
- Develop and implement water quality management programmes; and
- Evaluate the effectiveness of management actions.

When planning a water monitoring programme, it is important to define clearly the major objective or purpose of the monitoring programme, what information is needed and what is already available, and the major gaps that need to be filled.

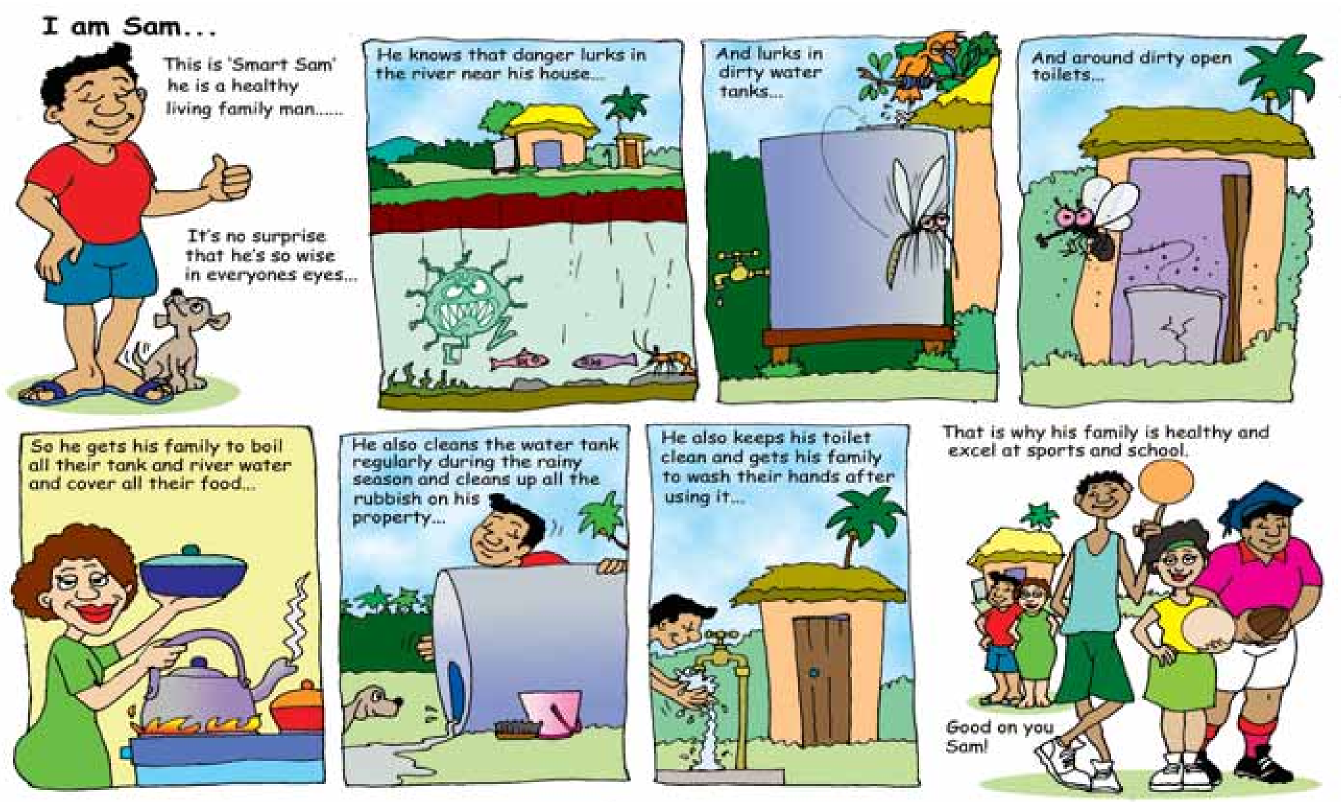
Community Water Monitoring and Action!

Awareness and action towards clean drinking water at community level is critical in improving health and quality of living. Protecting water sources from pollution and maintaining the high quality of water supplies plays a critical role in efforts to protect the health of people, ensure a good quality of life and provide for sustainable development.

Water monitoring can:

- Alert a community to contaminants in time to prevent health problems!
- Help increase awareness and promote community actions for "healthy water and healthy people".
- Encourage communities to examine roles and responsibilities in keeping drinking water safe.
- Engage communities in actions that promote safe water.
- Assist communities to develop long- term plans to manage water resources.

This process starts with investigating water quality and thinking about ways to prevent pollution and improve water sources. It is important to learn about the situation in your community: Where the water supply is coming from, How safe it is, What it is being used for, How it is being polluted or wasted, and What you can do to prevent pollution and conserve water. By being better informed, you will be able to participate actively in decisions concerning the use and management of your water resources. You can motivate your community to plan and take action to protect your health and the environment.



Reference Notes

1. Information on this page adapted from: *The Pacific Framework for Action on Drinking Water Quality and Health;* 2005; WHO.
2. Information on this page adapted from: *The Pacific Regional Action Plan on Sustainable Water Management;* 2002; SOPAC.
3. Information on this page adapted from: *The Pacific Framework for Action on Drinking Water Quality and Health;* 2005; WHO.
4. Information on this page developed by Live and Learn Environmental Education in partnership with the World Health Organization (WHO); 2005; Project Report available at Live and Learn Environmental Education and World Health Organization.
5. Information on this page adapted from: *Guidelines for Drinking-Water Quality, Volume 1, Recommendations;* 2004; WHO.
6. Information on this page adapted from: *Guidelines for Drinking-Water Quality, Volume 3, Surveillance and Control of Community Supplies;* 1997; WHO.
7. Refer to **Annex C** for more information on Water-Bourne Diseases.
8. Refer to **Annex B** for Some Water Treatment Tips.
9. Refer to the **Water Awareness and Education Tool** for more information on developing Community Water Management Plans.
10. Information on this page adapted from: *Water Quality Monitoring: A practical guide to the design and implementation of freshwater quality studies and monitoring programmes;* J.Batram & R. Balance; 1996; UNEP & WHO.

Annex A: Glossary

Cholera – is an infectious disease caused by the bacterium Vibrio cholerae. Transmission to humans occurs through the process of ingesting contaminated water or food.

Deforestation – is the conversion of forested areas to non-forest land for pasture, urban use, logged area, or wasteland. This often causes soil erosion and increasing run-off into rivers and streams, affecting water quality and survival of aquatic plant and animal species.

Desalination – a process of removing excess salts and other minerals from water. Some Pacific Island countries have desalination plants that have broken down and are unable to be repaired due to unavailable equipment parts or lack of technical skill or expertise to repair the machines. The plants become 'unproductive white elephants' and may cause damage to the environment as they rust away.

Dysentery – is frequent, small-volume, severe diarrhoea that shows blood in the faeces along with intestinal cramping and painful straining to pass stool.

Environmental Audit – Is the process of assessing our actions and attitudes towards the environment and also to monitor how we use our resources.

Faecal coliform –is bacteria found in the mammal intestinal wall and faeces, often used as indicator for feacal contamination in drinking water.

Freshwater – often refers to bodies of water containing low concentration of dissolved salts and other total dissolved salts.

Freshwater lens – is freshwater that are collected underground and floats above the heavier salty sea water. This freshwater lens can be refilled by rainfall, and is a major water source in many Pacific coral atolls and limestone islands.

Giardiasis – is a disease caused by the flagellate protozoan Giardia lamblia (also sometimes called Giardia intestinalis and Giardia duodenalis). The giardia organism inhabits the digestive tract of a wide variety of domestic and wild animal species, including humans.

Groundwater – water that is trapped under the ground for many years, located beneath the ground surface in soil pore spaces and rocks, it can either be frozen or liquid. Groundwater is accessed through wells or boreholes, being pumped up to the surface.

Hepatitis – an infectious disease of the liver caused by a virus that can be found in contaminated food and water.

Hygiene – refers to practices associated with ensuring good health and cleanliness. The scientific term "hygiene" refers to the maintenance of health and healthy living.

Lakes - is a body of water or other liquid of considerable size contained on a body of land.

Microbial pathogen – infectious agent; is a biological agent that causes disease or illness to its host.

Pathogen – something that can cause disease, for example, a bacterium or a virus.

Potable water – is water that is intended to be ingested through drinking by humans. Water of sufficient quality to serve as drinking water is termed potable water whether it is used as such or not.

River - is a natural waterway that transits water through a landscape from higher to lower elevations.

Sanitation – generally refers to the provision of facilities and services for the safe disposal of human urine and faeces. Inadequate sanitation is a major cause of disease worldwide and improving sanitation is known to have a significant beneficial impact on health both in households and across communities. The word 'sanitation' also refers to the maintenance of hygienic conditions, through services such as garbage collection and wastewater disposal.

Surface water – water collecting on the ground or in a stream, river, lake, wetland, or ocean is called surface water.

Typhoid – is an acute illness associated with fever caused by the Salmonellae Typhi bacteria. The bacteria is deposited in water or food by a human carrier, and are then spread to other people in the area.

Volatile Organic Compounds – are organic chemical compounds that have high enough vapour pressures under normal conditions to significantly vapourise and enter the atmosphere. An example is methane.

Annex B: Some Water Treatment Tips

Water is treated to kill and remove dangerous bacteria in the water; and improve the colour, odour and taste of water. Types of water treatment include:

USING FILTERS or FILTERING

- This is placed over the tap and is made up of carbon.
- They are a very good way of removing dirt and chlorine from the water, but they do not remove bacteria.
- These filters should be changed regularly or bacteria will grow in them and contaminate the water.
- Do not place a cloth/fabric over the tap because it can introduce bacteria into the water.

USING BLEACH or BLEACHING

- Using laundry bleach is an inexpensive way to kill bacteria and algae in the water tank.
- Bleach your tank on a monthly basis, or if it is during rainy periods, at least once a week.
- Given below is a table showing the amount of bleach to use for the different volumes of water:

Water Volume	Regular Bleach
1 gallon ≈ 4.5 litres	3 Drops
5 gallons ≈ 23 litres	10 Drops or ¼ teaspoon
55 gallons ≈ 250 litres	2 teaspoons
100 gallons ≈ 450 litres	1 tablespoon
200 gallons ≈ 900 litres	2 tablespoons
500 gallons ≈ 2300 litres	5 tablespoons or $^{1}/_{3}$ cup
850 gallons ≈ 3900 litres	10 tablespoons or $^{2}/_{3}$ cup
1000 gallons ≈ 4500 litres	12 tablespoon or ¾ cup

- The above table is based on the assumption that the water tank is full, clean and has a cover.
- If your tank is not clean, you must clean it out in order for the bleach to be effective; other wise your tank will remain contaminated.
- To add bleach to your tank, measure it with a measuring cup and pour it into a bucket of clean water, then pour the bucket into the tank. This will result in an even distribution of the bleach.
- The tank must be covered and not used for at least 24 hours for the bleach to be effective.
- To get rid off the smell of bleach, pour the water into a clean container, filling it to the top. Put a lid on it (or cover it), leaving a small amount of air in the container a let the container sit at room temperature or leave it in the fridge overnight. By the next day, the smell of chlorine will have left the water.

BOILING WATER

- Boiling is the best way to kill bacteria, viruses and parasites.

Proper Boiling Water Procedures:

1. Choose a clean pot that is big enough to hold water and a lid that fits
2. Don't fill the pot all the way up as you need more room for water to bubble
3. Place the pot on the stove and turn the heat to high. If you want to speed the process cover the pot with the lid
4. Keep checking the pot to see how the water is doing
5. Check to see if the water is boiling and leave it to boil for another minute until you see big air bubbles. Wait for bubbles that rise to the top of the pot
6. After boiling let it stand to cool down before pouring the cooled boiled water into a jug ready to be used.

ADVANTAGE OF BOILING WATER

- Pathogens that might be lurking in your water will be killed if the water is boiled at least 1 minute at full boil.
- Boiling will also drive out some of the Volatile Organic Compounds (VOCs), bacteria and pathogens that cause water borne disease.

Annex C: Some Information on Water-borne Diseases

Bacteria /*Disease*	Description	How it is Spread	Symptoms	Treatment
Cryptosporidium/ **Cryptosporidiosis**	A microscopic, single celled parasite found in water in a round egg that is highly resistant to cold and moist conditions. It can survive in the water for months after contamination, meaning that people who drink water contaminated by the parasite can still get sick months after it first entered the water source.	It is spread as a result of water being exposed to animal faeces. Human beings get infected by drinking contaminated water or eating something that came into contact with cattle faeces, such as, eating unwashed fruits and vegetables spread with contaminated manure or washed with contaminated water.	Diarrhoea, abdominal cramps, upset stomach, nausea and headaches.	Effective filtration at treatment facilities and boiling water at home.
Escherichia *Coli* (E. Coli) / Diarrhoea	This is commonly found in the intestine of animals and humans. The presence of E. Coli in water indicates contamination by raw sewage.	This is when human and animal faeces are washed into the water sources, such as wells, streams and rivers. When people drink from these water sources without treating the water, they can get sick.	Bloody diarrhoea, severe abdominal cramps and flu symptoms such as fever, nausea and running stomach.	Treatment with chlorine and effective filtration and boil dirty looking drinking water.
Giardia *Lamblia/* Giardiasis	This is a single celled animal (protozoa) that moves with the aid of five flagella (tiny tentacles). It exists as a cyst and survives in water, soil or fruit and vegetables for a long time after contamination.	This is when human and animal faeces are washed into the water sources, such as wells, streams and rivers. When people drink from these water sources or clean their food with contaminated water without treating the water, they get infected.	Diarrhoea, nausea and fever.	Effective filtration at treatment plants and boiling of water at home.
Shigella/ **Shigellosis**	This is a bacteria that causes Shigellosis which pass from infected person to another.	This is spread when bacterium passing from stools or soiled fingers of one person to the mouth of another person.	Diarrhoea Fever Stomach Cramp	It can be stopped by frequent and careful hand washing with soap. Frequent and careful hand washing is important among all age groups.

Salmonella *Typhi*/ Typhoid	This is a bacterium that causes *salmonellosis* or *typhoid.*	Infections occur as a result of consumption of contaminated food mainly of animal origin, for example, milk, egg, meat poultry etc.	Fever, abdominal pains, diarrhoea, nausea, vomiting and dehydration (which can become life threatening, especially in the very young and very old.)	Water to be chlorinated and/ or boiled.
Vibrio *cholerae*/ Cholera	This is an acute diarrhoeal disease caused by the infection of the intestine with the bacterium *vibrio cholerae*.	It is spread when a person eats contaminated food or drinks contaminated water. It can spread rapidly in areas with inadequate treatment of drinking water.	Watery diarrhoea, vomiting, muscle cramps, dehydration (due to rapid loss of water from the body) and fever.	Chlorine treatment and boiling your drinking water. ***Precautions during Outbreak:*** * Drink only water treated with chlorine or boiled. * Eat food that is thoroughly cooked and still hot, or fruit that you have peeled yourself. * Avoid undercooked or raw food (e.g. Fish). * Avoid salads made from raw vegetables and fruits. * Avoid drinks and food from roadside vendors.

Source: WHO

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Water Education for Teachers

COMMUNITY TOOLKIT

KEEPING YOUR DRINKING WATER SAFE

CONDUCTING A WATER AUDIT

Tool for Conducting a Water Audit

The Tool for Conducting a Water Audit is part of the Keeping Your Drinking Water Safe Community Toolkit developed by Live & Learn Environmental Education. The toolkit is designed to be used by Community Trainers, Health Officers, Community Workers, and Facilitators, to raise awareness about the need to keep water clean and promote responsible attitudes, behaviour and actions to ensure safe and lasting drinking water supplies.

Live & Learn Environmental Education is thankful to those who have contributed to the development of the ***'Keeping Your Drinking Water Safe Community Toolkit'.*** They include:

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The ***Keeping Your Drinking Water Safe Community Toolkit*** contains:

- An Introductory Guide containing background information and annexes
- Tool for Conducting a Water Audit
- Tool for Conducting Sanitary Surveys
- Tool on Snapshots to Monitoring Water Sources
- Tool For Water Quality Monitoring Using The Hydrogen-Sulphide (H_2S) Paper-Strip Test
- Tool on Water Awareness and Education
- Tool for Water Management Actions
- Comic and Paper-strip test Instruction Flipchart

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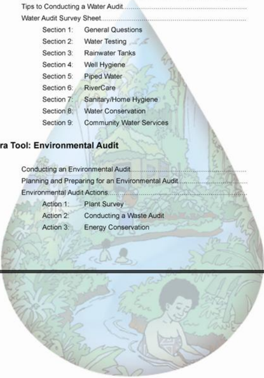


Knowing More About Your Water

Water quality is as important as water supply. Water quality is affected by rainwater drain. Chemicals, oils, fats, paints, litter and fertilizers, all have the potential to pollute our waterways. By taking a moment to dispose of these substances safely, we can protect our waterways and the plants, animals and humans that depend on them.

A water audit is simply a series of questions and observations that are made to find out more about water, how it is used, and whether it is at risk of being contaminated. The main reason to do a water audit is to get a better understanding about water in order to carry out the right measures to make sure it is kept clean and healthy. This audit seeks to find out the following:

- How is water being used?
- What are the sources of water (where does the water come from?)
- Is the water at risk of being contaminated by disease causing germs?
- What activities are putting the water at risk of contamination?
- How is water being wasted, and how can more be saved?

The audit will allow you and the household to discover the answers to these questions. Then, with this new knowledge, households and communities can create an action plan to address the findings of the audit and to promote proper sanitation, hygiene, and health in their communities.

Method:

1) Draw a map of the community environment.

2) On this map mark areas where water is being used, for example you can mark areas such as taps, drains, gardens, water tanks etc. This map follows the movement of water i.e. drains, or absorbed into the soil etc.

3) Copy the Water Audit Survey Sheet to be used by the auditors to conduct the water audit with each household in the community.

Tips for conducting a Audit

Before you start

- Make sure that you introduce yourself properly if you don't know the people you are surveying, try to make them comfortable and build some rapport before starting
- Clearly state the purpose of the survey and give a brief overview. Allow the people to ask questions
- Explain that your conversation will be confidential
- Tell the people how long the survey will take, and make sure that it is a convenient time

Conducting the Audit

- Begin with some friendly general conversation to help the people feel at ease
- Ask the questions in order and try to keep the conversation to the topic of the question
- Be cautious about asking "why" because it can make people feel like you are passing judgment on them
- Beware of asking the questions in a way that could influence the householder's answers. For example, never ask "Don't you think that ..."? This is called a leading question
- Be sure that you have clearly understood the answer. If not, ask the person to repeat the answer. Always ask the householder to explain words and ideas that you do not fully understand. Do not assume that you know what the answer is because of your own knowledge and experience
- Avoid passing judgment, giving advice or your own opinion
- Avoid discussions that are not useful. Keep to the topic of the survey

Closing the Audit

- Ask the householders if there are any questions they would like to ask you
- Discuss the next steps
- Thank the participants for their time and trouble

WATER AUDIT SURVEY SHEET TO COPY

Community: ....

Date of Visit: ....Time of Visit: ....

Name of Household: ....

Name of Auditor: ....

Section 1: General Questions

1. How long have you lived here?

....

2. How many people live in this home?

....

3.

Water Source (Where do you get your water from?)	What do you use it for?	Does it ever run out? (Explain)	Do you think it is safe to drink? (Explain)
Water Tank			
Well			
River			
Others (Please state)			

4. Do you ever boil your drinking water? Yes ☐ No ☐

Why? (If someone told you to boil water, please identify/state the name of the person and where they work?)

....

....

5.

How often do people in your house get sick with:	Often	Occassionally	Never
Diarrhoea			
Vomiting			
A disease that you think is linked to water (please explain			

6. Why do you think they get sick?

....

....

7. What do you think you could do to reduce the number of illnesses?

....

....

General Comments:

....

....

....

Section 2: Water Testing

1. Has your drinking water ever been tested? Yes ☐ No ☐

If your answer is 'yes,' Questions 2-5; If you answered 'no', move to Question 6.

2. How was it tested? (By whom?)

....

....

3. How often was your water tested?

....

4. Were the results Good or Bad?

....

5. If your results were bad, what steps/actions did you take?

....

....

6. Do you think Water Testing is important? Why?

....

....

....

General comments on Water Testing:

....

....

....

Section 3: Rainwater Tanks

1. What kind of Rainwater Tank do you have? (please tick)

☐ Aluminum ☐ Cement ☐ Fibre Glass

☐ Other Please describe: ....

2. How often is your rainwater tank cleaned?

....

3. Do you ever treat or clean the water in your rainwater tank? Yes ☐ No ☐

4. How is the tank cleaned or treated? Who cleans it?

....

....

5.

Condition of Gutters (if present)	Please tick ✓	How often are the gutters cleaned?	Please tick ✓
Very good – very few leaves, no dirt or evidence of animals		Often (every 1 – 2 months)	
Good – few leaves, little dirt or evidence of animals		Occasionally (twice a year)	
Poor – many leaves, some dirt and/or evidence of animals		Rarely (once a year or less)	
		Never	

6. Do birds or other animals have access to the rooftop? Yes ☐ No ☐

7. Are there trees over hanging the catchments (e.g. roof) of the water tank? Yes No

8. Is there an intake screen on the tank? Yes ☐ No ☐
If you ticked 'yes', how often is it cleaned? ....

....

9. Is there any uncovered opening on the rainwater tank? Yes ☐ No ☐

General comments on Rainwater Tanks:

....

....

....

Section 4: Well Hygiene

1. What kind of well do you have?

☐ Drilled (bore) ☐ Dug ☐ Open ☐ Sealed

Other, Please describe:..

....

....

2. Do animals have access to the well? Yes ☐ No ☐
Please comment:
....
....

3. Is the water in the well treated? Yes ☐ No ☐
If yes, how? ....
....
How often and by whom? ....
....

4.

What types of toilets are 'nearby' in the community (include neighboring properties)	Approximate distance from well (meters)	Are these 'uphill,' 'downhill' or on 'flat ground'
Pit Toilet		
*VIP Toilet		
Septic Tank		
Area where people defecate (e.g. in the bush or river)		
Other (please explain):		

Ventilated Improved Pit Toilet

5. Describe the vegetation surrounding the well, that is, the plant cover, how close are the plants to the well, is it bushy, etc.
....
....
....

General comments on Wells:
....
....
....

Section 5: Piped Water

1. Do you have access to piped water via a tap? Yes ☐ No ☐
How many households share this tap? ....
....

2. Is the area around the tap stand fenced Yes ☐ No ☐
Please describe the area ……………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

3. Does water accumulate near the tap stand Yes ☐ No ☐
If you answered 'yes', please describe the area……………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

4.

What types of toilets are 'nearby' in the community (include neighboring properties)	Approximate distance from tap stand (meters)	Are these 'uphill,' 'downhill' or on 'flat ground'
Pit		
VIP Toilet		
Septic tank		
Area where people defecate (e.g. in the bush or river)		
Other (please explain):		

6. Please describe condition of the taps:……………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

General comments on Piped Water:

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

Section 6: RiverCare

1. How far is the house to the nearest creek or river?

……………………………………………………………………………………………………

2. How is the river used by people in the household? (You may tick more than one answer)

Drinking ☐ Washing clothes ☐ Cleaning dishes ☐ Fishing ☐

Washing (cars) ☐ Disposing of waste water ☐ Dumping rubbish ☐ Toilet ☐
Providing water for animals (e.g. pigs or cows) Other ☐ (Please describe)

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

3. If the house is close to a river, rate the condition of the riverbanks:

Condition	Rating	Description
Excellent	4	Almost all native plants (no introduced weeds or gardens); almost all of the ground is covered by plants; good mix of trees, shrubs and smaller plants; no signs of disturbance; no access to animals
Good	3	Mostly native plants; good cover of plants, good mix of trees, shrubs and smaller plants; no signs of recent disturbance; little or restricted access of animals
Fair	2	Mixture of native plants and introduced plants; moderate cover of plants (some spaces); narrow corridor of plants (less than 5 m); evidence of recent site disturbance; little or restricted access of animals
Poor	1	Mostly introduced plants such as weeds, grasses and gardens; little cover by native shrubs or trees; lots of bare ground, extensive site disturbance; unrestricted access for animals

Rating Scale:

Left bank (facing downstream) – circle a number: 1 2 3 4

Right bank (facing downstream) – circle a number: 1 2 3 4

4. Comment on access of animals to the stream:

....

....

....

....

5. Describe the condition and source of any drains running into the stream

....

....

....

....

6. Where does your rubbish (solid waste) go? (You may tick more than one answer)

Community landfill site ☐ Hole near the house ☐ Bush ☐ River ☐

Ocean ☐ Burned ☐ Other ☐ (Please describe)

....

....

....

....

7. Where does the wastewater go?

Type of Waste Water	Where does it go?
Shower	
Toilet	
Washing (clothes)	
Washing (dishes)	
Other (Please explain)	

General comments on RiverCare:

....

....

....

Section 7: Sanitary/ Home Hygiene

1. After using the toilet, people in my house wash their hands with soap:

   Always ☐ Sometime ☐ Never ☐

2. Is there any soap in the hand washbasin at present? Yes ☐ No ☐

3. Do you store drinking water in your house? Yes ☐ No ☐

If yes, please describe how it is kept (is it covered, what is it kept in, etc?):

....

....

....

General comments on Sanitary/ Home Hygiene:

....

....

....

Section 8: Water Conservation

1. Have you ever had a shortage of water? Yes ☐ No ☐

(If 'yes' please explain)

....

....

2. What things do you do to save water?

....

....

....

3. Are you aware of any leaks (in your house/ community), and if so, where are they?

....

....

....

4. Comment on the condition of taps (are they dripping or leaking?)

....

....

5. Comment on the condition of flush toilets (are they leaking or running?)

....

....

6. If you report these leaks, who do you report them to?

....

....

7. Who is responsible for fixing leaks in your community / house?

....

....

8. Who pays for plumbing repairs?

....

....

9. Do you water plants or bath animals? (If so, how often do you water plants or bath animals?)

....

....

Comments on Water Conservation:

....

....

....

Section 9: Community Water Services

1. Who do you think is responsible for providing drinking water in your community?

....

....

2. Who do you think is responsible for protecting the quality of water?

....

....

3. Do you have a water committee in your community?

Yes ☐ No ☐ Not Sure ☐

If yes, please describe the activities of the water committee

....

....

....

....

4. Does the committee carry out water testing on a regular basis?

Yes ☐ No ☐ Not Sure ☐

Are you involved?

....

....

....

General comments on Community Water Services

....

....

....

Overall and Additional Comments:

....

....

....

....

Signature of Householder:..

Signature of Auditor:..

Conducting an Environmental Audit

The state of our water resources is linked to many other environmental, economic and social issues, such as poor waste disposal and littering, deforestation and soil erosion. It is important to review how communities use and manage other environmental resources, in order to assess how these actions affect or relate to community water issues. This review can be done through conducting an environmental audit.

An **environmental audit** is the process of:

- Assessing our actions and attitudes towards the environment.
- Monitoring and measuring the use of resources.

An environmental audit provides baseline data against which improvements in environmental management can be measured. An audit provides us with the first step to investigate solutions to environmental problems such as water pollution, waste and energy conservation. Problems and issues can be identified through an audit, which can then begin the problem solving process.

What Outcomes Can Be Expected?

An environmental audit is valuable for the community as it will assist members to identify problems in the community environment and more specifically help identify resources used. It provides the first step for individuals to investigate solutions to environmental problems such as waste, water and energy conservation. More importantly, an Environmental Audit can encourage community members to have a good look at their own attitudes towards the environment. Community outcomes can include the building of knowledge and skills to:

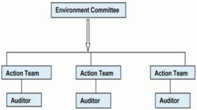
- Identify resources used in their daily routine.
- Record and interpret data about the use of these resources.
- Become more responsible in their use of these resources.
- Use teamwork to conserve these resources.
- Write, implement and evaluate a plan to use resources wisely.

Planning and Preparing for an Environmental Audit

Establish groups to carry out environmental activities, by following the example structure shown below. Once groups are established, some planning and preparation must be done, for example:

- *Identify desired goals and outcomes for the audit and management plan (e.g. to increase awareness, to change attitudes, to eliminate waste, to reduce electricity bills).*
- *Identify tasks and responsibilities and assign them to various action teams. It is common to assign action teams to particular issues (e.g. energy, water, materials, waste etc.) but you are free to assign responsibilities in the way that best suits your needs.*
- *Consider linking community environmental activities to existing International, National or Community events such as Arbor Week, Environment Week, World Water Day and so on.*
- *Assess resources available for environmental activities.*
- *Make contact with members of the community who are likely to have 'expert' knowledge about community resources.*
- *Publicize plans for environmental activities on notice boards or at community meetings.*

EXAMPLE STRUCTURE OF GROUP



Elect an ***environmental committee*** to initiate and oversee environmental activities, if one does not already exist.

Form ***action teams*** to carry out environmental activities. Action teams might include a range of representatives from community groups and other stakeholders.

Elect an ***auditor*** from each action team. Auditors will be responsible for collating data collected by their teams.

Hold regular ***elections*** for the environment committee. Whatever groups you decide to use, remember that they should include representatives from all areas of the community. The more people who contribute to environmental management, the more effective it will be, not only in collecting data, but bringing about real change and improvement.

Environmental Audit Actions

Below are some examples on how to conduct activities as part of an Environmental Audit:

ACTION 1: PLANT SURVEY

1. Divide a map of your community into areas and assign each area to an action team. Visit each area and identify all species of plants growing there. Use elders in your villages to help you identify plants and add this information to your map.
2. Find out which plants growing in your community are locally native and which are introduced species. Research the problems associated with introduced species of plants.
3. Identify areas around the community that have been cleared or that are lacking in trees and plants. Highlight these areas on your map.
4. Find a creek or waterway near your community. Look to see whether the riverbanks are well vegetated. If you find areas with little or no plant cover, note the effects on the banks and the water.
5. Identify local native plants suitable for your community. Consult elders, other community groups, nearby nurseries or other stakeholders for help.

ACTION 2: CONDUCTING A WASTE AUDIT

1. Brainstorm and compile a list of waste, litter-types, rubbish found in your community.
2. Divide a map of your community into areas and assign each area to an action team. Survey all areas and use your list to tally how much litter or rubbish of each type is present. Try this activity on different days of the week and see if results are different, if so, work out why.
3. Prepare a map showing the types and quantities of litter/rubbish found in different areas of the community. Use colour codes and symbols.
4. Using your map, identify 'hotspots' where litter/rubbish is most likely to cause environmental impacts. Consider quantities of litter/rubbish and the effects of these on other community resources such as water, soils and even human health
5. Identify which members of the community use litter/ rubbish hotspots.
6. On your map, also identify compost areas and rubbish pits.
7. Identify which members of the community use these areas or practice composting. Is there a need for training in the community in practical waste management actions? If so, what can be done to address this?

8. Develop a survey form to find out attitudes to litter/ rubbish/ waste. Questions to ask may include:
   - Why do people litter?
   - What harm does litter cause?
   - What could be done to reduce litter or waste?
   - What type of litter/ rubbish/ waste do people most dislike? Why?

   Use the form to interview a sample of residents. Be sure to include users of litter hotspots.
9. Compare the results from your litter survey with those from your water audit. Does litter have an impact on community water resources?
10. Where do you think most of the litter objects at the litter hotspots have come from originally?
11. Will more litter bins and recycling bins help to stop people from littering?
12. What else is needed?

WASTE REDUCTION AND RECYCLING

- Reduce paper use (reuse returnable handouts).
- Reuse paper.
- Collect and recycle paper from every household.
- Reuse or recycle cardboard boxes.
- Collect and return beverage containers.
- Collect and reuse cans and glass.
- Compost organic waste.
- Reduce plastic consumption.
- Identify recycling possibilities for plastics.
- Salvage reusable materials and supplies.
- Avoid or minimize the use of disposable dishes, cups, paper towels etc.
- Purchase recycled copy paper, computer paper and envelopes
- Buy environmentally friendly products.

Example Waste Survey

How many community rubbish bins are available in your community? Number ______

Are the bins full?	Yes	No
Are the bins clean?	Yes	No
Can the rubbish fall out of the bins?	Yes	No
Is the rubbish around the bin?	Yes	No
Are more bins needed? (If yes, what actions can you take)	Yes	No
Are there any recycling bins available?	Yes	No
Are there compost heaps around?		

What are the major types of rubbish in the community? ……………………………………………

……………………………………………………………………………………………………

What can be done to reduce littering and waste?……………………………………………………

……………………………………………………………………………………………………

EXAMPLE WASTE AUDIT SURVEY SHEET

Community: ……………………………………………………………………………………………

Date of Visit: ……………………………… Time of Visit: ……………………………………………

Name of Household: ……………………………………………………………………………………

Name of Auditor: ………………………………………………………………………………………

1. Do you have a proper rubbish bin? ....
   If you answered 'no', what do you use as a rubbish bin? ……………………………………
2. What is the most common type of rubbish that you put in the rubbish bin?
   ……………………………………………………………………………………………
   ……………………………………………………………………………………………
3. Does your household practice 3Rs? Yes____ No______
4. Do you use compost? Yes____ No______
5. Do you purchase environmentally friendly products? …….
   Explain……………………………………………………………………………………
6. How many plastic bags would you use in a day? ……….A week? …….
7. How do you dispose of plastic bags and plastic containers?
   Burn ………………. Bury ………………….
   Others ……………. Please explain: …………………………………………………
   ……………………………………………………………………………………………
8. Are you aware of the effects of burning plastics? Are you aware of the effects of poor waste disposal on the environment? On human health? ……………………………………
   ……………………………………………………………………………………………
9. What type of household rubbish or waste do you notice in wells, rivers and creeks around the community? Are any of these toxic? (i.e. they have dangerous chemicals which may be harmful to the environment, or human health)
   ……………………………………………………………………………………………
   ……………………………………………………………………………………………
10. State some things you may be able to do to reduce waste
    ……………………………………………………………………………………………
    ……………………………………………………………………………………………

ACTION 3: ENERGY CONSERVATION

Energy is used to move people and goods, and to provide power for lighting, heating, cooling and cooking. Computers and telephones, and a range of other appliances, also require energy.

To conserve energy, alternative methods can be used. Use of skylight can be one option. The sun or the solar energy is another alternative source of energy. Solar energy is a renewable resource and does not have the side effects of fossil fuel burning. Water and wind can also be harnessed to generate energy and are also readily renewable. These alternative sources could meet some of our energy needs.

By using energy wisely, you can:

- *Conserve non-renewable resources for future generations*
- *Reduce greenhouse gases*
- *Save money on electricity costs*

EXAMPLE ENERGY AUDIT SURVEY SHEET

Community: ……………………………………………………………………………………

Date of Visit: ……………………………… Time of Visit: ……………………………………

Name of Household: ……………………………………………………………………………

Name of Auditor: ………………………………………………………………………………

1. How many switches do you have in your household?
   1____, 2 ____, 3 ____, more than 3 ____

2. How many power points do you have?
   1____, 2 ____, 3 ____, more than 3 ____

3. We use the light everyday. Yes____ No______

4. We use the light only when it becomes dark. Yes____ No______

5. Electrical Appliances in your household. Do you have a:

- refrigerator Yes____ No______
- electric kettle Yes____ No______
- microwave Yes____ No______
- washing machine Yes____ No______
- toaster Yes____ No______
- sandwich maker Yes____ No______
- coffee maker Yes____ No______
- computer Yes____ No______
- photocopier machine Yes____ No______
- fax machine Yes____ No______

6. How often do you use electrical items in your household?

- refrigerator ....per day .... per week
- electric kettle ....per day .... per week
- microwave ....per day .... per week
- washing machine ....per day .... per week
- toaster ....per day .... per week
- sandwich maker ....per day .... per week
- coffee maker ....per day .... per week
- computer ....per day .... per week
- photocopier machine ....per day .... per week
- fax machine ....per day .... per week

7. Have you got labels/ notice near switches to promote energy conservation?
Yes____ No______

8. What are the relationships between energy use and water resources?

____
____

9. State some of the ways you may be able to save energy in your household?

____
____

10. List some ways of conserving energy that be promoted in your community or included in your community plan?

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Live & Learn Environmental Education

World Health Organization

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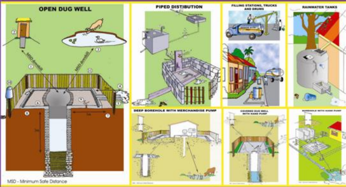
FIJI WET
Water Education for Teachers

KEEPING YOUR DRINKING WATER SAFE

CONDUCTING SANITARY SURVEYS



Tool for Conducting a Sanitary Survey

The Tool for Conducting a Sanitary Survey is part of the Keeping Your Drinking Water Safe Community Toolkit developed by Live & Learn Environmental Education. The toolkit is designed to be used by Community Trainers, Health Officers, Community Workers, and Facilitators, to raise awareness about the need to keep water clean and promote responsible attitudes, behaviour and actions to ensure safe and lasting drinking water supplies.

Live & Learn Environmental Education is thankful to those who have contributed to the development of the ***'Keeping Your Drinking Water Safe Community Toolkit'.*** They include:

- The Australian Agency for International Development (AusAID), for funding the 2-year Pacific Drinking Water Safety Plan Programme, which provided financial support for production of this valuable resource.
- The World Health Organization (WHO) and the Pacific Islands Applied Geoscience Commission (SOPAC) for support, guidance and advice during the development of the toolkit.
- The Institute of Applied Science University of the South Pacific, for reviewing the scientific and technical information presented in this toolkit.
- The Government agencies, in-country partners and people of Fiji, Vanuatu, Cook Islands, Tonga, Palau, Samoa, who provided valuable lessons learned.
- The Water & Sewerage Department, Curriculum Development Unit, National Water Quality Monitoring Laboratory and Ministry of Health, Fiji
- Helti Pasifik Komuniti Program, The Foundation of the Peoples of the South Pacific International (FSPI) and affiliates.

The ***Keeping Your Drinking Water Safe Community Toolkit*** contains:

- An Introductory Guide containing background information and annexes
- Tool for Conducting a Water Audit
- Tool for Conducting Sanitary Surveys
- Tool on Snapshots to Monitoring Water Sources
- Tool For Water Quality Monitoring Using The Hydrogen-Sulphide (H_2S) Paper-Strip Test
- Tool on Water Awareness and Education
- Tool for Water Management Actions
- Comic and Paper-strip test Instruction Flipchart

This document is an output of a regional programme funded by AusAID, for effective management of drinking water supplies in Pacific Island Countries. The views expressed are not necessarily that of AusAID, World Health Organization and/or the Pacific Islands Applied Geoscience Commisssion.

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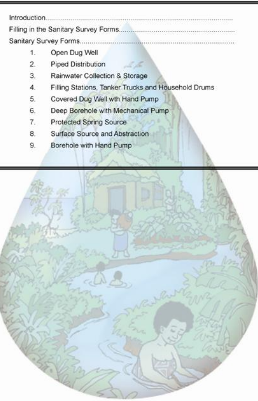
CONDUCTING A SANITARY SURVEY



Conducting a Sanitary Survey

A Sanitary Inspection or Sanitary Survey, is an on- site inspection and evaluation of all conditions, devices, and practices in a water supply system that pose an actual or potential danger to the health and well- being of the consumer.

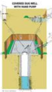
In communities, where qualified surveyors may not be able to conduct frequent visits, responsible community members can learn how to conduct the Sanitary Survey. They should sign the report, and agree to act on the recommendations where this is feasible.

The Sanitary Surveys for rainwater tanks, piped water systems, wells, and drums, help communities to check that their water sources are safe and free from contaminants. The Sanitary Surveys do not need a laboratory to be able to identify sources of water contamination and actions needed to address this.

It is important to fill in the relevant Sanitary Survey Form every time there is water sampling. The Sanitary Survey contains information that is linked to the water source or the water storage container e.g. drums and tanks.

You can use the Sanitary Survey Form provided for wells, piped distribution, rainwater systems, and trucked water to find out if your source is being contaminated.

Before filling in the Sanitary Survey Forms, make sure that you are filling in the correct form for the water source. There are nine Sanitary Survey Forms and accompanying diagrams.



Filling in the Sanitary Survey Forms

Every time a Sanitary Surveyor is going out to do a Sanitary Survey, he or she needs to fill in the correct Sanitary Survey Form. All the relevant details need to be filled.

1. Fill in the general information- Province/ Island/ Village; Date and Time when you are conducting the survey.

2. Fill in the Survey Number for your collection point, for example Survey no. 2.

3. Answer the specific information for assessment questions by circling Y ("Yes") or N ("No").

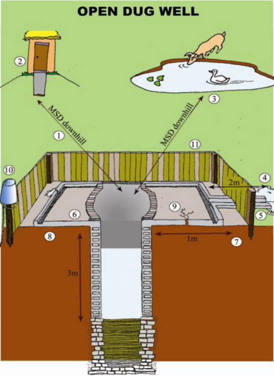
4. Total the score of risks, which is the number of "Yes" answers. The risks represent sources of possible contamination of your water source. For example, if you have circled 'yes' to the question 'Is there a toilet within 10 metres of the well?', then there is a risk that the water in the well could get contaminated from seepage of wastes from the toilet into the groundwater source.

5. Refer to the contamination risk score. If your score is high or very high, this means that your water source is in danger of being contaminated (if it isn't contaminated already), i.e. the risk of contamination is high!

6. If you are also conducting the H_2S test, try to link your risk score with the result from the H_2S test of water sampled from this water source. If your water is contaminated, the Sanitary Survey Form will give you a good idea why and where the source of contamination is from.

7. Use the Sanitary Survey to identify where the risks are, or sources of contamination, and implement actions to address the problem. For example, clean the gutters, move toilets away to a safer distance from the water source, etc.

8. Fill in the Results and Recommendations and leave the form with the community or household concerned so that they can take action to protect their water source.



MSD - Minimum Safe Distance

Adapted by Live & Learn Environmental Education from the World Health Organization's *Guidelines For Drinking –Water Quality (2nd Edition), Volume 3: Surveillance and Control of Community Supplies*

1. OPEN DUG WELL

I General Information

Province/Village/ Island/ Community: ....

Date: .... Time:..

Survey number: ....

II Specific Information for Risk Assessment

1.	Is there a toilet within 10 m of the well?	Y/N
2.	Is the nearest toilet on higher ground than the well?	Y/N
3.	Is there any other source of pollution (e.g. animal excreta, rubbish) within 10 m of the well?	Y/N
4.	Is the drainage poor, causing non-movement water within 2 m of the well?	Y/N
5.	Is there a faulty drainage channel? Is it broken, permitting ponding?	Y/N
6.	Is the wall (parapet) around the well cracked, or too low, allowing surface water to enter the well?	Y/N
7.	Is the concrete floor less than 1 m wide around the well?	Y/N
8.	Are the walls of the well inadequately sealed at any point for 3 m below ground?	Y/N
9.	Are there any cracks in the concrete floor around the well, which could permit water to enter the well?	Y/N
10.	Are the rope and bucket left in such a position that they may become contaminated?	Y/N
11.	Does the installation require fencing?	Y/N

Total score of risks .... /11

Contamination risk score: 9-11 = very high; 6-8 = high;
3-5 = intermediate; 0-2 = low

III Results and Recommendations

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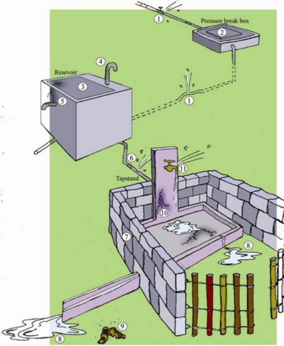
Signature of Surveyor ....

PIPED DISTRIBUTION



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2. PIPED DISTRIBUTION

I General Information

Province/Village/ Island/ Community: ....

Date: .... Time:...

Survey number: ....

II Specific Information for Risk Assessment

1.	Is there any point of leakage between source and reservoir?	Y/N
2.	If there are any pressure break boxes, are their covers dirty?	Y/N
	If there is a reservoir:	
3.	Is the inspection cover dirty?	Y/N
4.	Are any air vents dirty?	Y/N
5.	Is the reservoir cracked or leaking?	Y/N
6.	Are there any leaks in the distribution system?	Y/N
7.	Is the area around the tap stand unfenced (or fencing incomplete)?	Y/N
8.	Does water accumulate near the tap stand (requires improved drainage canal)?	Y/N
9.	Are there human or animal excreta within 10 m of the tap stand?	Y/N
10.	Is the tap stand cracked or eroded?	Y/N
11.	Does the tap leak?	Y/N

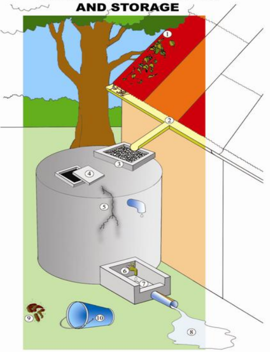
Total score of risks .... /11

Contamination risk score: 9-11 = very high; 6-8 = high;
3-5 = intermediate; 0-2 = low

III Results and Recommendations

Signature of Surveyor ....

RAINWATER COLLECTION AND STORAGE



Adapted by Live & Learn Environmental Education from the World Health Organization's *Guidelines For Drinking –Water Quality (2nd Edition), Volume 3: Surveillance and Control of Community Supplies*

3. RAINWATER COLLECTION AND STORAGE

I General Information

Province/Village/ Island/ Community: ....

Date: .... Time:...

Survey number: ....

II Specific Information for Risk Assessment

1.	Is there any visible contamination of the roof catchments area (plants, dirt, or excreta)?	Y/N
2.	Are the guttering channels that collect water dirty?	Y/N
3.	Does the tank inlet not have any mesh sieve or fine gravel?	Y/N
4.	Is there any other point of entry to the tank that is not properly covered?	Y/N
5.	Are there any cracks on the walls or top of the tank that could let water in?	Y/N
6.	Is the tap leaking or faulty?	Y/N
7.	Is the concrete floor under the tap dirty?	Y/N
8.	Is the water collection area inadequately drained?	Y/N
9.	Is there any source of pollution around the tank or water collection area? (e.g. excreta, trees growing beside the tank)	Y/N
10.	Is a bucket in use and left in a place where it may become contaminated?	Y/N

Total score of risks ..../10

Contamination risk score: 9-10 = very high; 6-8 = high; 3-5 = intermediate; 0-2 =low

III Results and Recommendations

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Signature of Surveyor ....

FILLING STATIONS, TANKER TRUCKS AND HOUSEHOLD DRUMS

Adapted by Live & Learn Environmental Education from the World Health Organization's *Guidelines For Drinking -Water Quality (2nd Edition), Volume 3: Surveillance and Control of Community Supplies*

4. FILLING STATIONS, TANKER TRUCKS AND HOUSEHOLD DRUMS

I General Information

Province/Village/ Island/ Community: ....

Date: ……………………………………………….. Time:……………………………………

Survey number: ....

II Specific Information for Risk Assessment

Tanker Filling Station

1.	Is the chlorine level at the filling station less than 0.5 mg/litre?	Y/N
2.	Is the filling station excluded from the routine quality control programme of the water authority?	Y/N
3.	Is the discharge pipe dirty?	Y/N
Tanker Trucks		
4.	Is the tanker ever used for transporting other liquids besides drinking water?	Y/N
5.	Is the filler hole dirty or is the lid missing?	Y/N
6.	Is the delivery hose dirty or stored unsafely?	Y/N
Household Drums		
7.	Can contaminants (e.g. soil, leaves or other rubbish) enter the drum during filling?	Y/N
8.	Does the drum lack a cover?	Y/N
9.	Does the drum need a tap for withdrawal of water?	Y/N
10.	Is there stagnant water around the drums?	Y/N

Total score of risks ..../10

Contamination risk score: 9-10 = very high; 6-8 = high;
3-5 = intermediate; 0-2 =low

III Results and Recommendations

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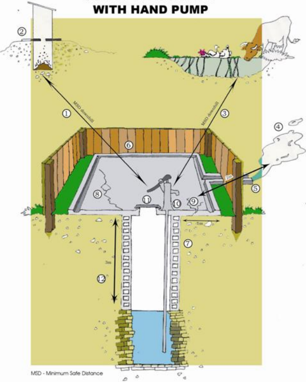
Signature of Surveyor ……………………………………………………

COVERED DUG WELL WITH HAND PUMP



MSD - Minimum Safe Distance

Adapted by Live & Learn Environmental Education from the World Health Organization's *Guidelines For Drinking –Water Quality (2nd Edition), Volume 3: Surveillance and Control of Community Supplies*

5. COVERED DUG WELL WITH HAND PUMP

I General Information

Province/Village/ Island/ Community: ....

Date: ……………...................……………… Time:……………………......……………………

Survey number: ....

II Specific Information for Risk Assessment

1.	Is there a toilet within 10m of the well and hand pump?	Y/N
2.	Is the nearest latrine on higher ground than the well and hand pump?	Y/N
3.	Is there any other source of pollution (e.g. animals excreta, rubbish) within 10m of the well?	Y/N
4.	Is the drainage poor, causing non- moving water within 2m of the well?	Y/N
5.	Is there a faulty drainage channel? Is it broken, allowing ponding?	Y/N
6.	Is the wall or fencing around the well inadequate, allowing animals in?	Y/N
7.	Is the concrete floor less than 1m wide all around the well?	Y/N
8.	Is there any ponding on the concrete floor around the hand pump?	Y/N
9.	Are there any cracks in the concrete floor around the well which could permit water to enter the well?	Y/N
10.	Is the hand pump loose where it is attached to the base allowing water to enter the casing or pipes?	Y/N
11.	Is the cover of the well unsanitary?	Y/N
12.	Are the walls of the well inadequately sealed at any point for 3m below ground level?	Y/N

Total score of risks: …………/12

Contamination risk score: 9-12=very high; 6-8=high; 3-5=intermediate; 0-2=low

III Results and Recommendations

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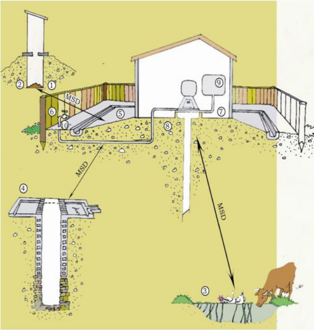
Signature of Surveyor ………………………………………………

DEEP BOREHOLE WITH MECHANICAL PUMP



MSD - Minimum Safe Distance

Adapted by Live & Learn Environmental Education from the World Health Organization's *Guidelines For Drinking –Water Quality (2nd Edition), Volume 3: Surveillance and Control of Community Supplies*

6. DEEP BOREHOLE WITH MECHANICAL PUMP

I General Information

Province/Village/ Island/ Community: ....

Date: ……………... Time:………………………...……………………

Survey number: ....

II Specific Information for Risk Assessment

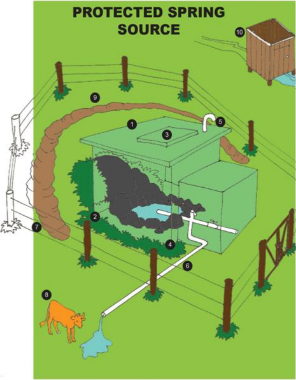
1.	Is there a toilet or sewer within15-20m of the pumphouse?	Y/N
2.	Is the nearest toilet a pit toilet that passes through to the soil, i.e. unsewered?	Y/N
3.	Is there any other source of pollution (e.g. animals excreta, rubbish, and surface water) within 10m of the borehole?	Y/N
4.	Is there any uncapped well within 15-20m of the borehole?	Y/N
5.	Is the drainage area around the pump house faulty? Is it broken permitting ponding and /or leakage to ground?	Y/N
6.	Is the fencing around the installation damaged in anyway which would permit any unauthorized entry or allow animals in?	Y/N
7.	Is water able to seep through the floor of the pump house?	Y/N
8.	Is the well seal unsafe or unsanitary?	Y/N
9.	Is the chlorination functioning properly?	Y/N
10.	Is chlorine present at the sampling tap?	Y/N

Total score of risk: ……………./10

Contamination risk score: 9-10=very high; 6-8=high; 3-5=intermediate; 0-2=low

III Results and Recommendations

Signature of Surveyor ………………………………………………



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7. PROTECTED SPRING SOURCE

I General Information

Province/Village/ Island/ Community: ....

Date: .... Time:...

Survey number: ....

II Specific Information for Risk Assessment

1.	Is the spring source unprotected by stone or concrete wall, or spring box and therefore open to surface contamination?	Y/N
2.	Is the stonewall protecting the spring source faulty?	Y/N
3.	If there is a spring box, is there an unsanitary inspection cover in the stonewall?	Y/N
4.	Does the spring box contain contaminating silt or animals?	Y/N
5.	If there is an air vent in the stone wall, is it unclean or unsanitary?	Y/N
6.	If there is an overflow pipe, is it unclean or unsanitary?	Y/N
7.	Is the area around the spring unfenced?	Y/N
8.	Can animals have access to within 10m of the spring source?	Y/N
9.	Does the spring lack a surface water diversion ditch above it, or (if present) is it nonfunctional?	Y/N
10.	Are there any toilet uphill of the spring?	Y/N

Total Score of Risk: ………/10

Contamination Risk Score: 9-10=very high; 6-8=high; 3-5=intermediate; 0-2=low

III Results and Recommendations

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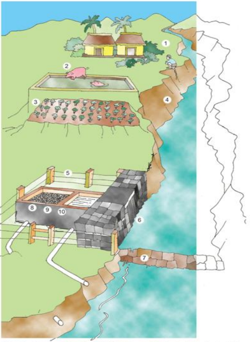
Signature of Surveyor ……………………………………………………

SURFACE SOURCE AND ABSTRACTION



Adapted by Live & Learn Environmental Education from the World Health Organization's *Guidelines For Drinking -Water Quality (2nd Edition), Volume 3: Surveillance and Control of Community Supplies*

8. SURFACE SOURCE AND ABSTRACTION

I General Information

Province/Village/ Island/ Community: ....

Date: ………………………………………………… Time:………………………………………

Survey number: ....

II Specific Information for Risk Assessment

1.	Is there any human houses upstream, polluting the source?	Y/N
2.	Are there any farm animals upstream, polluting the source?	Y/N
3.	Is there any crop production or industrial pollution upstream?	Y/N
4.	Is there a risk of landslide or mudflow (causing deforestation) in the catchment area?	Y/N
5.	Is the intake installation unfenced?	Y/N
6.	Is the intake unscreened?	Y/N
7.	Does the abstraction point lack a minimum head device (e.g. dam)?	Y/N
8.	Does the system require sand or gravel filter?	Y/N
9.	If there is a filter, is it functioning badly?	Y/N
10.	Is the flow uncontrolled?	Y/N

Total score of risk: ……………./10

Contamination risk score: 9-10=very high; 6-8=high; 3-5=intermediate; 0-2=low

III Results and Recommendations

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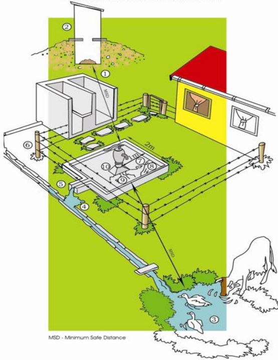
Signature of Surveyor ………………………………………………

BOREHOLE WITH HAND PUMP



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9. BOREHOLE WITH HAND PUMP

I General Information

Province/Village/ Island/ Community: ....

Date: .... Time:...

Survey number: ....

II Specific Information for Risk Assessment

1.	Is there a toilet within 10m of the hand pump?	Y/N
2.	Is there a toilet uphill of the hand pump?	Y/N
3.	Are there any other sources of pollution within 10m of hand pump? (e.g. animal excreta, rubbish, surface water)	Y/N
4.	Is the drainage poor allowing water to collect within 2m of the hand pump?	Y/N
5.	Is the drainage channel faulty, cracked or broken, permitting ponding and does it need cleaning?	Y/N
6.	Is the fencing around the hand pump inadequate, allowing animals in?	Y/N
7.	Is the concrete floor less than 1m wide all around the hand pump?	Y/N
8.	Is there any ponding on the concrete floor around the hand pump?	Y/N
9.	Are there any cracks in the concrete floor around the hand pump which could permit water to enter the well?	Y/N
10.	Is the hand pump loose at the point of attachment to the base so that water could enter the casing?	Y/N

Total Score of Risk: ………./10

Contamination Risk Score: 9-10=very high; 6-8=high; 3-5=intermediate; 0-2=low

III Results and Recommendations

Signature of Surveyor ………………………………………………

Live & Learn Environmental Education

World Health Organization

Australian Government
AusAID

SOPAC

FIJI WET
Water Education for Teachers

COMMUNITY TOOLKIT

KEEPING YOUR DRINKING WATER SAFE

SNAPSHOTS TO MONITORING WATER SOURCES


Source: Pacific Islands Applied Geoscience Commission (SOPAC)

Visible contamination of the roof catchment area
Dirty gutters and down pipe can contribute to the poor quality of water in the tank. Bird droppings add contamination and leaves, twigs, soil and dust can deteriorate the quality of the water.

Make sure that the gutter that leads to the mouth of the rainwater tank is clean and free from shrubs, dead leaves, soil and other debris


Source: Live & Learn Environmental Education

Guttering channels that water sits in
Algae and mosses found growing on the guttering channels for collection of water can also increase algae growth on the walls of the tank, affecting the quality of the water.

Keep the gutter free from algae and mosses. Tank owners need to check gutters and roofing regularly and keep it clean!

No wire mesh at the tank inlet

Mesh wire over the tank inlet is mainly used to trap larger debris like twigs, leaves, dirt and bird droppings. It also prevents the entry of animals such as mice, rats and birds into the tank, which can drown and contaminate the water.

Source: Live & Learn Environmental Education

Put mesh wire or a sieve on the mouth of the tank to keep rubbish and animals out of the tank or place gravel on top of the wire mesh to prevent rubbish from falling in.

Other points of entry into the tank that are not covered

Any other opening on the rainwater tank that is not covered might allow organisms and dirt to enter the rainwater tank.

Source: Live & Learn Environmental Education

Check your water tank! If the tank has cracks or openings, cover these up and keep closed to prevent water from getting contaminated!

Source: Live & Learn Environmental Education

Cracks on the walls of the tank

Leakage means that a lot of water is wasted and cracks can also be an entry point for contamination.

All cracks on the walls of the tight should be fixed and tightly sealed to prevent water from seeping outside the tank and germs from entering into the tank!

Source: Pacific Islands Applied Geoscience Commission (SOPAC)

Other sources of pollution around the tank or water collection area

Other sources of pollution include trees and shrubs beside the tank that drop debris in the water and crack pipes and tanks with their roots.

Cut tree branches beside the tank! Maintaining the surrounding area around the tank and water collection area is important! Grasses and shrubs should be kept short at all times so that your water storage area does not become a breeding site for pests!


Source: Live & Learn Environmental Education

Outside wall of tank is not clean

When the outside wall of the rainwater tank is not clean and plants are growing on the sides then leakage is indicated. Water quality is best in a totally sealed tank.

Keep the outside walls of the tank clean! Remove grasses and shrubs from the walls, find out where the tank is leaking from and fix it. The state of the outside wall can sometimes tell you what the inside wall of the tank may look like! If the outside walls are mouldy, check inside!

Inside wall of tank not clean

The wall inside the tank may get dirty due to algae and mould growth or mud that will affect the water quality. Tanks need to be occasionally emptied and cleaned out.

The cleanliness of the wall inside the tank is very important, as this is where your water is stored! Rainwater should be flushed out and the tank cleaned once a year to maintain the water quality.


Source: Live & Learn Environmental Education


Source: Live & Learn Environmental Education

Source: Live & Learn Environmental Education

Concrete floor under the tap is dirty

If the concrete floor under the tap is not clean and collection of the water not done properly then contamination of the water in the bucket is possible.

The concrete floor under the tap should be kept clean and the bucket that is used to draw water should be placed in a safe place- not within the reach of small children and animals. Remove any rubbish from around the tap area!

Source: Live & Learn Environmental Education

Water collection area not drained properly

If the water collection area is not properly drained, algae are encouraged to grow under the tap. Also the sitting water can be a source of contamination and breeding area for mosquitoes.

The water collection area should have a good outlet so that water can freely flow out of the water collection area. Water collecting in ponds is unhygienic and unsanitary, and will attract mosquitoes and other pests!

WHAT TO CHECK FOR?

* Toilet within 10m of the well
* Nearest toilet on lower ground than the well
* Poor drainage, causing non-movement of water within 2m of the well
* Wall around the well cracked
* Concrete floor less than 1m wide around the well
* Walls of the well inadequately sealed at any point

Source: Live & Learn Environmental Education

NO OPEN WELL IS FREE FROM CONTAMINATION!

When the mouth of the well is not covered, water inside is exposed to bacteria, animals, leaves and dust.

Keep the well covered! Build a shelter over the well, or cover the opening with a piece of timber or clean sheet of roofing iron or canvas.

Source: Live & Learn Environmental Education

Water entry points

Cracks in the concrete floor around the well can allow contaminated water from the ground to seep into the well water.

Make sure that the cracks on the floor of the well are well sealed and when installing a new well ensure that the concrete floor area are well established and have no cracks on the floor.

Source: Live & Learn Environmental Education

Protecting your well

Fencing would protect the well from animals and other possible sources of contamination. The rope and bucket being used to draw water from the well are left in a position where they may become contaminated by animals.

Keep wells fenced and hang buckets on a post!

Source: Fiji Institute of Technology (FIT)

Color of water

If the water looks green then this indicates high algal growth and that the quality of the water is poor. Algal growth is boosted by high levels of nutrients like nitrates and phosphates that come from wastewater and inland runoff.

Agricultural activities near the riverbank could result in run-off of harmful chemicals and nutrients from land to river. Make sure that there is a buffer zone on the bank of the river. This is 'free area' about 15 metres from the river edge inland where no agricultural activities take place, and may also be a belt of trees along a riverbank.

Source: Live & Learn Environmental Education

Bank erosion

When trees growing along the riverbank are removed this can cause soil erosion, changing the color of the water to a dirty brown. This sediment in the water prevents sunlight filtering through, impacting aquatic plants.

Plant native trees or trees that have the ability to absorb nutrients and hold soil together on the banks of the river. The root system of the trees will help stabilise the banks of the river, preventing erosion.

Source: Live & Learn Environmental Education

Solid waste pollution

Examples of solid waste often found in water include plastics, cans, bottles and food wrappers. Throwing rubbish carelessly beside the riverbank is a sign of land pollution but this solid waste will end up in the water affecting the quality.

Source: Fiji Institute of Technology (FIT)

Remove rubbish, litter from the river and surroundings to prevent water from being polluted! Don't treat riverbanks as a rubbish dump. The waste will eventually end up in the water.

Source: Live & Learn Environmental Education

Wastewater

Wastewater from homes and industries affect water quality, increasing levels of nutrients such as nitrates and phosphates, which promote algae growth. Too much algae growth will result in organisms such as river fish dying or moving to other areas.

Wastewater from homes is not for drinking, but can be reused in gardens or toilets.

Source: Live & Learn Environmental Education

Source: Live & Learn Environmental Education

Home discharge pipes

Household discharge pipes that empty directly into a waterway deliver wastewater with detergents from washing, soap and other contaminants that increase the level of nutrients. The nutrient phosphate, from detergents and soaps, and fertilizers in land runoff, causes water pollution and the growth of algae and waterweeds.

Household discharge pipes can direct wastewater into a "soak pit" instead of into rivers and streams. Wastewater drained into rivers and streams can increase the level of phosphate and nitrates in the water, and negatively affect living organisms.

Source: Live & Learn Environmental Education

Pigpens beside a waterway

Pigpens built beside a river or mangrove swamp lead to increased levels of nutrients in the water from the pig waste. This contaminates the water, destroys habitat and kills some organisms.

Pig pens beside a river causes pollution, contaminates water, kills mangroves, coral reef and marine life, and leads to major health hazards! Farmers should move pigpens away from rivers and streams or try other types of pig farming like compost piggery.

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COMMUNITY TOOLKIT

KEEPING YOUR DRINKING WATER SAFE

WATER QUALITY MONITORING USING THE H_2S TEST

Tool for Water Quality Monitoring Using The Hydrogen-Sulphide (H_2S) Paper-Strip Test

The Tool for Water Quality Monitoring Using the H_2S Test, is part of the Keeping Your Drinking Water Safe Community Toolkit developed by Live & Learn Environmental Education. The toolkit is designed to be used by Community Trainers, Health Officers, Community Workers, and Facilitators, to raise awareness about the need to keep water clean and promote responsible attitudes, behaviour and actions to ensure safe and lasting drinking water supplies.

Live & Learn Environmental Education is thankful to those who have contributed to the development of the ***'Keeping Your Drinking Water Safe Community Toolkit'.*** They include:

- The Australian Agency for International Development (AusAID), for funding the 2-year Pacific Drinking Water Safety Plan Programme, which provided financial support for production of this valuable resource.
- The World Health Organization (WHO) and the Pacific Islands Applied Geoscience Commission (SOPAC) for support, guidance and advice during the development of the toolkit.
- The Institute of Applied Science University of the South Pacific, for reviewing the scientific and technical information presented in this toolkit.
- The Government agencies, in-country partners and people of Fiji, Vanuatu, Cook Islands, Tonga, Palau, Samoa, who provided valuable lessons learned.
- The Water & Sewerage Department, Curriculum Development Unit, National Water Quality Monitoring Laboratory and Ministry of Health, Fiji
- Helti Pasifik Komuniti Program, The Foundation of the Peoples of the South Pacific International (FSPI) and affiliates.

The ***Keeping Your Drinking Water Safe Community Toolkit*** contains:

- An Introductory Guide containing background information and annexes
- Tool for Conducting a Water Audit
- Tool for Conducting Sanitary Surveys
- Tool on Snapshots to Monitoring Water Sources
- Tool For Water Quality Monitoring Using The Hydrogen-Sulphide (H_2S) Paper-Strip Test
- Tool on Water Awareness and Education
- Tool for Water Management Actions
- Comic and Paper-strip test Instruction Flipchart

This document is an output of a regional programme funded by AusAID, for effective management of drinking water supplies in Pacific Island Countries. The views expressed are not necessarily that of AusAID, World Health Organization and/or the Pacific Islands Applied Geoscience Commisssion.

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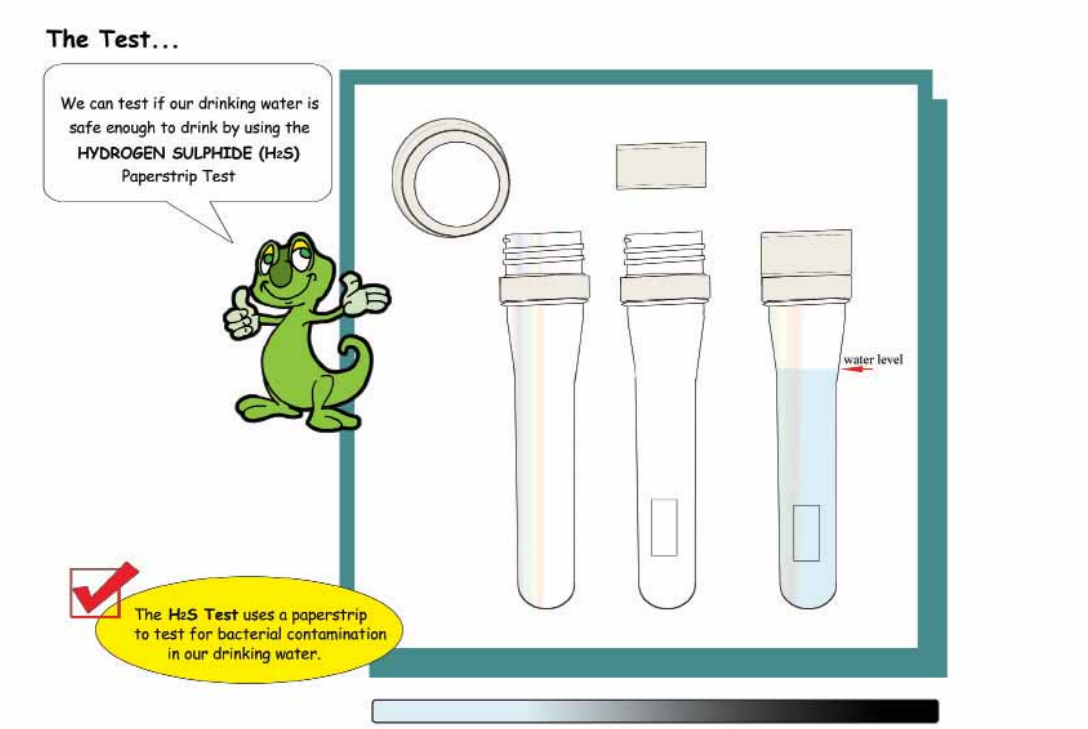
Water Monitoring Using the Hydrogen Sulphide Paper-Strip Test

Annexes

Introduction

Water testing can alert a community to contaminants in time to prevent health problems. Conventional methods of testing require advanced laboratories, highly trained technicians, and expensive supplies - many of which cannot be afforded by most communities or are unavailable in isolated communities.

The Hydrogen Sulphide (H_2S) Paper Strip Test is a drinking water quality test to find out if any of the water being used or stored is already contaminated. It is a very simple test where a water sample is collected, and changes colour if it is contaminated. It's as simple as that!



Getting ready to test one of the wells in Veinuqa village

Testing Our Drinking Water

Contaminated water means that action needs to be taken urgently! The H_2S Paper Strip test can be used regularly to test the quality of water supplies and help people to recognize the risks and take actions if needed.

The H_2S Paper Strip Test was first used in India to test for bacteria contamination in drinking water. Since then many more communities have used it globally and in the Pacific region.

H_2S Sample bottles and result sheet

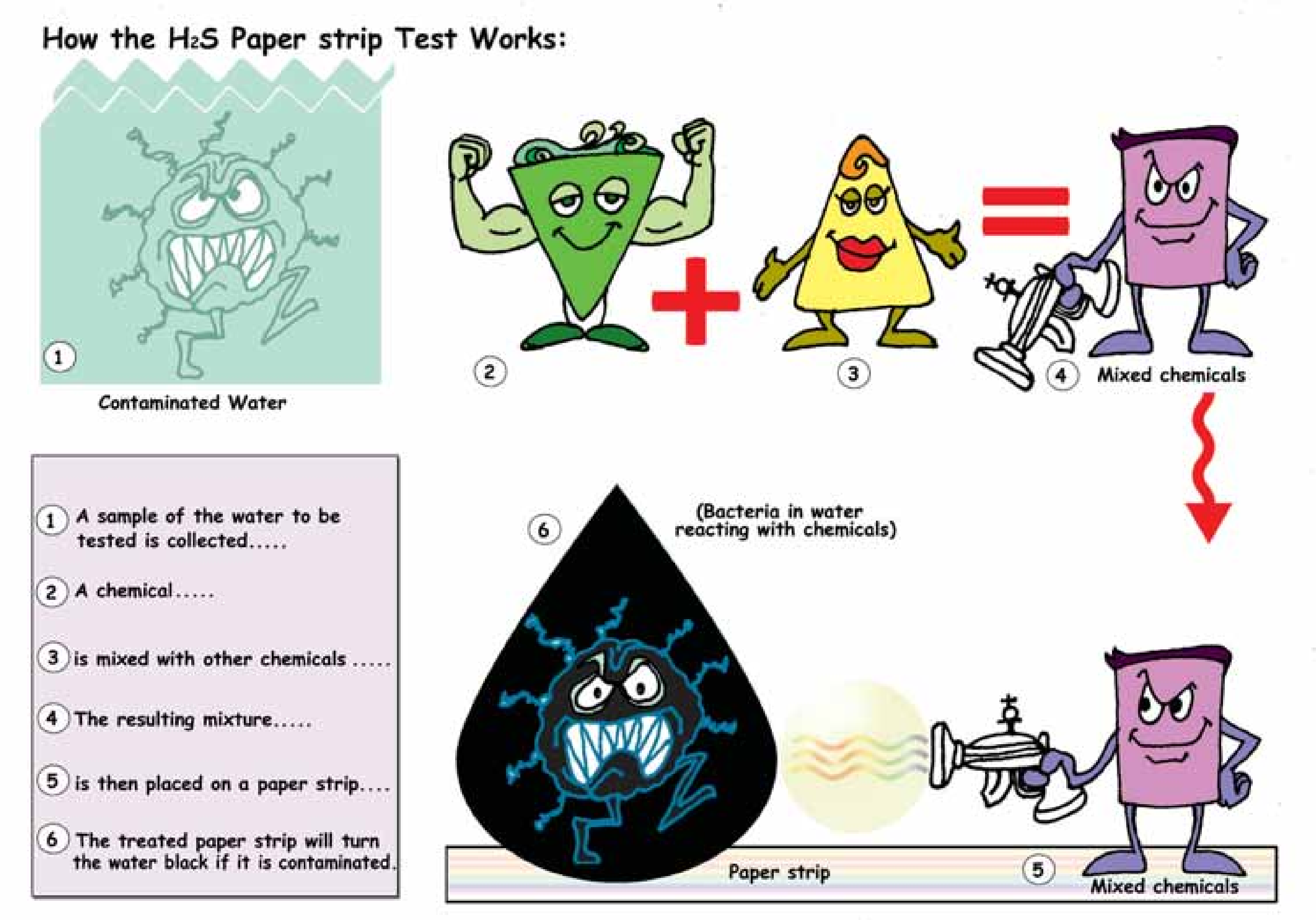
The advantages of the H_2S Paper Strip test are, that it is low-cost, does not require samples to be shipped or refrigerated, does not require a laboratory or expensive equipment, and most importantly, it is easy to understand and carry out in the field!

How does it work?

The H_2S test is a simple test that will tell us if the water being tested is contaminated within three days (or less). The test identifies if Hydrogen Sulphide (H_2S) is in the sample. H_2S is a gas produced by some harmful bacteria- this is the gas that smells like rotten eggs.

If H_2S is in the water sample, it means that harmful bacteria or viruses from human or animal waste could be in the water.

In order to check for the presence of harmful bacteria in water, a water sample is filled into the test bottle with the paper strip. Chemicals have been mixed into a solution and placed on the paper strip. The paper strip will react with the water sample by turning black if it comes into contact with hydrogen sulphide.



If the water sample or paper-strip turns black, this shows that hydrogen sulphide was produced. This means that it is likely that bacteria are present in the water- that is, the water has been contaminated. This also means that we need to take urgent action.

What can we use the H_2S Test for?

1. For monitoring of rural and outer island water supply systems where it may be difficult to conduct conventional testing due to isolation or a lack of appropriate laboratory facilities.

2. For routine monitoring of reticulated systems; i.e. water that is distributed through a piped system.

3. To identify if there is a need for further analysis of the water sample.

4. To determine the cleanliness of water storage tanks, rainwater cisterns and other household storage containers.

5. To identify sources of contamination or the point in a piped system where bacteria may be entering the water source.

6. To select which spring is best to develop.

7. To check how effective you have been in disinfecting a water source, or to verify that a well has been properly protected.

8. As a tool in health and hygiene education to show villagers how water becomes contaminated and what they can do about it.

9. For monitoring during emergencies and disasters such as cyclones when water-borne diseases are more likely to occur and conventional testing is difficult.

10. To demonstrate how easily hands become contaminated and how easily they can contaminate food and water.

Source: Pacific Islands Applied Geoscience Commission (SOPAC)

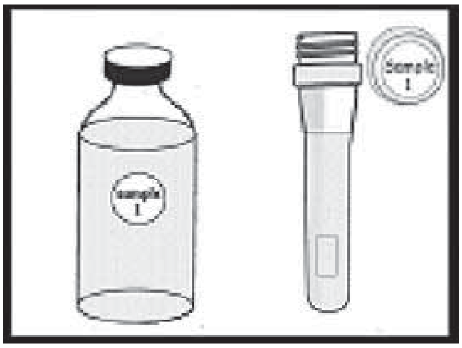
The H_2S test can identify whether the water in your storage containers are 'safe' to drink.

Source: Pacific Islands Applied Geoscience Commission (SOPAC)

For example, the H_2S test can be used to demonstrate the effectiveness of washing hand with soap; i.e. to illustrate how bacteria can get from the hands to the mouth and into the body. This can be done by pouring clean water over unwashed hands and testing it, and having others wash their hands with soap and repeating the exercise.

Instructions

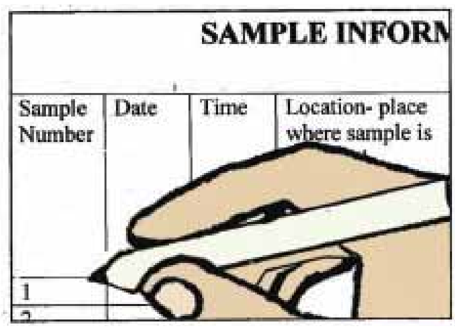
Step 1: Filling in the details



- Fill in sample number and date on the round sticker or sticker strip label and stick on the sample bottle (be careful not to get the sticker wet).

- Record your sample number, date, time, location and description of the water source sampled on the Result Record Sheet.

- Record any other information e.g. turbidity, smell, source of pollution, faulty pump etc.

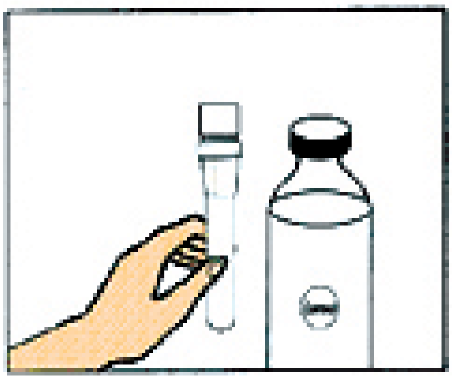


> Note!
>
> ▪ Do not open the test bottle until you are ready to fill them with your water sample.
> ▪ Make sure that no contamination occurs e.g. by touching the mouth of the bottle.
> ▪ Do not hold the cap from the inside.

Step 2: Collecting the Control (Optional)

- Collect a sample of uncontaminated water e.g. distilled water, boiled water, bottled water, water treated with chlorine. This is to be used as the control.

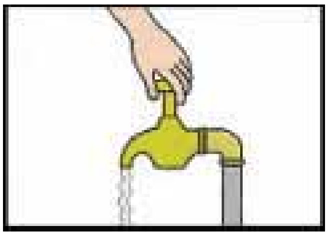
- There may be a slight change in the colour of the sample to a pale yellow or light brown due to the colour change of the reagent. This is normal.

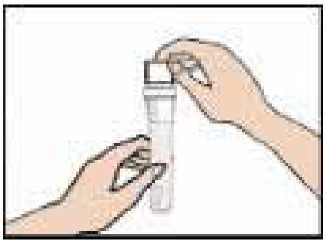


A control is used to compare the colour change in the test samples, and to ensure that the sample bottles are not contaminated before use.

Instructions

Step 3: Collecting the water sample:

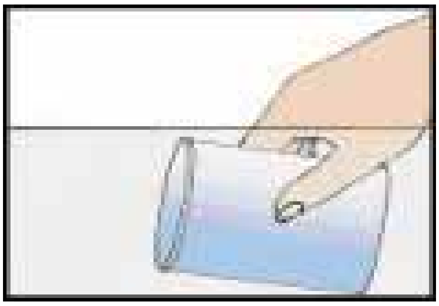




A. From the tap

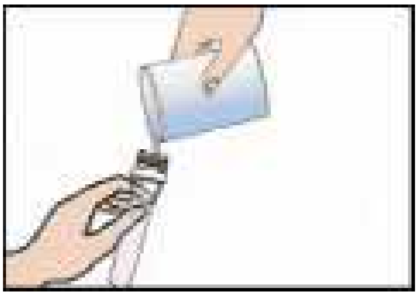
- First clean the mouth or the outlet of the tap with a clean cloth.
- Turn on the tap and allow the water to flow for 15 to 20 seconds.
- Collect sample water from the tap by filling the sample bottle up to the mark. (Fill 10ml or slightly more.)
- Fill the test bottle carefully, this is because the test bottle will fill very quickly to the marked line and may overflow.
- If you do overfill the bottle, do not spill the water out and do not worry. Your result will still be valid.
- Immediately close the sample bottle.

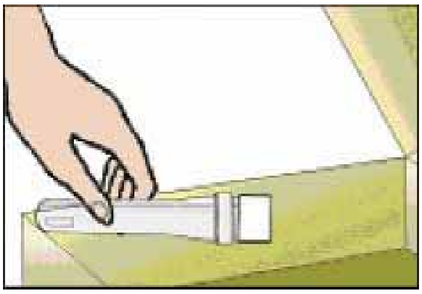
Step 3: Collecting the water sample:



B. From storage containers such as water tanks, and wells or rivers

- Rinse the container to collect the water several times.
- Collect a sample of water from the container by filling the sample bottle up to the mark.
- Close the sample bottle. Make sure that no contamination occurs.





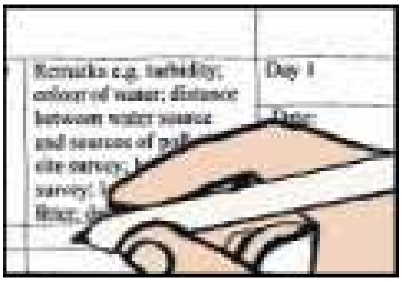
Place all the test samples in a dark place at room temperature.

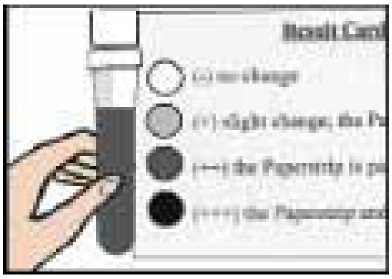
Do not expose your bottles to direct sunlight. Store in a dark place. The sun's rays can kill the bacteria inside the test bottles and you will not get a true result.

Instructions

Step 4: Checking your results

- Check your test sample at the same time each day for 3 days for changes in colour.
- Use the Result Record Sheet to record the date and time for each observation of your test sample, and your result for each day.
- Compare the colour change of your test sample with that of the control.
- Use the H_2S Colour Code to indicate the degree of contamination.





It is important to check your test sample everyday for 3 days, and to keep a good record of your results.

Note!

- Keep the test bottles stored away from children! Do not put it in a place where a child can reach it!
- Do not open used bottles with the water sample. Return the used bottles to get replacements.

H_2S Colour Code

(-) No change

(+) Slight change, the paper strip or water sample has turned grey.

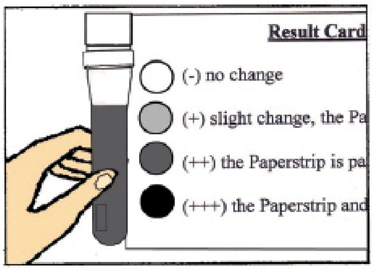
(++) The paper strip or water sample is partially black.

(+++) The paper strip and the water sample are noticeably black.

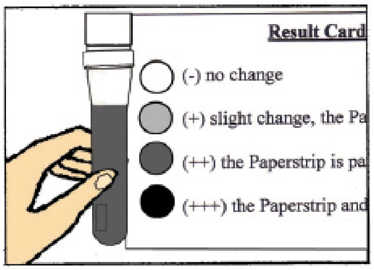
Instructions

Step 5: Analysing your results. What do your results mean?

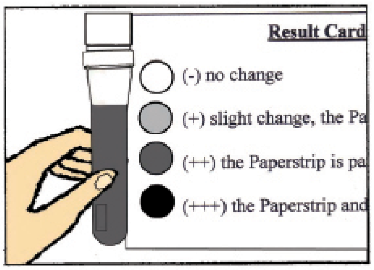
- (-) If there is no colour change, this indicates that the water is clean and likely to be free from bacterial contamination.



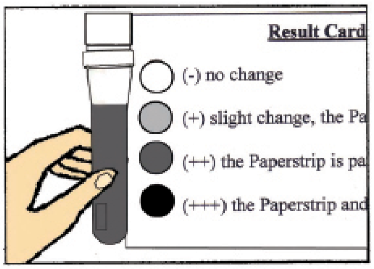
- (+) If the water sample or paper strip has turned grey, there is a possibility that bacteria is present in the water. ***Wait for a few days and check again.***



- (++) If the water sample or paper strip has turned partially black then there is some amount of bacterial contamination in the drinking water. ***Conduct a sanitary survey to check your water source.***



- (+++) If the paper strip and the water sample are noticeably black then there is a very high risk of bacterial contamination in the drinking water, therefore, it is not safe for drinking.
Take immediate action! Your water is contaminated!



- (+++) If there is a fast reaction- that is, the water sample and paper strip turns black overnight, which means that there is a high probability of bacteria present! ***Take immediate action! Your water is contaminated!***


Source: Live & Learn

If your water is contaminated, you should clean out your water storage containers, tanks or well and boil the water before you drink it! Conduct a sanitary survey and check for the source of contamination. Sample the water in your well, tanks and containers again after this to check if you have eliminated the contamination!

Filling in the Result Record Sheet

Every time a Water Monitor is going out for water monitoring, he or she needs to fill in the provided Result Record Sheet. All the relevant details need to be filled.

1. Fill in the address or where you doing the water sampling e.g. Nailega Village, Tailevu.
2. Write in your sample number in the first column.
3. Fill in the type of water source that you are sampling e.g. rainwater tank.
4. Record the date and time of sampling.
5. Identify the location of your sample e.g. the Heilala Community main water tank.
6. In the "Remarks" column, fill in information like the color of the water, the smell, or if there is faulty tap or pipe.
7. Use the colour code to find out your results- e.g. "+" or "++" and record this in the "Results" column. Fill in your observation each day for three days and record the date and time of observation.
8. The "Notes" column can be used for other information like the source of contamination or if there is a latrine/ toilet built within a short distance from the drinking water source.
9. Copy the Result Record Sheet provided on the next page to use and distribute.

Example of the Result Record Sheet

H_2S PAPERSTRIP TEST – RESULT SHEET.

Community Address: ______________________________
____

Name of Water Monitor: ______________________________

						RESULTS		
Sample Number	**Type of water source: (deep well – borehole, river, rainwater etc.)**	**Date:**	**Time:**	**Location: place where the sample is collected**	**Remarks**	**Day 1 Date: Time:**	**Day2 Date: Time**	**Day 3 Date: Time:**
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

Notes:

Result Record Sheet to copy

RESULT RECORD SHEET FOR THE H_2S PAPER STRIP TEST

Community & Address: ______________________

Name of Water Monitor: ______________________

Sample Number	**Type of water source** (deep well, dam, borehole, river, rainwater etc.)	**Date**	**Time**	**Location** (place where the sample is collected)	**Remarks** (is the water muddy, coloured, contain solids or materials in suspension also an problems at sampling site like a leaking tap, unclean, drainage problems etc.)	**Results each day over 3 days** (-clear, +grey colour, ++part black, +++very black)		
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

Notes (Distance between water source and possible pollution like a compost pit, septic tank, toilet or farm):

____

____

____

Annex A: Contact List for H_2S Test Bottles

Fiji

Producers:

IAS (USP)

Contact: Prof. Bill Aalbersberg ; aalbersberg@usp.ac.fj

Ms. Arun Pande ; pande_a@usp.ac.fj

Distributors:

WHO (SP)

Contact: Mr. Steve Iddings; IddingsS@wpro.who.int

Ms. Tema Vakaotia; VakaotiaT@wpro.who.int

Cook Islands

Producers:

Ministry of Health

Contact: Ms. Peia Ben; p.ben@health.gov.ck

Department of Water Works

Contact: Mr. Adrian Teotahi; hydro@mow.gov.ck

Distributors:

National Environment Service

Contact: Ms Deyna Marsh; deyna@environment.org.ck

Vanuatu

Producers & Distributors: Ministry of Health

Contact: Ms. Nelly Muru Ham; nham@vanuatu.gov.vu

Tonga

Producers and Distributors: Ministry of Health

Contact: Ms Telesia Talia'uli; ttaliauli@health.gov.to

Palau

Producers and Distributors: Division of Environmental Health (MoH)

Contact: Ms. Joanne Maireng; sengk@palaunet.com

For all other countries, requests for test kits and materials/resources can be sent directly to:

Mr. Steve Iddings or Ms. Tema Vakaotia at World Health Organization (SP) Office, Level 4, Plaza 1, Provident Plaza, 33 Ellery Street, Suva, Fiji. Phone: (679) 323 4100

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Annex C: Technical Report on the H_2S Test

The Hydrogen Sulphide (H_2S) Paper-Strip Test

A simple test for monitoring drinking water quality in the Pacific Islands

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**Disclaimer: This document reflects the views of the authors and not necessarily those of WHO*

Introduction

Many people living in the Pacific Island region are reliant on drinking water from shallow ground water lenses and streams, or from roof catchment systems. These water resources are often scarce and vulnerable to contamination from poorly installed sanitation facilities (Falkland 1999). The majority of the Pacific's population therefore is at risk to waterborne diseases (Prüss et al., 2002). Many islands are too small in size and under resourced to support conventional water treatment facilities and distribution networks. In urban areas, distribution and treatment systems are reasonably common although maintaining the systems in good working order is sometimes difficult. People living in rural areas and outer island groups are most at risk of contracting waterborne diseases, as they do not typically have access to treated water.

Microbiological and chemical testing of drinking water quality should be performed to indicate whether water is safe to drink. Unfortunately, in many Pacific Islands the infrastructure needed to adequately monitor water quality is either non-existent or inadequate. A lack of monitoring is particularly apparent for outer islands and rural areas.

Typically, the key water quality parameter that indicates safety is is the absence faecal coliform bacteria in the sample. These bacteria indicate the probability of pathogens (e.g. typhoid and cholera) being present. Sophisticated and costly equipment is required to test for these organisms; i.e. an incubator, filtration apparatus, and chemical reagents, which must be stored under refrigeration. The cost of one test can be more than NZ$30, depending upon the type of test and method used. In addition, samples for coliform analyses must be kept chilled and delivered to the laboratory within 6 h. in order to adequate preserve the sample. In all cases, the time elapsed between collection and examination should not exceed 24 h (APHA, 1995). Although there are several commercially available portable kits that make it possible to carry out on-site water quality testing, these are usually costly and require technical expertise to operate (Bartram & Balance 1996).

An alternative low-cost test for faecal contamination in drinking water which is simple to use and easy to interpret is the hydrogen sulphide (H_2S) paper-strip test (Manja et al. 1982).

Aim of this Report

The aim of this report is to provide information on the scientific basis, manufacture and use of the H_2S paper strip test in the Pacific Islands. Suggestions are given on how the test could be utilised for rural, outer island and community-based water quality monitoring.

Indicators of faecal pollution

Untreated or improperly treated drinking water may contain microorganisms of faecal origin that are pathogenic (disease causing) such as those that cause cholera and typhoid fever. The presence of pathogens in drinking water is usually due to human and animal waste entering the water source. The sanitation facilities that are used predominantly in rural/outer islands of the Pacific are septic tanks and pit latrines, which do not provide sufficient treatment to remove pathogens. The waste outflow from these types of facilities, in certain soil conditions can travel several hundred metres underground (Dillion 1997). Animals (e.g. pigs and cows) in the area of an unprotected water supplies can also cause serious contamination and pose risks to public health.

It is difficult and expensive to test for the pathogenic organisms that may be present in contaminated drinking water. Therefore indicator organisms are used to determine the risk that these organisms might be present in drinking water. Indicator organisms are always present in high numbers in faecal material, whether or not pathogenic organisms may be present. A high level of indicator organisms in a water sample indicates a high risk that pathogenic organisms might also be present. The most common indicator organisms used to determine bacteriological water quality are total and faecal coliforms.

The coliform group of bacteria, along with many other naturally occurring bacteria, inhabit the intestinal tract of warm-blooded animals, including humans, and are discharged in their faeces. Faecal coliform presence indicates that water is contaminated with faecal matter and is not safe for drinking purposes. In the tropics, coliforms are not an ideal indicator as they can occur naturally and reproduce in soil and water at the ambient temperatures (WHO 1996). Other indicator organisms are sometimes used which are in the Enterococcus bacteria group such as faecal streptococci (WHO, 1996), and Clostridium perfringens. The problems noted above with the sophisticated testing procedures and equipment required for the analysis of the above indicator organisms make their use difficult in rural areas and on outer islands.

Another less commonly used indicator is sulphide-reducing bacteria and the following sections outline the use of a low cost test for these bacteria in drinking water called the hydrogen sulphide (H_2S) paper-strip test. There are many advantages of this test for use in rural and remote Pacific Island communities particularly where conventional monitoring is not possible or too expensive.

Background and scientific basis of the H_2S test

In 1975, Allen and Geldreich showed that the presence of coliforms in water was also associated with hydrogen sulphide (H_2S) producing organisms. In 1982, Manja et al. developed a simple paper-strip method to screen for bacteriological contamination of potable waters. This study and several subsequent studies, have found that the H_2S test gave generally good agreement with the standard Most Probable Number (MPN) and membrane filtration methods commonly used for determining the presence and number of coliform and faecal coliform organisms (Hazbun & Parker 1983; Dutka 1990; Castillo et al. 1994; Martins et al. 1997; WHO 2002). As noted in a multi-country intercomparison study summarised by Dutka (1990), this test is "an ideal tool for testing rural and isolated drinking water supplies".

Bacteria can produce hydrogen sulphide through the anaerobic catabolism of cysteine, an amino acid containing the sulfahydryl group, or by the use of elemental sulphur or some oxidised sulphur compounds as the terminal electron acceptor in their metabolic processes. All members of the Enterobacteriacae group are capable of the former while the latter occurs in dissimilatory sulphate-reducing bacteria. The H_2S test uses a medium with thiosulphate as a sulphur source and ferric ammonium citrate as an "indicator," only certain enteric bacteria will produce hydrogen sulphide resulting in the development of a black precipitate. Hydrogen sulphide is produced by the reduction of thiosulphate and then reacts with the ferric salt to form an insoluble black ferrous sulphide precipitate. Members of the Enterobacteriacae group such as Salmonella, Citrobacter, Clostridia, Klebsiella and Proteus are all able to produce hydrogen sulphide in such a medium. Some other non-gut bacteria can reduce thiosulphate into hydrogen sulphide in anaerobic conditions. These bacteria are not typically present in drinking water. The presence of the iron as an indicator in the H_2S medium, would inhibit some naturally occurring bacteria from producing hydrogen sulphide.

The Codex Alimentarious Commission recommends the use of sulphite reducing anerobes as an indicator for testing bottled natural mineral water (CAC/RCP 48-2001). A report by WHO (2002) did not recommend the use of H_2S bacteria for routine monitoring of water supplies due to the possibility of false positives from naturally occurring sulphite reducing bacteria. Nevertheless, these bacteria can be a valuable tool in that they show a lack of sanitary protection somewhere within the system and indicate a need for further investigation and/or treatment.

Basics of the H_2S paper strip test

The H_2S test is recommended for testing drinking water derived from surface water, boreholes, and rainwater sources for faecal contamination[1] .

The reagents used to make the H_2S paper strip test are common laboratory chemicals. By adding a measured amount of "boiled" water and a common liquid detergent to the reagents, a measured amount is impregnated on a piece of absorbent paper and dried in a low-temperature oven. The dried paper strip is placed in a clear small plastic or glass bottle or tube. A water sample is collected in the container containing the reagents and stored in the dark at room temperature for about 3 days. If the sample contains hydrogen sulphide producing organisms, the pad and water turn black in. The black colour and the rotten egg smell of hydrogen sulphide clearly indicate that there is a problem. With such an indicator it is not difficult to convince uneducated villagers that the water may not be safe to drink.

Advantages of H_2S test for use in the Pacific Islands

The advantage of this test over other more sophisticated analyses like the total and faecal coliforms (membrane filtration and Most Probable Number) methods is that it is:

1. Low in cost, the cost of reagents for one test is estimated at NZ$0.08 (see Appendix 4). All other materials used can be found locally.
2. When making up and using the test it is not necessary to have access to a laboratory or expensive equipment like an autoclave or incubator. Only a simple balance to weigh the media, pipettes, and a method of sterilizing the kits (hot oven, autoclave, UV light) are needed.
3. Does not require samples to be shipped or stored under refrigeration.
4. Samples are incubated at room temperature.
5. Is very easy to use in the field as it consists of only a sample tube.
6. Simple for non-technical people to understand as a clear colour change is observed.

For these reasons the test can be distributed to households/communities so they can test their own water. With sufficient public education on the test, there should be no need to go back and tell them that their water is safe or contaminated as they are conducting the test themselves. If results indicate high risk, households would be instructed to treat their water to make it bacteriologically safe before drinking.

[1]The test is not currently recommended for use in testing seawater.

Disadvantages of H_2S test for use in the Pacific Islands

1. Sulphide reducing bacteria (responsible for production of H_2S) are common in the intestinal tracts of most animals making them good indicators for faecal contamination. However, there are some bacteria within the group that occur naturally around thermal vents, vegetation undergoing bacterial decomposition, etc., which may yield a false positive test result (WHO 2002). For most drinking water supplies and all rainwater cistern systems, such 'false positives' would not be expected. As mentioned above there are members of the coliform group that are naturally occurring as well.

2. Some H_2S producing bacteria such as C. perfringens are spore formers and hence they may be present long after a pollution episode has occurred (WHO, 1996). However, pathogens may also survive for long periods of time in the tropics (Dillion 1997).

3. Another criticism of the test has been its use as a presence/absence test. The number of indicator organisms in a water sample can indicate the degree of contamination and therefore relative risk to public health. The H_2S test just indicates whether there is a risk, not the degree of risk. However, the speed of the reaction (color change from clear to black) indicates bacterial density. The faster the reaction, the greater the numbers of organisms present. If necessary, estimates of the concentration of bacteria of faecal origin can be made by controlling the volume of the sample used, or by using a three tube or five tube series Most Probable Number method.

Making the H2S paper strip test

1. Any type of glass bottle or plastic tube with a volume of between 15-200 ml, which has a heat resistant cap/lid, can be used. The bottles or tubes are first cleaned by washing in detergent, rinsing with tap water, soaking in a 5% bleach solution overnight and rinsing with tap water and drying in air or in an oven.

2. If no volume marks are present on the bottles, they can be marked at 10ml, 20ml or 100ml volume, or any volume in-between – depending upon the bottle size. The authors typically use bottles marked at a 10ml volume. This volume calibration is typically done by measuring the required (i.e. 10, 20, 100mL) of water into a graduated cylinder or other measuring device, pouring the measured volume into a sample bottle, standing the bottle upright and then making a mark on the bottle where the water level is. By lining up this bottle with another bottle, the other bottles can be marked in

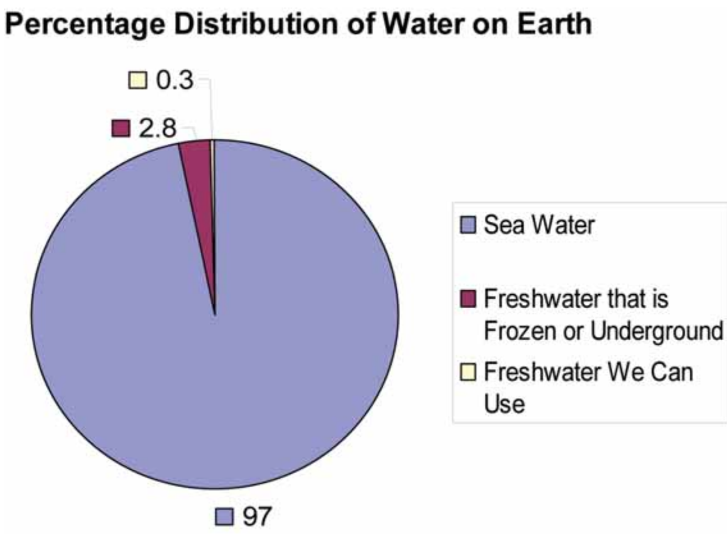
approximately the same place. A glass marking pencil, permanent ink pen or tape can be used to mark the desired volume.

3. The medium used in the test is prepared from the following chemicals, which are dissolved into distilled or boiled tap water. Shake or stir the mixture to dissolve the chemicals.

H_2S Media Formula

Bacteriological peptone	40.0g
Dipotassium hydrogen phosphate	3.0g
Ferric ammonium citrate	1.5g
Sodium thiosulphate	2.0g
Citrate (optional but increases sensitivity)	g?
Liquid detergent (e.g. Teepol)	2.0ml
Water (distilled or boiled tap)	100.0ml

4. Taking absorbent paper, filter paper, non-toxic paper toweling, gauze, absorbent pads used for membrane filtration, or any other type of absorbent material[2], place a measured quantity of media onto the paper. Each paper strip for a 10ml test sample needs to contain 0.5ml of media (50ml sample will use 1ml of media and a 100ml sample will require 2.5ml of media etc[3]). Large adsorbent pads can be cut to a size that has absorbed 0.5ml of media. For example in the picture below, the pad is ready to be cut into eight paper strips, therefore 4mL of the media will have been poured onto the pad (0.5 mL per strip).



[2]Coasters used in bars work well (if no black ink is used).
[3]A pipette graduated at 0.1ml intervals may be necessary for this.

5. The next step is to dry the strips in an oven at about 55°C. A conventional household oven on low temperature can be used. These reagent-impregnated strips can be stored dry (in an envelope or preferably a zip locked bag) for several months – until ready for use.

6. Before conducting the test, a strip or strips are introduced into the appropriate (clean) sample bottle.

7. Bottles should next be loosely capped and sterilized by various possible means:

- Plastic and/or glass tubes can be placed in a hot air oven at about 120oC for 60 minutes.
- If the tubes are clear plastic they can be sterilized under UV-light for at least 30 minutes.
- If the tubes are autoclavable-glass (pyrex), sterilization can be done with an autoclave for 30 minutes.
- Tubes can be placed in a simple pressure cooker for 15 minutes at 115oC.
- It can also be done by steam (in a rice steamer) for about 30 minutes.

Sterilization in a hot-air oven

Following any of the heat treatments, the tubes or bottles are then allowed to cool and the caps or lids tightly sealed. The tubes or bottles should be stored in a dark place until ready for use. Experience has shown they can be stored for at least 5 years in this manner.

Alternatively, the media can be prepared in pre-weighed, dry form and stored until ready for use. A central laboratory could make the impregnated pads (filter paper) and provide these in sealed plastic "zip-locked" bags or envelopes, or provide ready-made tubes or sample containers. In dry form, these reagent-impregnated pads can be stored indefinitely. The only step required of the community is to insert the reagent coated paper strip in sample containers 15-200 ml in size, and sterilize.

Sampling Procedure:

A basic instruction sheet for distribution to individual households on sampling and interpreting results is shown in Appendix 1. The following procedures are for conducting a survey of water quality using the H_2S test.

1. At the time of sampling, label each container with a sample number.

2. Write the sample number, date and time of collection on the special report form (see Appendix 2). Include on the sheet additional information on the type of water sampled (well, surface, rain water, treated supply, etc.) and exact location of collection, such as "at the tap nearest the borehole." Under remarks note if the water was visibly turbid or has any other characteristic that should be noted.

3. At the bottom of the report form there is space reserved for "Notes." Record any observations that may have influenced the quality of the water sampled. For example, distance to a nearby source of pollution, faulty pump, or state of sanitary protection (if a well or spring).

4. Standard procedures specify that if the sample is from a tap, flame the mouth of the tap to eliminate the chance of accidental contamination (a false positive), then, let the water run freely for about 15-20 seconds. Place the opened H_2S sample collection bottle under the tap and collect the appropriate amount (e.g. up to 10mL calibration mark) being careful not to contaminate the cap. It should be noted however that samples should not be collected from taps that are leaking and flaming the tap is not necessary if you are testing the quality of the water as it is actually consumed.

5. If the water to be sampled is from a storage container, tank or cistern; a natural flowing water body like a spring or stream; or from a dug well, use the utensil that is normally used by the consumer or water collector to collect the sample, rinsing it several times before collecting the sample.

6. Every day of sampling, a control sample should be collected and analysed. This is a sample that is known to be uncontaminated, such as boiled water, commercially bottled water, or water treated with chlorine. The control sample is used as a benchmark to compare color change in the test samples and to insure that the sample bottles have been properly sterilized prior to use (Note: There will be slight change in the color of the sample to a pale yellow or light brown due to the color of the reagent, which is normal).

Reading and Interpreting Results:

1. After sampling, place all test samples in a dark place and incubate at room temperature for a total of three days. Every 12-18 hours examine the samples for changes in color. The date and time of each observation is recorded on the report form and the observations are recorded as follows: (-) = no change; (+) = slight change, the paper strip or water has turned gray; (++) = the paper strip is partially black; (+++) = the strip and the water sample itself are noticeably black.

2. As noted above, a color change indicates the presence of bacteria of faecal origin. The speed of the reaction will determine the density of organisms present; i.e. the quicker the reaction the higher the number of faecal organisms presence. This can also be interpreted in terms of a risk factor. For example, a slight color change (+) on day three indicates a lesser risk than a strong (+++) change on day 1.

3. To determine actual risks to health, H_2S test results must be considered in parallel with the results of a sanitary survey. An example of a sanitary survey form for rainwater tanks is shown in Appendix 3. For example, if a drinking water well is unprotected and the results of the H_2S test are positive on the first day, the users should be informed that a risk to health is likely, and steps must be taken to disinfect the water. Usually after seeing the results first hand, the user understands that the water supply in question is not suitable for drinking purposes. In such cases the users are generally receptive to taking corrective action; i.e. to protect the well from contamination, or to learning about disinfection (treating water to kill bacteria).

Various household disinfection techniques could be recommended such as boiling, adding a few drops of chlorine bleach (4 drops per litre), and/or putting the water in a clear plastic bottle and exposing it to full sunlight for a minimum of 4 hours (e.g. 10:00am-2:00pm). Two H_2S tubes could be distributed to each household, with instructions to fill one with untreated water and the other with water that has been treated. After the 2-3 days of incubation, no color change should occur in the treated sample, which clearly shows that the organisms that caused the untreated sample to turn black have been deactivated.

How the H_2S test can be used:

This low-cost test has several useful functions[4] . This test can be used:

1. For monitoring of rural and outer island water supply systems where it may be difficult to conduct conventional testing due to a lack of appropriate laboratory facilities. This, along with sanitary survey data (information identifying conditions that may lead to the contamination of a water supply source) would make it possible for communities to monitor their own water supplies without having to rely on central laboratory services. If community-based programmes of this nature can be established, outer islands could carry out their own water quality monitoring and surveillance programmes and initiate corrective action when needed. This would help to protect public health in these areas and result in a substantial cost savings to island governments.

2. For routine monitoring of reticulated systems; i.e. water that is distributed through a piped system. If a positive result is observed, another sample can be collected for further analysis by conventional means e.g. for faecal coliform enumeration;

3. To determine the cleanliness of water storage tanks, rainwater cisterns and other household storage containers;

4. To identify sources of contamination or the point in a reticulated system where bacteriological contamination is being introduced.

5. To select which spring is best to develop;

6. To determine effectiveness of disinfecting a water source, or to verify that a well has been properly protected;

7. As a tool in health and hygiene education to show villagers how water becomes contaminated and what they can do about it. Communities would also have evidence to alert the relevant authorities that water which is supposedly treated is still contaminated.

[4]Keep in mind that this is a tool to illustrate bacteriological contamination and is not a standard method that is admissible in legal proceedings. The major usefulness of this test is it's application as a low-cost educational tool.

8. For monitoring during emergencies and disasters such as cyclones where conventional testing is difficult. For example, following a cyclone, thousands of kits could be locally manufactured and distributed in a short time period (few days) to individual households by community health workers along with printed material on their use. As most water sources on outer islands are localized small community or individual sources, time and resources could be focussed on distribution of the kits to the maximum number of people. This would mean that many more drinking water supplies are tested compared to if conventional methods were used by a water or health agency. This should enable better protection of human health following disasters.

9. To identify sources of pollution entering streams and rivers by comparing differences in incubation times of samples collected at regular intervals along the stream or river;

10. To demonstrate how easily hands become contaminated and how easily they can contaminate food and water. For example, it can be used to demonstrate the effectiveness of washing hand with soap; i.e. to illustrate the faecal oral route of disease transmission. This is done by pouring clean (boiled and cooled) water over unwashed hands and testing it, and having others wash their hands with soap and repeating the exercise; and,

11. To determine if a food contact surface is contaminated with an a common foodborne pathogen like Salmonella by swabbing the surface with a sterile swab and inserting the swab in an H_2S tube containing sterile water.

Commercial availability of H_2S test

Although the test is very simple to make and this should be possible in most countries, the test may also be purchased when manufacture is not possible.

1. H2S tests or chemical reagents may also be able to be obtained on a 'cost of manufacture only' basis from the

Institute of Applied Sciences,
University of the South Pacific,
Box 1168,
Suva,
Fiji Islands.

pH: (679) 3212967 or 3212965
Fax: (679) 3300373
See website for email contact details: www.usp.ac.fj/ias

2. HACH chemical company make a H2S test called the Pathoscreen test.

Validation of H_2S test for use in the Pacific Islands

The H_2S test has been used in several Pacific countries but no detailed comparisons have been published where this test method is compared against other methods of assessing the microbiological quality of water. For this reason we undertook laboratory and field testing and validation procedures to ensure the test was suitable for use in the Pacific Islands.

Laboratory Testing

In order to determine how this test can be developed for use in developing countries, a series of experiments were conducted on three naturally occurring water types which are commonly used as drinking water sources:

1. Water from a large river (currently used as a water supply) flowing through a rural catchment.
2. Water from a small creek flowing through a semi-urban area.
3. Water from a typical household rainwater cistern system found in Fiji.

The intent of these experiments were to determine how well the test correlates with other traditional water quality tests and whether or not the time it takes for a reaction to occur correlates with bacterial density and relative risk. All analyses were undertaken using validated methods in the microbiological laboratory at the Institute of Applied Sciences, University of the South Pacific, Suva, Fiji.

The table below shows the time taken for H_2S development compared to bacteria counts (Colony Forming Units per 100 mL, CFU/100mL) using conventional methods for total (TC) and faecal (FC) coliforms. The time taken for H2S development is separated into the time taken for intial (grey colouration, +) and final (dark black colouration, +++) colour development. The creek water was the most contaminated water with very high counts of total and faecal coliforms, and this water also took the shortest time to turn black. The rain water took longer (92 h) to turn fully black and had low levels of faecal contamination. We also examined the use of the H_2S method to determine bacteria counts using a Most Probable Number (MPN) method (serial dilutions made of sample and these dilution placed in separate H_2S tubes). The results agreed well with the trends in the other results indicating that, if necessary, the H_2S test could be used to estimate bacteria numbers.

Site	Time for H_2S development	Time for H_2S development	TC	FC	MPN H_2S
	initial colour	full colour	CFU/100 mL	CFU/100 mL	CFU/100 mL
River water	40 hours	59 hours	480000	62	250
Creek water	23 hours	25 hours	3820000	2700000	16000
Rainwater	42 hours	92 hours	490000	1	5

The same samples were tested for faecal streptococci (FS, Enteroccocci), Salmonella (2 different types of test) and Clostridium perfringens. The faecal streptococci results were similar to the faecal coliforms which is not unexpected as both these indicator bacteria groups would be expected to be found together in faecally contaminated water. C. perfringens, a definite indicator of faecal pollution, was also found in the river and creek samples but not the rain water. Salmonella results were variable with one test showing positive for creek water and one test showing positive for river water. Salmonella would be expected to be at much lower levels than the other types of bacteria so the statistical probability of finding it in one portion of the sample and not another would be high.

Site	FS col/100 mL	C. perfringens P/A	Salmonella (BSA) PEA	Salmonella (HEA) P/A
River water	63	yes	Absence	Presence
Creek Water	710000	yes	Presence	Absence
Rainwater	5	no	Absence	Absence

In summary, the best correlation of H_2S colour development time with other bacteria levels was for faecal coliforms, faecal streptococci and Clostridium perfringens. This is similar to other studies (see WHO 2002) and indicates the suitability of the H_2S test for testing drinking water for faecal pollution.

Field testing of the Hydrogen Sulphide (H_2S) test following Cyclone Ami

The difficulties in conducting water quality monitoring on remote islands are increased following natural disasters such as cyclones. An evaluation of the H_2S test against the conventional indicator organisms (total and faecal coliforms) was undertaken following the occurrence of Cyclone Ami in the Fiji Islands (SOPAC technical report #?). The H_2S test turned positive (black) for most samples that had faecal and total coliform levels above the respective WHO guidelines. Only about 11% and 8% of the samples that showed faecal and total coliform bacteria respectively did not test positive in the H_2S test, yielding 'false-negative' results. Similar disparities have been observed in other studies (see WHO 2002a for a summary) and are not unexpected as the coliform tests measure different bacterial groups than the H_2S test. Also the sample volume used in the H2S test (10mL) is less than for the coliform-type indicators (100 mL), so the statistical probabilities of finding bacteria will differ. Lastly, there is an increased risk of introducing bacterial contamination when collecting and examining samples for faecal and total coliforms, due to the increased number of handling and filtration procedures, as compared to the H_2S test. This is particularly relevant when using the membrane filtration method in difficult non-laboratory conditions prevalent on outer islands. Upon closer examination of our results we found many of the 'false negative' samples had quite low levels of faecal and total coliform bacteria (e.g. see Labasa water depot sample results in Table 1 of SOPAC technical report #?). Therefore we believe that in many cases people drinking water that gave 'false negative' results in the H_2S tests would not necessarily be exposed to an increased risk to waterborne diseases.

About 2% and 6% percent of the samples that tested positive in the H_2S test did not have any total and faecal coliform bacteria respectively present. These are termed possible 'false-positives.' Similar findings have been documented in the literature (see WHO 2002 for a summary). This is likely due to the fact that some H_2S reducing bacteria (e.g. Clostridium sp.) persist in the environment longer than coliform bacteria. (WHO 2002). It could possibly be due to naturally occurring sulphide reducing bacteria being present, but the conditions needed for these bacteria to thrive are anaerobic waters with high organic matter and sulphate content. None of the waters we sampled fitted this description so we consider these results are unlikely to be false-positives in the sense of a natural H_2S producer being present. In any case, a false positive result indicates a problem, which when used in conjunction with a sanitary survey can provide information that would result in the suspect water either not being used, justify the system being cleaned and disinfected, the supply being disinfected or would suggest additional testing using conventional means. Nevertheless, following a disaster event, any positive test results should be regarded as unsafe for drinking purposes and disinfected.

We conducted a second visit to Vanua Levu, and several of the positive H_2S tests were re-tested for the presence of the spore-forming anaerobic bacteria, Clostridium perfringens, which is a strong H_2S producer and an indicator of faecal pollution. The results showed a relationship with the speed of H_2S development. Nearly 50% of the samples returned positive C. perfringens results, which indicated faecal contamination had entered into water supplies and/or the reticulation system. About 25% of samples that tested positive with the H_2S test had undetectable levels of C. perfringens. However, these were generally the samples where the H_2S test was slow to turn black, indicating that few H_2S producing micro-organisms were present when the sample was collected. Although it is suggested that further research on the quality of drinking waters in the Pacific should be performed to confirm the link between positive H_2S test results and the presence of faecal contamination and pathogens, the results thus far indicate that this test is valid.

Conclusion

The test is well suited for testing drinking water supplies for faecal contamination in the Pacific Islands, particularly in remote rural and outer island areas. The significant advantages of the H_2S test compared to other conventional microbiological (faecal and total coliforms) analyses is that it is very low in cost and does not require sophisticated equipment to manufacture or carry out the analyses. H_2S kits can easily be produced in Pacific Island countries where laboratories are often poorly equipped, or distributed by a regional organization, when needed. The results from H_2S tests are visual and therefore simple for people to understand, as a black colour change occurs when bacteria levels in drinking water are high. This enables communities and community health workers with minimum training to safely test their own water supplies. The time the H_2S test takes to turn black shows a correlation with faecal levels so an indication of the risk that pathogenic organisms are present can be obtained.

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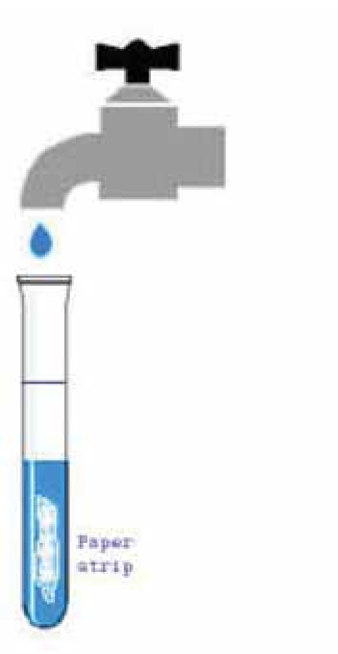
Appendix 1

Household Name:……………………………......................……Phone: ……........……………
Street address/location:……………………………………………………...................................………

Water Quality Testing Using the Hydrogen-Sulphide (paper strip) Test

Good water is essential for health. You can use this simple paper strip test to determine if your water is safe to drink. If the tube turns black within three days of collecting the sample, you must treat your water before drinking it, as harmful bacteria may be present.



When collecting a sample:

1. Allow the tap to run for about 30 seconds.
2. Uncap the lid of the sample tube and fill with water up to the mark.
3. Tightly cap the sample tube and put in a dark place to incubate for 3 days.
4. For comparison purposes, collect a sample of water that you know is safe, like boiled water or commercially bottled water.
5. Observe the samples every 12 hours (morning and evening) for 3 days and note below if water and /or the paper strip turns black. The water in the tube will have a slight brownish colour immediately after collecting the sample. This is due to the chemicals used and is considered normal.

DAY - 1		DAY - 2		DAY - 3	
TIME IN TUBE	12 hours	24 hours	36 hours	48 hours	60 hours
COLOUR CHANGE NOTED (Y/N)	*Yes/ No*	**Yes/ No**	**Yes/ No**	**Yes/ No**	**Yes/ No**
High Risk		*Moderate Risk*		*Low Risk*	

Note: If the sample tube turns black within 3 days of collection this indicated the presence of bacteria that could cause disease. In such cases the water should be treated before drinking. Treatment consists of boiling, filtering[5] , adding chlorine (household bleach), or exposing a 600ml clear plastic bottle of water to direct sunlight for a period of 4-6 hours.

Boiling means bringing the water to a rolling boil for a minimum period of 2 minutes.

Chlorine can be administered by adding 4-5 drops of household bleach to each litre of water treated or by adding chlorine tablets (meant for purifying drinking water) according to the instructions on the box, usually one tablet per litre.

[5]Filtering does not kill bacteria, it only reduces the number and lowers the risk to health.

For further information contact: SOPAC, Ph (679) 338 1377 or watersector@sopac.org

Appendix 2

WATER QUALITY TESTING - DATA SHEET

Address: ______________________________

Location of source (describe): ______________________________

SAMPLE NUMBER	TYPE WATER SOURCE: (Deep well - borehole; shallow well; surface water; spring; etc.)	DATE: of sample collection	TIME: of sample collection	LOCATION: (place where sample is collected)	REMARKS[1]	RESULTS[2]: DAY 1 Date:		DAY 2 Date:		DAY 3 Date:	
						TIME	TIME	TIME	TIME	TIME	TIME
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											

Notes: ______________________________

1. Indicate under "remarks" if the water is visible turbid, colored, or contains settable solids or material in suspension. Also, note any problem at the sampling site like a leaking tap, area unclean or littered, drainage problems, etc.
2. Results: a (-) indicates a negative; a (+), grey color, the reaction has started; (++) the reagent pad is now partially black; (+++) the reagent pad and the water is noticably black.
3. Notes: Indicate the distance between the water source and any sources of pollution, like a compost pit, septic tank, leach field, etc.

Appendix 3: Rainwater Cistern Systems - Sanitary Survey

Country: ____ Date of visit: _____________

Atoll: _______________________________________ Island: ____________________

Name of community/ village: ____________ Est. pop. of village: ____ Est. # (households) in village: ___

Name of family *(it is suggested that the tank be numbered for easy identification)*: ____________________

____

Number of people in family that drink water from this tank: _________ *[Note location of tank on map – use same number as sample]*

Sample No.: _____ *[Number that corresponds to number on H2S sample tube]* SCORE

1. Condition of ROOF: good (0)____; fair (1)____; poor (2)____
2. Condition of guttering: good (0)____; fair (1)____; poor (2)____
3. Guttering sloped to drain: yes (0)____; no (2)____
4. Inlet screened or protected: yes (0)____; no (2)____
5. Interior tank clean: good (0)____; fair (1)____; poor (2)____
6. Condition of tank: good (0)____; fair (1)____; poor (2)____
7. Method of withdrawal by tap: yes (0)____; no (2)____
8. Tap and other plumbing in good repair: yes (0)____; no (2)____
9. Method for diverting first flush available: yes (0)____; no (2)____
10. No vegetation overhanging roof catchment area: yes (0)____; no (2)____

TOTAL:

OTHER INFORMATION:

1. Type GUTTERING: vinyl ____; PVC ____; metal ____; other [describe]: ____________________
____
2. Type TANK: fibreglass ____; poured concrete ____; ferrocement ____; PVC ____; galvanized iron ____; other: [describe]____________________
3. Location of tank: On raised platform ____; at ground level ____; partially below ground ____; majority of tank below ground ____
4. Estimated capacity of tank, in m3: ________ (V=πr2h)
5. Date constructed: ______________ Date when last cleaned: ________________
6. Other method of withdrawal [example, a bucket]: __________________________
7. Describe method for diverting first flush, if available (sketch on reverse):

RECOMMENDATIONS: ____
____
____

1. H2S test (score): negative (0)____; positive, day 1(11)____; day 2(9)____; day 3 (3)____
2. Sanitary Survey- Risk Score: _________

Relative risk = 1+2: LOW (<5)_____; MODERATE (5-10)_____; HIGH (>10)_____

Appendix 4: Cost of H_2S media

Recent prices in New Zealand dollars (quoted by Biolab Scientific) for the H_2S media

	Cost (NZD)	Cost per gram (NZD)
Peptone 500g	$174.80	0.35
Di potassium hydrogen orthophosphate 500g	$103.60	0.21
Ferric ammonium citrate 100g	$30.20	0.30
Sodium Thiosulphate	$56.99	

According to the formula;

40g peptone	= $14.00
3g Di potassium hydrogen orthophosphate	= $0.63
1.5g Ferric ammonium citrate	= $0.45
2g Sodium Thiosulphate	= $0.22

The total is: $15.30 for enough chemicals to make 200 tests or roughly NZD $0.08 per test.

This does not count the absorbent paper, sample container or lab time and equipment.

We can assume these could be free of charge. We obtain free pre-form bottles from Coca Cola company.

Compare this to the cost of an ampoule of MF-endo or other media, the H2S test is much cheaper. Also, with the other tests you have real lab time and equipment use involved.

The H_2S can adequately indicate when a risk to human health occurs there is no excuse for not undertaking water testing because of a lack of financial or material resources.

As noted above: the test or chemicals may also be obtained on a 'cost of manufacture only' basis from the Institute of Applied Sciences, University of the South Pacific.

Note Taking

LIVE & LEARN ENVIRONMENTAL EDUCATION

World Health Organization

Australian Government
AusAID

SOPAC

FIJI WET
Water Education for Teachers

COMMUNITY TOOLKIT

KEEPING YOUR DRINKING WATER SAFE

WATER AWARENESS AND EDUCATION

Tool for Water Awareness and Education

The Tool for Water Awareness and Education is part of the Keeping Your Drinking Water Safe Community Toolkit developed by Live & Learn Environmental Education. The toolkit is designed to be used by Community Trainers, Health Officers, Community Workers, and Facilitators, to raise awareness about the need to keep water clean and promote responsible attitudes, behaviour and actions to ensure safe and lasting drinking water supplies.

Live & Learn Environmental Education is thankful to those who have contributed to the development of the ***'Keeping Your Drinking Water Safe Community Toolkit'.*** They include:

- The Australian Agency for International Development (AusAID), for funding the 2-year Pacific Drinking Water Safety Plan Programme, which provided financial support for production of this valuable resource.
- The World Health Organization (WHO) and the Pacific Islands Applied Geoscience Commission (SOPAC) for support, guidance and advice during the development of the toolkit.
- The Institute of Applied Science University of the South Pacific, for reviewing the scientific and technical information presented in this toolkit.
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- Helti Pasifik Komuniti Program, The Foundation of the Peoples of the South Pacific International (FSPI) and affiliates.
- Thank you Project WET (Water Education for Teachers) International Foundation for permission to use the activity **Sum of The Parts** (pp 267-270); as published in the Project WET Curriculum and Activity Guide; copyright 1995 by the Project WET International Foundation. Used with permission.

The ***Keeping Your Drinking Water Safe Community Toolkit*** contains:

- An Introductory Guide containing background information and annexes
- Tool for Conducting a Water Audit
- Tool for Conducting Sanitary Surveys
- Tool on Snapshots to Monitoring Water Sources
- Tool For Water Quality Monitoring Using The Hydrogen-Sulphide (H_2S) Paper-Strip Test
- Tool on Water Awareness and Education
- Tool for Water Management Actions
- Comic and Paper-strip test Instruction Flipchart

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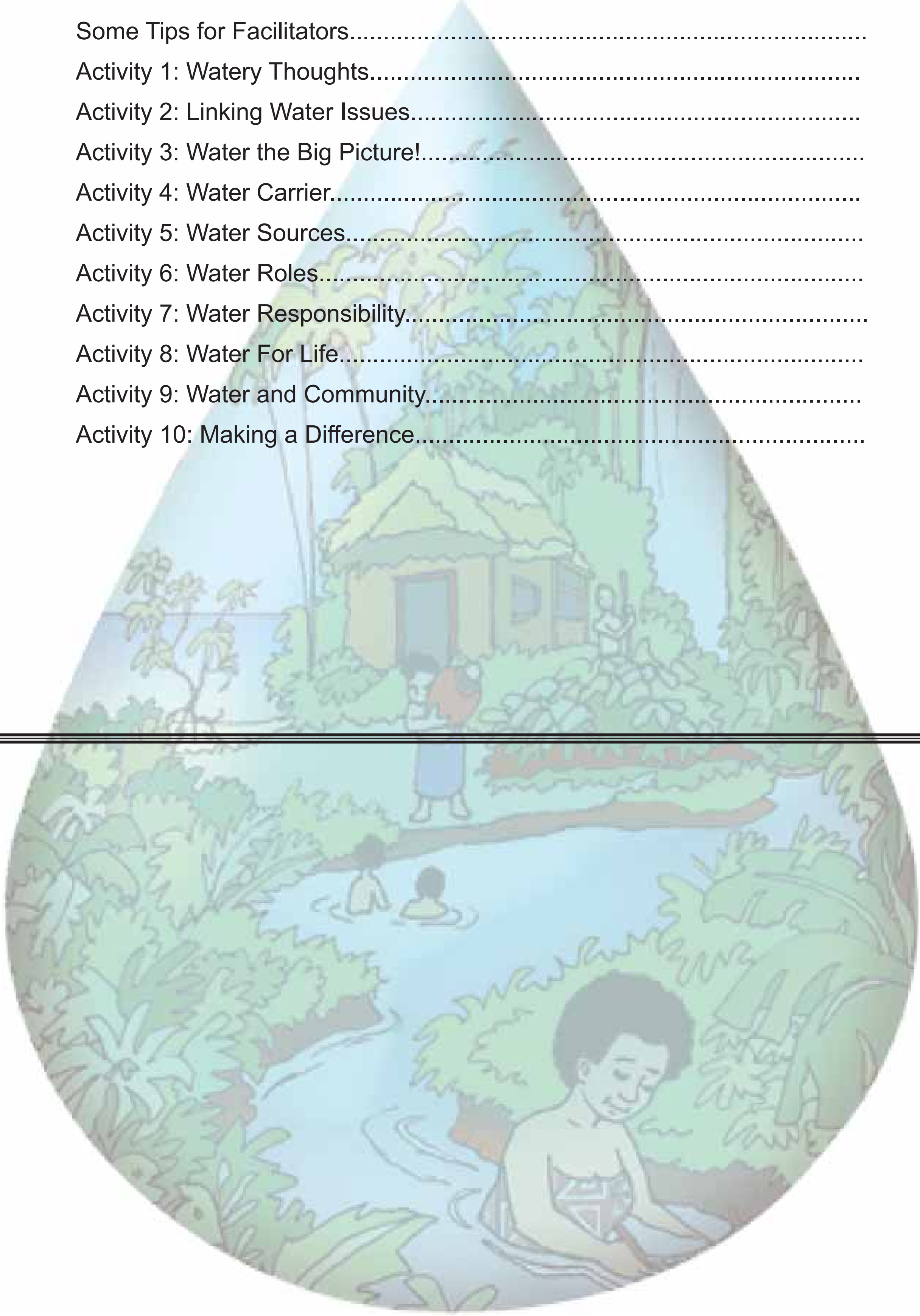
WATER AWARENESS AND EDUCATION



Water Awareness and Education

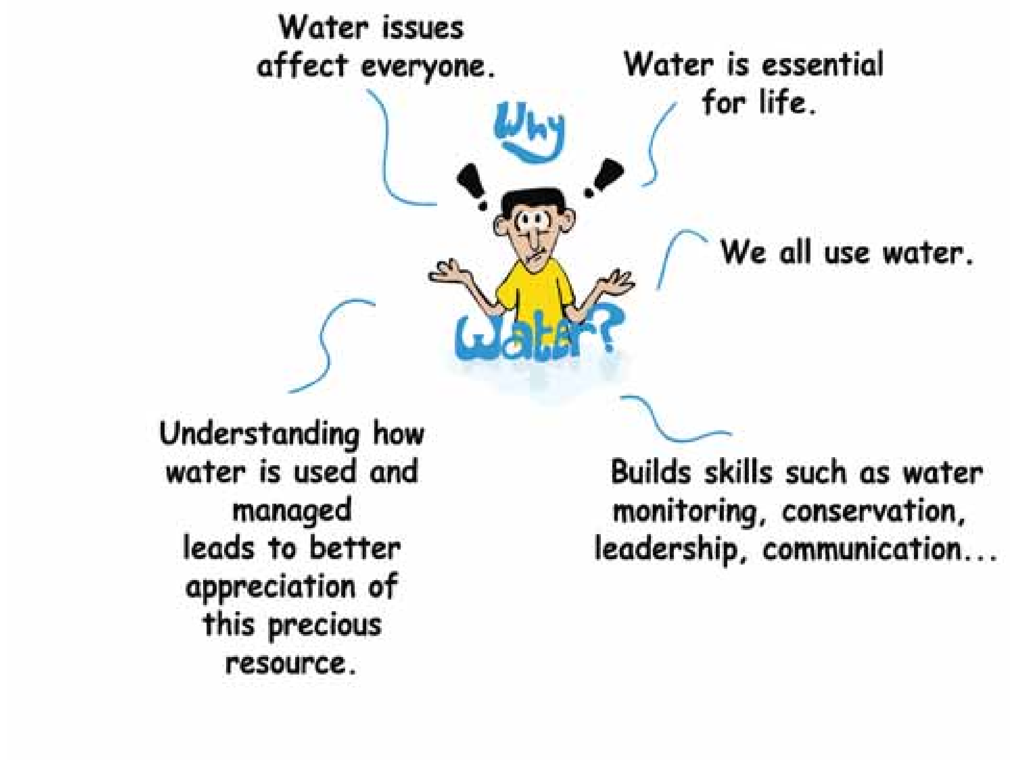
Water awareness and education involves finding out more about the importance of water, understanding our responsibilities and how we look after our water sources, investigating water quality and making decisions.

By being better informed, community members can participate more actively in decisions concerning how their water resources are used and managed.

Water awareness and education can lead to mobilising community actions to improve water resources, health and quality of living.

Why Learn about Water?

It is important to learn about the situation in the community- where the water supply is coming from, how safe it is, how water is being used, how it is being polluted or wasted, and what can be done to prevent water pollution and conserve water.



The Water Awareness and Education Activities provided are designed to:

- Promote the sharing and understanding of ideas on the importance of water;
- Examine the relationships between water and health, community, livelihoods and well-being;
- Appreciate the roles and responsibilities we all have towards taking care of our water sources;
- Assist communities to plan for safe water, for better use and management of water sources, and to improve water quality.

The activities may be followed in the order i.e. Activity 1 to 10, to be facilitated during a community workshop or the facilitator may choose the activities that are most relevant to facilitate with participants.

Some Tips for Facilitators

Below are some tips that you could use as the facilitator when you are carrying out the training in the field. To be a good facilitator requires time and experience, and, learning by doing it is the best way.

Some key characteristics of being a good facilitator include:

- Warm personality, with an ability to show acceptance of participants.
- Social skills, with an ability to bring the group together and control it.
- A manner of teaching which generate and uses ideas and skills of participants.
- Organizing ability, so that the resources or venues are booked and workshop or meeting logistics arranged smoothly.
- Skills in noticing and resolving participants' problems.
- Enthusiasm for the subject and being able to put it across in an interesting way.
- Flexibility in responding to participants' changing needs.
- Knowledge of the subject matter.

Here are a few tips for good facilitation!

- Look at the group members; do not stare at your notes or the guide. Make eye contact with the whole group by letting your eyes roam around the room. Call members by their right name.
- Smile – even if you are nervous or uneasy.
- Avoid placing barriers between yourself and your group members. Be open in your posture and sit at the same level as the group members.
- Avoid distracting body movements e.g. don't fiddle with pens or touch your hair. Your audience might focus on these nervous gestures rather than listen to you.
- Speak clearly and do not be afraid of pauses.
- Prepare thoroughly a day before your training to familiarize yourself with the task ahead of you. This might also build your confidence.
- Start talking to group members as they begin to arrive, smile and be relaxed.

- Speak to group members as equals, use the words 'we' or 'our' instead of 'you' or 'your'. For example, 'we have to' and 'our project, rather than 'you have to' and 'your project….'
- Have breaks/ games or energisers when appropriate.
- Pause after your key points to allow the group to absorb them. This is the moment to look carefully at the participants. You will be able to tell whether they have understood you from the expression on their faces and their body language.
- Act a little. In a large group you have to go a long way before you are in danger of going over the top.
- Speak clearly. A clear voice carries further and sound better. It also does not become strained so easily. Sound the words carefully. Do not let them run together.

Source: Live & Learn

"It is important for facilitators to involve all participants in sharing knowledge and experiences. Learning can be good fun!"

Participants at a Community Based Water Quality Monitoring Training for Trainers in the Cook Islands, 2007

Source: Live & Learn

Be sure to ask questions!

This is a very important tool! Effective questioning allows you to involve participants as you critically examine issues. Questions can help you to:

- Test assumptions
- Invite participation
- Gather information
- Promote discussion
- Develop a deeper understanding of what is being discussed

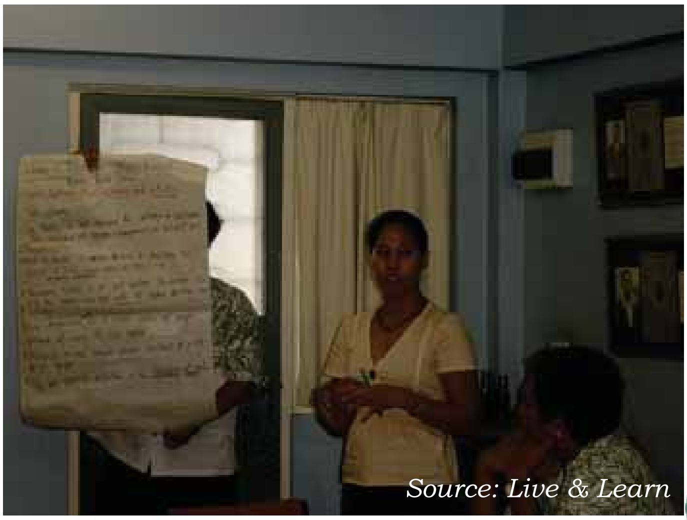
Take Notes!

- Recording what happens during your workshop or meeting is very important as it can help people to stay focused, and it makes it possible for the group to see how its views have developed and to share experiences with other groups.
- Written notes also make it easier to include any initiatives or activities undertaken by the community in a newsletter or on a website and other communities can be aware of activities.
- Keeping notes also shows that the knowledge and experiences of community members is valued.
- Choose a note taker or decide whether one person will take on the job or whether the role will be shared around.
- Notes could cover things such as:
    - What has been discussed/discovered;
    - Key issues/ideas;
    - Points of particular controversy
    - Agreed action outcomes, activities.

And finally, evaluate your progress

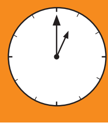
- As a facilitator, you need to get feedback about what worked well, what didn't work, any changes that need to be made to the resource materials or facilitation, and extra work that you might need to do.
- You can prepare evaluation forms to be distributed to participants at the end of your workshop.
- Evaluation in communities should be a time for members to look back at what they have achieved and celebrate achievements!


Source: Live & Learn


Source: Live & Learn

ACTIVITY 1

Watery Thoughts



10-15 Minutes

Purpose: To be aware of the importance of sharing views, thoughts and ideas about water, sanitation and hygiene.

Materials: Paper and pens
Container to represent the *'Fruit Salad Bowl'*

What to do:

1. Hand out a piece of paper to each participant (a small piece is fine!).
2. Read the following question to participants:
   How do you feel, or what do you think about water, sanitation and hygiene?
3. Ask participants to think about the question and to write down their feelings, thoughts, views or ideas on the piece of paper. They can write one word or a sentence and do not need to put their name on the piece of paper.
4. Once participants have finished writing, collect all pieces of paper into the 'Fruit Salad Bowl'.
5. Ask a participant to mix the 'fruit salad'. Pass the bowl around and ask each person to choose one piece of paper.
6. Each participant should then read the sentence aloud to the group.
7. After all participants have read out a sentence, facilitate a discussion with participants regarding their feelings or thoughts about water, sanitation and hygiene. Suggested questions to ask:
   - *What were some interesting thoughts about water, sanitation and hygiene?*
   - *Were the views all similar? Were there some differences?*
   - *Do we all feel or think that water is an important resource and should be protected? Why or why not?*
   - *Why were feelings, thoughts and ideas collected in a 'fruit salad bowl'?*

Note to facilitator:

Make a note of participant responses about water, sanitation and hygiene. Keep this list and review it after some of the training sessions. Have thoughts or feelings changed?

Linking Water Issues

40 Minutes

Purpose: To share knowledge and understanding of the links between water, health and livelihoods.

Materials : Newsprints/ butchers paper, **picture cards** and markers

What to do:

1. There are **three sets** of picture cards- **A, B and C**- to copy. If you cannot photocopy the cards, then prepare card labels (without the pictures).

2. Divide participants into three groups and ask each group to identify a leader, a recorder and a note taker for their group.

3. Distribute the newsprints, markers and one set of picture cards to each group.

4. Ask groups to discuss the links between the picture cards and prepare stories or a role-play to show the links. *The groups may also decide to arrange the cards in any order depending on their discussions. They may decide to arrange picture cards in a cycle, a series of flow charts or so forth.*

5. Give each group 10-15 minutes to discuss and present their water links- stories, role-play etc to the rest of the participants.

6. Once all groups have completed their presentations, facilitate a group discussion. Suggested questions to ask:
   - *What were some of the new things you learnt?*
   - *Does your community face these problems? Why?*
   - *Are members of the community aware of the links between water and their health and livelihoods?*
   - *What actions can be taken either individually or as a group to address problems or issues raised?*

Water The Big Picture!

60 Minutes

Purpose: To build on knowledge and understanding of the links between water, health, communities, economy and the environment.

Materials: Newsprints/ butchers paper, **picture cards** from previous activity and markers

What to do:

1. Form small groups with 5-6 participants per group.

2. Ask groups to choose one of the picture cards from Activity 2. *Each group should be given a different picture card.*

3. Each group should write down their 'problem' (from the picture card they have chosen) in the centre of the newsprint and circle the problem.

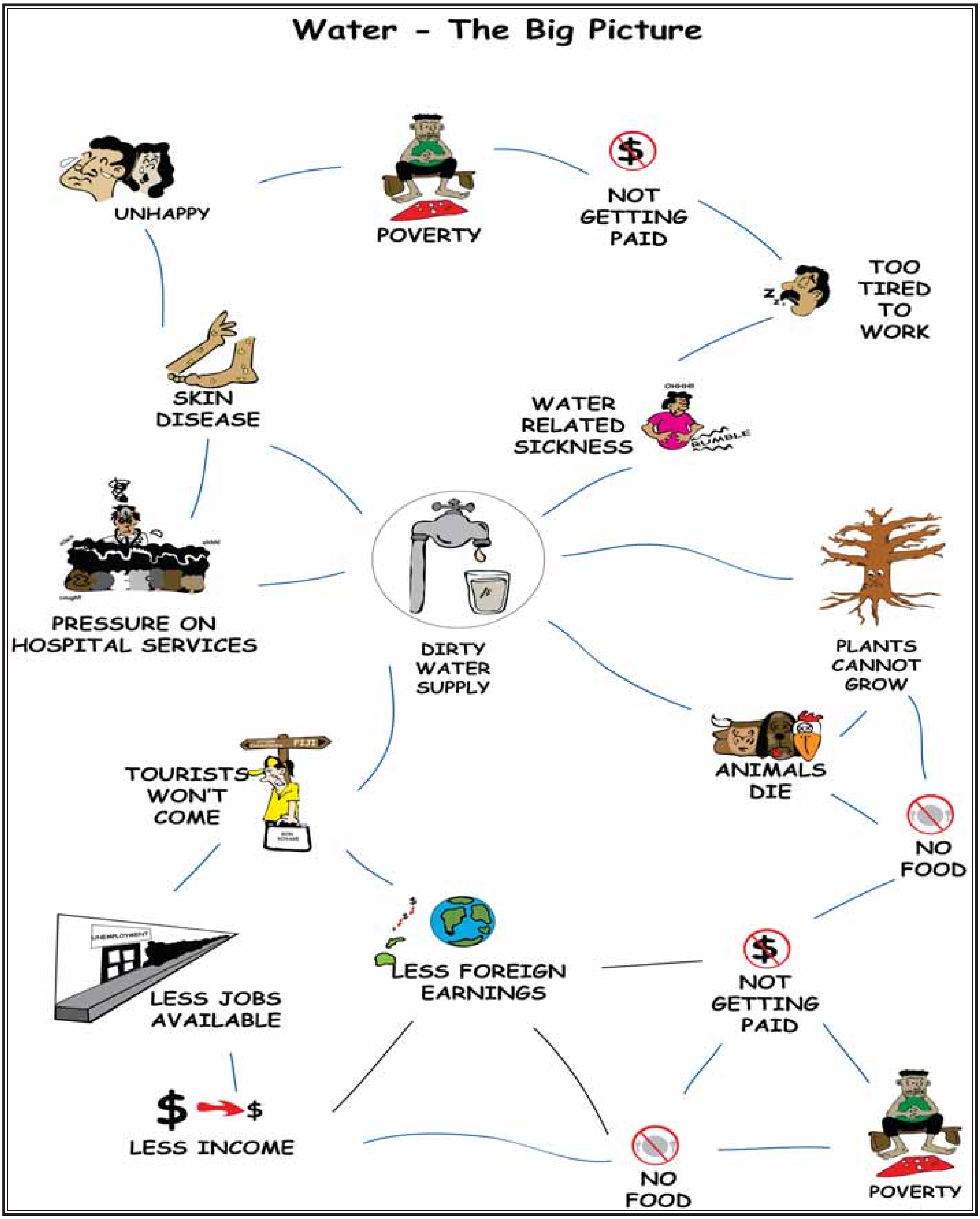
4. Ask participants: what are all the things that can happen because of this problem? What does your problem lead to?

5. Write these impacts on the newsprint connecting them with lines going out from the centre (problem).

6. Continue building the bigger picture of the problem showing the further impacts, consequences or effects of the problem on water sources, human health, society, the environment, the economy and so forth.

7. Give groups 20 minutes to complete the activity and then ask each group to present their water connections to the rest of the groups.

8. Facilitate a discussion with participants. Suggested questions to ask:
   - *Were you surprised by the all the consequences or effects of the problems?*
   - *Are water problems only related to the environment?*
   - *Are there any positive effects that can occur as a result of the problems identified? Discuss this further.*
   - *Identify areas where the chain of events or links can be broken. That is, where actions can be done to prevent the problem from 'expanding'.*
   - *What actions have been taken or can be taken in the community to solve these problems?*



An example of 'Water- The Big Picture' using the picture card 'Dirty Water Supply'. Participants can draw or write effects, or develop stories or role plays.

Water Carrier

15 Minutes

Purpose: To better understand how easily water-borne diseases can be spread.

Materials: Water, clean spray bottle

What to do:

1. Inform participants that the human body is home to all kinds of bacteria. Show participants the **Pathogen Photo-card** provided in the toolkit and discuss some of the different pathogens shown.

2. Some bacteria can be helpful but some can be very harmful. In this activity participants will demonstrate how harmful bacteria such as germs or pathogens are passed along to others through touch.

3. Tell participants that sometimes when people sneeze, they use their hand to cover their mouth.

4. Using a spray bottle, spray water onto your hand to demonstrate how fluid can get onto your hand when sneezing.

5. Use your wet hand to shake hands with a participant. Instruct that participant to shake hands with the next person without drying his/ her hand. Continue this until everyone has shaken hands.

6. How many participants shook a wet hand? What if germs or pathogens were in the sneeze fluids? Facilitate a discussion:
   - How are germs spread?
   - Water is a main carrier of bacteria and pollutants. Discuss the links between water & human health.

Note to facilitator:

You can also demonstrate how germs can be passed from hand to hand by putting glitter, wet sand or powder on your hand and shaking hands with everyone in the room. How many participants can see glitter, sand or powder on their hand?

Water Sources

30 Minutes

Purpose: To understand how water sources can be polluted.

Materials: Newsprints and markers

What to do:

1. Ask participants to identify their various water sources and list the water sources on a newsprint pasted up on the wall.

2. Divide participants into groups and get each group to choose a water source. For example, one group may choose the water tank, while the other group chooses the well.

3. Ask each group to draw or write the name of the chosen water source in the middle of the newsprint. Draw arrows pointing ***towards the water source*** to show the ways their water source can become contaminated. Label these arrows.

4. Draw arrows pointing *out from the water source* with labels or drawings showing *the results or impacts of drinking contaminated water in their community.*


Source: Live & Learn

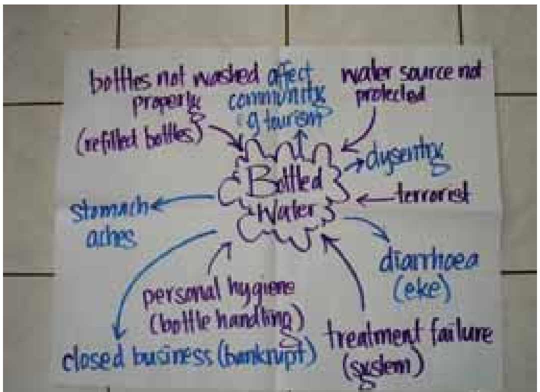
A group presenting their 'Water Source' diagram

5. Ask each group to present their drawings to the rest of the group and encourage discussion and questions. Facilitate discussion. Suggested questions to ask:

   - *What are some of the factors that might affect drinking water supplies?*
   - *What are the water-related problems faced by the community?*
   - *How do these problems affect the men, women, children and family? The community?*
   - *Are these problems easily resolved?*
   - *What are some things we can do to address these problems?*

Example of water sources identified during a Community Based Water Quality Monitoring Training for Trainers Workshop in the Cook Islands, October 2007

Water Source	Causes of contamination	Impacts of drinking contaminated water
Piped Water	Aging pipes, leakage, rusting, use of different pipe materials, poor workmanship, lack of maintenance, animal & human activities near water source, flash floods, vegetation & rubbish at water source or intake, pipe intrusion	Stomach cramps, death, typhoid, skin irritations, frustrated people, community disruption, affects education, loss of jobs, lack of hygiene, vomiting, diarrhea
Rain Water	Organic material, rat & bird droppings on roof, wind blown sprays, roofing iron & guttering contaminants, wind blown dust, industrial pollution-smoke & burnt chemical contaminants	Stomach cramps, reduction in income & education, increase in money spent on medical bills, more money spent on bottled water, rash, diarrhea
Bottled Water	Personal hygiene of those handling bottles, refilled bottles not washed properly, water source not protected, competitors disrupting system, treatment system fails	Stomach aches, affect community for example tourism, dysentery, diarrhea, affects business, bankruptcy
Ground Water	Industrial activities & pollutants, Agricultural activities, fertilizers, human wastes, septic tank leakage, solid wastes, dumps, natural geology of area, arsenic concentrations, poor pump maintenance, over-pumping, sea water contamination, wildlife contamination	Sick, diseases such as cholera, diarrhea, death and drop in population, agriculture exhaustion, economic loss in tourism & services, poor education, mutation, loss on increased costs for maintenance



Information in the table above gathered from the diagrams produced by each group

Source: Live & Learn

Water Roles

1-2 Hours

Purpose: To explore and understand the problems experienced by different groups in the community in relation to water.

Materials: Fact sheet, case study card, newsprint and markers

What to do:

1. Divide participants into three groups- men, women and youth.

2. Distribute newsprint and marker pens to each group. Ask the group to draw the picture of a man, woman or youth (according to their group) on the lower left-hand corner of the newsprint. For example, the women's group will draw a woman.

3. Draw a balloon coming out from the picture and write in it a problem faced by the group regarding water.

4. Draw more balloons coming out from the first balloon, and each balloon after to show the impacts or effects of each problem shown.

5. After creating a whole chain of balloons, get each group to present the problems they face regarding water in the community.

6. Facilitate a discussion with suggested questions:
   - *What were some of the issues raised?*
   - *Did all groups face the same problems? Why or why not?*
   - *Is there a group that faced the most problems regarding water? Why is this so and can it be changed?*
   - *Can the groups identify a link in their chain of balloons where the problem can be stopped?*
   - *Can participants relate lessons learnt in this activity to everyday life in the community? Discuss roles and responsibilities in communities.*
   - *How can we all contribute to sharing and accessing water fairly?*

Note to facilitator:

- *This activity examines how different things are connected and gives a good overview of the consequences of one problem on other sectors of society and actions for change.*
- *Issues related to limited and poor quality water are identified as well as connections with other community problems.*
- *Actions and decisions for ensuring good water access are listed.*
- *Areas for involvement of women in water decision-making are highlighted.*

Source: Live & Learn

Example of 'Water Roles' as drawn by a Women's group in Fiji

Water Responsibility
(Sum of the Parts. Used with permission)

1 Hour

Purpose: To appreciate the role we all need to play to develop responsible use of our water resources.

Materials: Newsprints or butcher's paper; drawing pens and pencils, items that represent wastes or pollutants such as stones, soil, leaves, screwed-up papers.

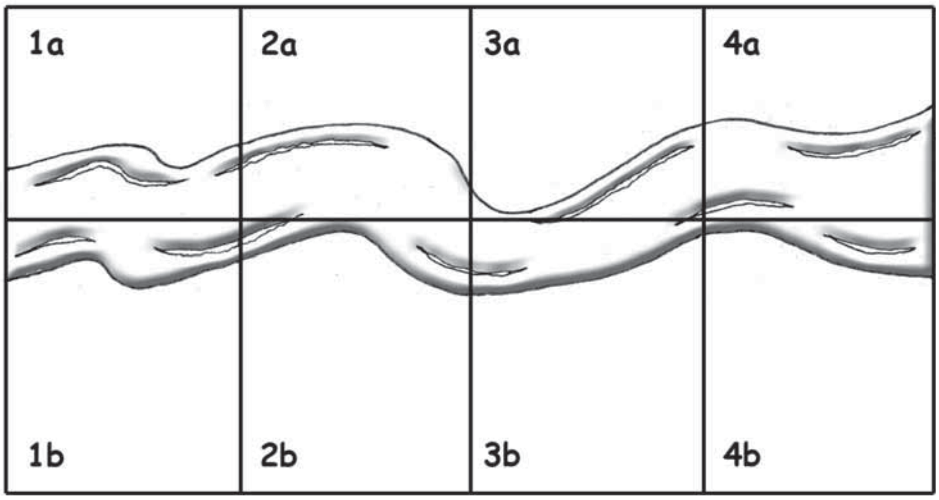
What to do:

1. You will need to prepare for this activity before the training session.

2. Using a blue marker, draw a river on newsprint or poster cardboard as shown below.

3. Each section of the newsprint should include a bit of river and blank space for riverfront property.

4. Put a number on the left hand top corner of each newsprint as shown below. You should be able to place each numbered newsprint next to the other to form one river.



Put the newsprints together and draw the river. Each piece is riverfront property. Mark the corner of each newsprint as shown. Participants should not easily notice the numbers.

5. Next, collect materials to take to the workshop or learning session. You will use these materials to represent pollutants in the river.

6. Divide the participants into 4 to 8 groups depending on the number of participants you have.

7. Give one newsprint to each group. Inform the participants that they have just been given a piece of riverfront property. How will they use it? What will they do? Group members need to discuss how they will share and develop their riverfront property and draw this on the newsprint. *The blue is water and the blank space is the land they own.*

8. Once groups have finished, ask them to look in the upper left hand corner of their property for a number. Explain that these properties are situated along the same river.

9. Starting with number 1a, ask participants to join their newsprints together. Get each group to stand next to their properties and describe how they have developed their land and how they will use the water.

10. Once groups have presented ask each group to identify any of the actions that added pollutants or wastes to the river.

11. Give groups 'pollutants' (small coloured cards, pencils, erasers, buttons etc) to add to the river to represent any wastes that come from their property. *Groups that add a lot of pollution to the river should be given a lot of items.*

12. After all groups have presented, ask group 1 to move their pollutants downstream to group 2. Group 2 then moves all the pollutants down to group 3 (downstream) and so on, until pollutants reach the group at the end of the river.

13. After all the items have reached the final group, discuss the activity:
    - *What happened?*
    - *Discuss the relationship between upstream and downstream water users. What actions upstream affect downstream water users?*
    - *What are some effects of polluting our water resources? What would happen if we continue to pollute or negatively affect our water resources?*
    - *Discuss practical ways of solving water issues.*
    - *What are the best plans or practices that could be taken to prevent waterways from pollution and degradation? What can we do to take care of our water resources?*

Water for Life

50 Minutes

Purpose: To identify necessary support mechanisms, actions and benefits for better water management and water quality monitoring in communities.

Materials: Newsprints, marker pens, paper leaves, fruits & roots *(cut out enough leaves, fruits and roots before the workshop/ learning session).*

What to do:

1. Draw the outline of a tree on newsprint and pin up on the blackboard or wall. Inform participants that in groups, they will be nurturing/building the community 'Water for Life Tree'.

2. Divide participants into small groups and give **each group 4 leaves, 2 fruits and 2 roots.** *(If they need more, they can collect extras from facilitators).*

3. Instruct participants to think about the **appropriate actions** they could implement in communities to improve water use and management, and mobilise community water monitoring. They should write these actions on the **leaves.**

4. Ask each group to come up and paste their leaves on the newsprint – they should read this out to everyone.

5. Ask participants to then discuss the **types of support** that will be needed to ensure that these actions are successful. They should write their responses on the **roots.** Attach these to the tree. (Read out first).

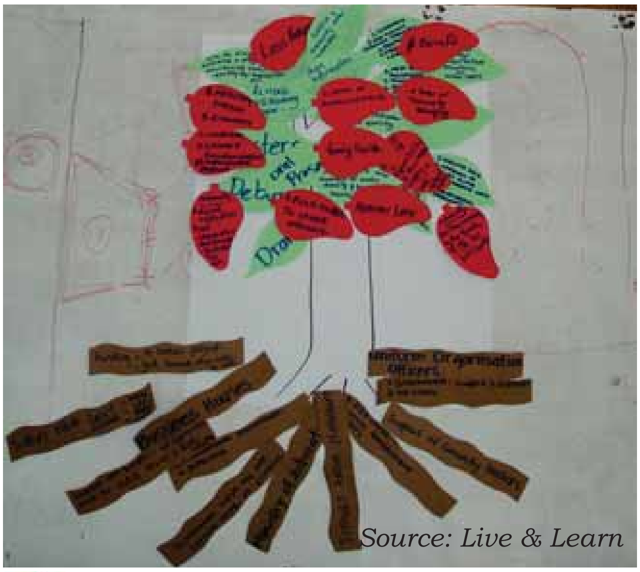
6. Ask participants to discuss the **benefits** of better water use and management, and of community water monitoring.
   What would some of the benefits be? To the community? The nation? To individuals? To the environment?
   They should write their responses on the **fruit** cards. Paste these on the tree. (Read out first).

7. Referring to the completed 'Water for Life Tree', facilitate a group discussion. Suggested questions to ask:
   - *How does the support that is received, guide the specific actions and activities that have been identified?*
   - *Why are roots important? What is the function of roots? What will happen to the tree if you remove the roots?*
   - *Using this as an example, what would happen if the things (approaches & structures) needed to carry out the actions and activities in communities are removed?*
   - *Why are the benefits represented as fruits of the tree?*
   - *Are there any specific actions that have been listed, that will be hard or challenging to do? Why? What can you do about it?*
   - *Who should be in charge of nurturing this "Water for Life Tree"?*

Community Comment: ***"...this activity is simple and effective! Very good to use for planning!"***

An example of a 'Water for Life Tree' shown below. The tree was developed at a training workshop to identify necessary support mechanisms, appropriate actions or activities and benefits of water quality monitoring in communities.
Responses from the tree are presented in the table on the right.

Source: Live & Learn, 2007


Source: Live & Learn

Tree Part	Group Responses
Leaves	Establish Water Committees & set responsibilities; Identify individuals in communities & conduct training; Collecting, recording & analyzing of water quality data; Presentation & sharing of analysed data to communities; Coordinate proposed activities; Drama; Awareness on TV & radio; Review & evaluate all activities
Roots	Financial Support from government & donor agencies; support from schools, government -National Environment Services, Ministry of Works, Department of Water Works, Ministry of Health & Ministry of Education, NGO's, business houses; Test kit supplies & equipment; Awareness support from government agencies & NGO's & Civil Society Organisation's (eg; Red Cross), Community leaders support;
Fruits	Less pollution; Monetary benefits to communities & nation; A sense of community belonging; Healthy families & community; Better quality of life: Less medical/health bills; Communities taking ownership and responsibility for their own water supply; A sense of empowerment; Role model to other nations; Regular water supply at all times; Practice conservation; Tourism boost; Cleaner environment; Better & improved agricultural produce; Healthier nation.

Water & Community

30 Minutes

Purpose: Explore the advantages of communities taking ownership of problems and participating in finding their own solutions

Materials: Nil

What to do:

Before you begin this activity, you should be aware of traditional protocol and sensitivities. The activity can be conducted with certain members of the group such as elders, chief etc playing the role of observers. Invite them to comment after the activity.

1. Ask the participants to stand in a circle, each person holding the hand of the person standing next to them.

2. Explain to the group that:
"everyone in the circle is a member of the same community. This is shown by community members holding hands- this is a rule, and you are not allowed to let go of the hands of the people standing next to you."

3. Ask the group to nominate a person who is **a good 'problem solver'** and have this person leave the circle and to go to a place (e.g. outside the room) where they cannot see the group.

4. Instruct the group to create a 'knot' of people. This must be achieved without releasing hands (this is very important). For example, people can go under someone else's arms, twist or turn around to 'tie the knot'. They should not release each other's hands while doing this.

5. When the 'community knot' is completed, invite the 'problem solver' back into the room.

6. Tell the 'problem solver' that: *"This community has a big problem – as you can see they are really tied up in a big knot. The task of the problem- solver is to solve this problem for the community. You must untangle the knot by telling them what to do. You cannot ask them for advice, physically touch anyone and they are not allowed to let go of the next person's hand. You must solve the problem as quickly as you can."*

7. Allow the problem solver 5 minutes to solve the problem. If the problem solver finds it too difficult to untie the knot, give him or her the option to give up.

8. Facilitate a discussion with the participants: Ask the group and problem solver: *Was it easy or difficult to solve the problem? Explain answers. How well did the problem solver understand the problem? Have you ever been in a situation where an 'outsider' has tried to solve a community problem? What happened?*

9. Now repeat the exercise by asking the community to make the same knot again. This time include the 'problem solver' in the knot as a member of the community.

10. Tell the group that they must solve the problem by themselves, with everyone's participation. When the group is ready tell them to untangle themselves as quickly as possible (they should not let go of each other's hands).

11. Facilitate a discussion with the participants: Ask the group:
    - *Was it easy or difficult to solve the problem. Explain answers.*
    - *How well did the group understand the problem, and how did they participate to solve it?*
    - *What are the advantages of solving a problem from within the community?*
    - *What are the advantages of community participation?*
    - *How can we relate this activity to our community water resources?*


Source: Live & Learn

Making a Difference

2 Hours

Purpose: To identify community water problems, identify causes, potential solutions, plan for action and keep track of changes.

Materials: Newsprints, marker pens, coloured cards

What to do:

1. After the groups have tested their drinking water they may want to develop an action plan to regularly monitor their water supply or to address their water issues.

2. The group can develop a work plan- this examines the issues, the effects, the causes, potential solutions, people responsible and proposed time when changes should take place. Draw a work plan table for the group using the example given below.

3. Distribute the tasks to be done amongst group members. Give out coloured card and write the name of the person responsible in the top left hand corner of the card or notepaper.

4. Give each task a deadline and stick the card onto the work plan or a calendar outline.

EXAMPLE WORK PLAN

PROBLEM	CAUSES	ACTIONS & RESPONSIBILITIES	WHEN TO TAKE ACTION	GOALS
Dirty Drinking water especially from the well and rainwater tank	***Tank***: -Dead leaves and debris from the gutter. -No sieve on the mouth of the tank -Tanks are not washed regularly - ***Well***: -Well not covered -People throwing their rubbish in the well -Cracks on the wall of the well	Set up a regular water monitoring group to ensure the following is done: ◦ Gutters cleaned; ◦ netting placed on mouth of the tank; ◦ drainage system under the tap of the tank cleared; ◦ cover for well provided ◦ cracks on wall repaired; ◦ develop plan for water monitoring and maintenance;	Plan of Action to be taken up during the Bose ni Koro and Bose ni Tikina 04/07/05	Decrease in the number of water related diseases
Leaking Pipe	-Damage tap and pipe	Repair pipe and change the tap	July	No more leaks

Note to facilitator:

- *Have regular meetings to review your work plan and fill in any missing tasks that come to mind – write a new action card for each additional task and place on the planning calendar.*
- *Review progress, as a group, on a regular basis. Cross out each accomplished task with a bold red line. Replace action cards and give a new date if behind schedule.*
- *Celebrate every small task when it gets done!*

Example: Community in Action!

The people of Naganivatu, a village community in Fiji, have been working to make a difference to their community water supply.

The dam where they access their water from is very muddy and open. Members of the community started cleaning out the mud from the dam- in some places, the mud had settled to a depth of over 1 metre. Cleaning out the dam has become a regular task.

The Headman of Naganivatu Village records all the work that the community members do together. The community members believe that their collaborative effort will help them improve their community water supply.

Community comment:

'Now we know that the solution is in our hands. It is a matter of us villagers working together in unity in trying to solve this major problem. If we work together, everything we do will be made easier'

Source: Live & Learn

Working together to clean up the dam in Naganivatu.

Wire meshing and broken pipes need to be replaced to improve the community's water supply and water quality.

Note Taking

Note Taking

Live & Learn Environmental Education

World Health Organization

Australian Government
AusAID

SOPAC

FIJI wet
Water Education for Teachers

COMMUNITY TOOLKIT

KEEPING YOUR DRINKING WATER SAFE

WATER MANAGEMENT ACTIONS

Tool for Water Management Actions

The Tool for Water Management Actions is part of the *Keeping Your Drinking Water Safe Community Toolkit* developed by Live & Learn Environmental Education. The toolkit is designed to be used by Community Trainers, Health Officers, Community Workers, and Facilitators, to raise awareness about the need to keep water clean and promote responsible attitudes, behaviour and actions to ensure safe and lasting drinking water supplies.

Live & Learn Environmental Education is thankful to those who have contributed to the development of the ***'Keeping Your Drinking Water Safe Community Toolkit'***. They include:

- The Australian Agency for International Development (AusAID), for funding the 2-year Pacific Drinking Water Safety Plan Programme, which provided financial support for production of this valuable resource.
- The World Health Organization (WHO) and the Pacific Islands Applied Geoscience Commission (SOPAC) for support, guidance and advice during the development of the toolkit.
- The Institute of Applied Science University of the South Pacific, for reviewing the scientific and technical information presented in this toolkit.
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- The Water & Sewerage Department, Curriculum Development Unit, National Water Quality Monitoring Laboratory and Ministry of Health, Fiji
- Helti Pasifik Komuniti Program, The Foundation of the Peoples of the South Pacific International (FSPI) and affiliates.

The *Keeping Your Drinking Water Safe Community Toolkit* contains:
- An Introductory Booklet containing background information and annexes
- Tool for Conducting a Water Audit
- Tool for Conducting Sanitary Surveys
- Tool on Snapshots to Monitoring Water Sources
- Tool For Water Quality Monitoring Using The Hydrogen-Sulphide (H_2S) Paper-Strip Test
- Tool on Water Awareness and Education
- Tool for Water Management Actions
- H_2S Comic and Paper-strip test Instruction Flipchart

This document is an output of a regional programme funded by AusAID, for effective management of drinking water supplies in Pacific Island Countries. The views expressed are not necessarily that of AusAID, World Health Organization and/or the Pacific Islands Applied Geoscience Commisssion.

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WATER MANAGEMENT ACTIONS

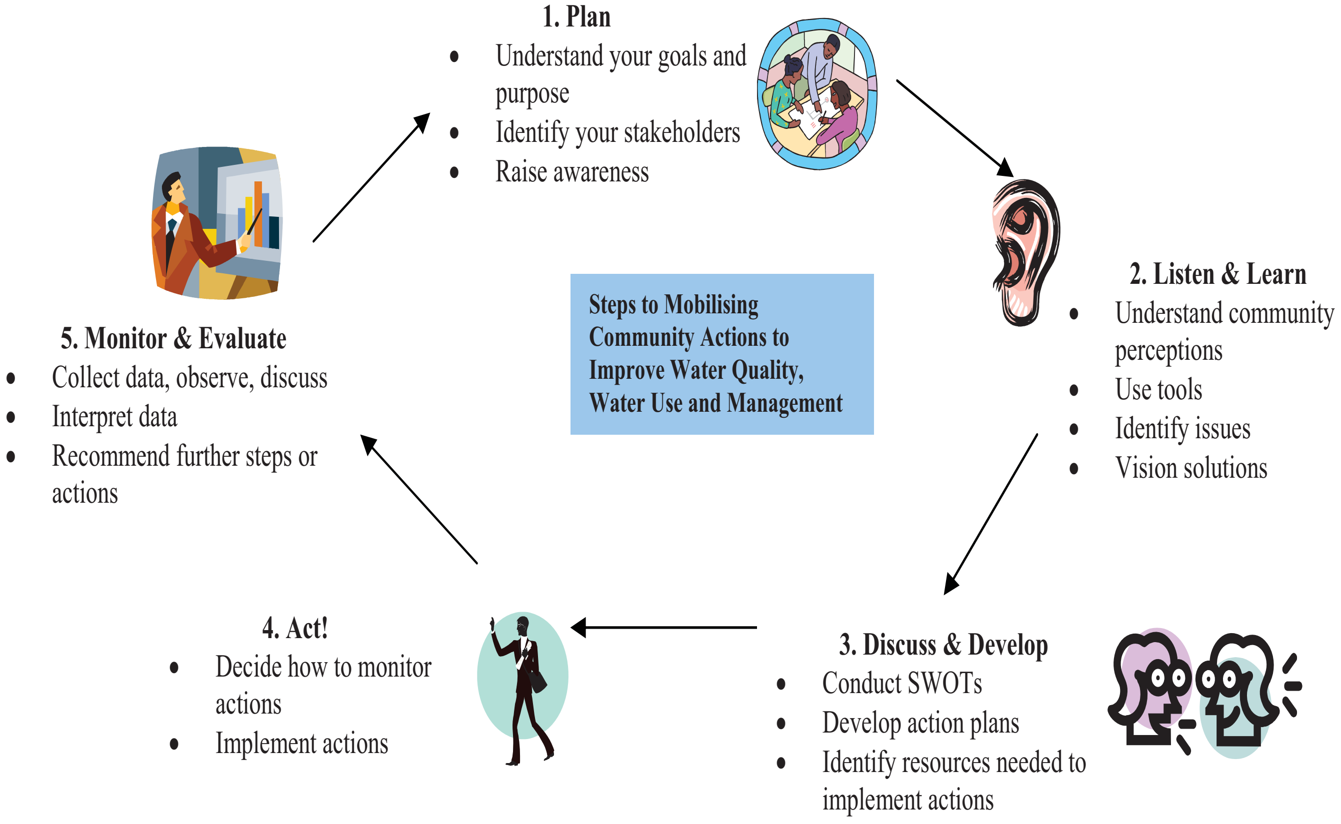
Introduction

Making a Difference!

Community water-quality monitoring builds the capacity of communities and individuals to:

- Describe water resources and identify problems faced in relation to water quality, use and management,
- Develop plans and set goals to improve water quality,
- Develop and implement actions to improve water quality and water management, and
- Evaluate the effectiveness of actions.

Steps to Mobilising Community Actions to Improve Water Quality, Water Use and Management



1. Plan

Community members need to plan and identify goals before they start implementing water management actions. Simple questions such as who, what, where, when, why, and how, can be used as a guide for planning. Some questions for the community to consider are:

- What are you going to do and why?
- What do you want to achieve?
- How will you know if you are successful?

It is important to identify stakeholders to support the implementation of community water management actions. Things to think about include:

- Who will the community work with and why?
- Are the different groups in the community represented as stakeholders? Plan for ways to get the most effective support from the community and stakeholders for water management actions and to reduce any barriers that may affect the actions.

Raising awareness in the community about water issues is important in order to get community support and promote informed decision- making. If conducting awareness raising sessions or workshops, consider:

- How long the activities will take,
- Whether the timing is suitable for all groups within the community,
- The location, skills and resources needed.

2. Listen & Learn

To effectively mobilize community action, it is important to listen and learn about different viewpoints or perceptions in the community. Keep notes on what is said by the different groups in the community, and facilitate discussions in order to get a common understanding and agreement about community needs, goals, priorities and proposed actions.

Various tools for community water- quality monitoring can be used to find out more about the water situation in the community. These and other tools such as focus group discussions, mapping and ranking, help communities to participate in identifying their problems, visioning or setting goals to improve their situation, and developing practical solutions to their problems.

3. Discuss, Develop & Act!

It is important to discuss and develop strategies to mobilize the community to take ownership for water management actions. There are often several solutions to the problems, or several actions that are proposed to address community problems. Some factors to consider when discussing and developing water management actions include:

- Is the action simple and practical?
- Does the action improve the situation?
- Does everyone benefit from it and does it help bring people together?
- What resources and skills are needed?
- Is it sustainable? Is external support needed to continue?

A good way to begin would be to list possible actions and conduct a SWOT analysis.

Example: SWOT analysis for Rainwater Harvesting Project

Strengths (positive factors)	Weakness (problems)
High, regular rainfall Tank is affordable Would supply large number of people May be able to source technical expertise from stakeholders	Lack of technical expertise Lack of skills needed to install tank-plumbing and brick layer
Opportunities (possible advantages that can be made use of in future)	**Threats (factors beyond control may influence success of projects)**
Can develop in to bigger project Encourage village members to work together May lead to skill development for youth	Cost of materials for rainwater tank and maintenance may increase Vandalism

Once actions are selected, a Community Action or Management Plan can be developed to address immediate problems and long- term goals. The plans should include timelines, roles and responsibilities. A column can be added to monitor progress.

Example: Action Plan

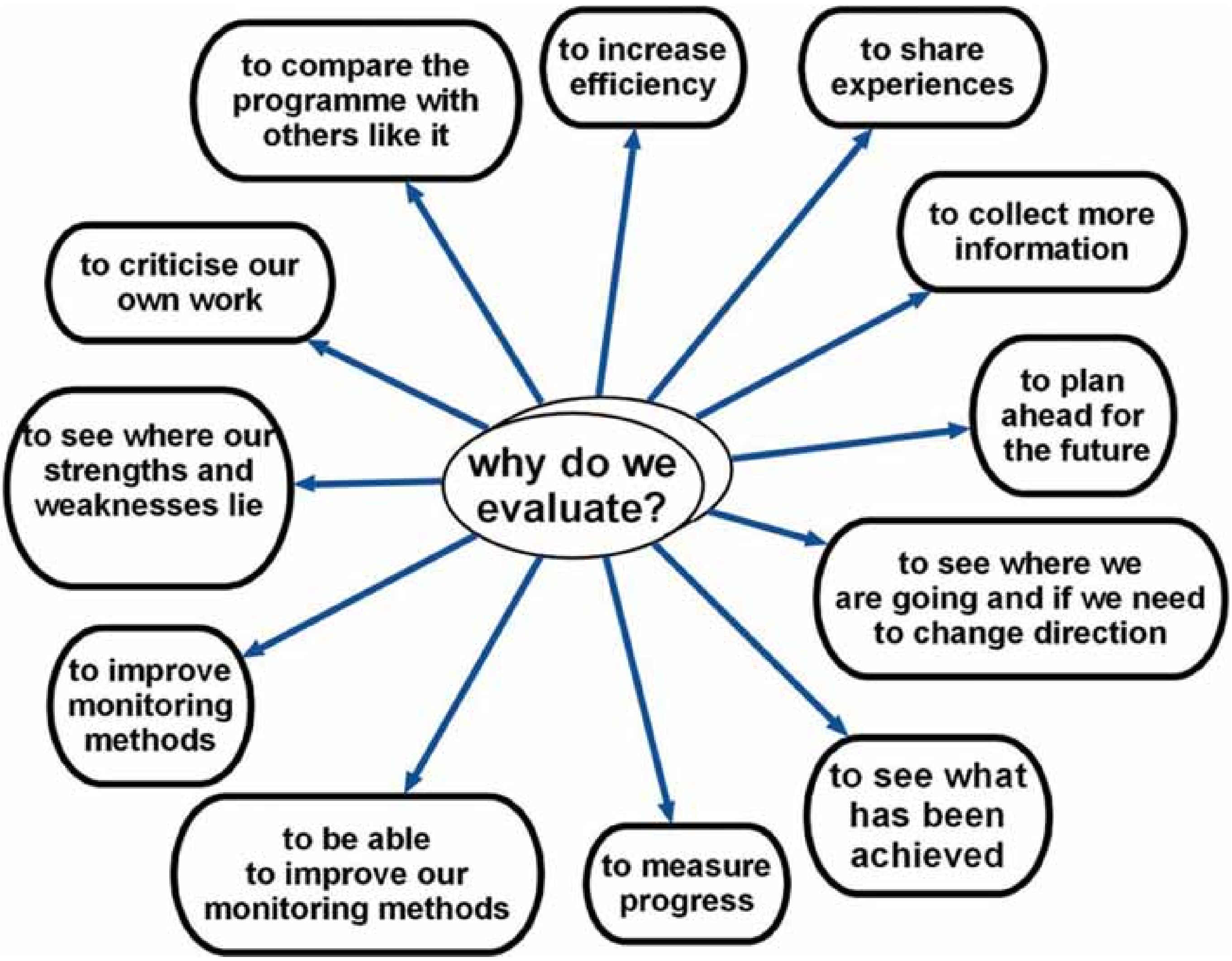
Project	Reason for change?	Who will manage it?	By when should it be achieved?	Funding?
Community compost	To reduce waste along rivers, coast and around community	Youth	December 2007	No funds needed.
Community compost piggery	To reduce animal waste flowing to the river/ sea.	Women	December 2007	Community fundraising/ seek govt. funding

Clear management structures and processes are needed. This includes clear responsibilities, accountability, decision-making process, transparency and working within existing laws. Regular meetings are important to inform community members of any developments or improvements made within the community.

4. Monitoring And Evaluating Your Progress

Consistently monitor the changes and actions that are taking place to improve water use and management. Monitoring and evaluation is important:

- It provides an opportunity for community members to reflect on their plans and their actions, and get feedback about what worked well and any changes that need to be made,
- Evaluation should be a time for group or community members to look back at what they have achieved and celebrate achievements,
- It should also be used to critically look at what didn't work, the reasons why and what the group wants to do about it.



Methods Of Monitoring And Evaluation

- General verbal feedback during meetings asking people to share their feelings and thoughts on plans and actions.
- Go through the list of expectations and ask if these have all been met.
- Distribute evaluation forms.
- Use a monitoring and evaluation checklist.

Emergency Disinfection of Community Water Sources using Chlorine

Instructions for the temporary disinfection of contaminated wells and rainwater tanks in the occurrence of a waterborne disease outbreak.

Step 1: CALCULATE HOW MUCH CHLORINE IS REQUIRED FOR DISINFECTION

To obtain the recommended safe chlorine residual of 0.3 mg/l, if using bleaching powder that is 30% chlorine, use the quantities given below.

Rainwater Tanks

Capacity of Rainwater Tank	Quality of Chlorine
Full rainwater tank of 250 litres	1 level teaspoon
Full rainwater tank of 500 litres	2 level teaspoon
Full rainwater tank of 1000 litres	4 level teaspoon

NB: Make sure that the teaspoons are level and not heaped. If the tanks are half full then use half the quantity of bleaching powder. If they are a quarter full use a quarter of the quantity and so on.

Step 2: CHLORINATING THE RAINWATER TANK OR GROUNDWATER WELL

The bleaching powder should be thoroughly mixed with 5 liters of clean water. Add the powder to the water, never the other way around.
Once mixed, the white calcium carbonate deposit should be removed by filtering the solution though a fine muslin filter. The clear solution can then be slowly added to the well and the well water and stirred.

Ground Water Wells

For A One Meter Diameter Well	
Depth of water from the bottom of well to water surface is 1 meter	ONE THIRD of a level teaspoon
Depth of water from the bottom of well to water surface is 2 meters	TWO THIRDS of a level teaspoon
Depth of water from the bottom of well to water surface is 3 meters	ONE level teaspoon

SAFETY PRECAUTIONS!

- Take care when handling bleaching powder and the solution. Do not inhale the powder.
- Wear rubber gloves, goggles and a mask when handling the powder and the solution.
- Wash any spilt solution or powder with excess amounts of water.
- Any contamination to the eyes should be immediately and thoroughly washed with fresh water and a doctor consulted as soon as possible.
- **DO NOT** store bleaching powder near any oil or diesel fuel - **if it mixes it will explode!**

- Keep all bleaching powder containers tightly closed and in a dry cool place. Store off the floor.
- Always store the chlorine solution out of sunlight and keep container covered.

*These instructions are for **temporary disinfection of community wells** and rainwater tanks. Once the rainwater tanks fill with further rain they can no longer be considered disinfected and the procedure would have to be repeated. Groundwater wells will become contaminated within several days as the water circulates if the contamination source is not identified and removed.*

SOME WATER TREATMENT TIPS

Water is treated to kill and remove dangerous bacteria in the water; and improve the colour, odour and taste of water. Types of water treatment include:

USING FILTERS or FILTERING

- This is placed over the tap and is made up of carbon.
- They are a very good way of removing dirt and chlorine from the water, but they do not remove bacteria or viruses.
- These filters should be changed regularly or bacteria will grow in them and contaminate the water.
- Do not place a cloth/fabric over the tap because it can introduce bacteria into the water.

USING BLEACH or BLEACHING

- Using laundry bleach is an inexpensive way to kill bacteria and algae in the water tank.
- Bleach your tank on a monthly basis, or if it is during rainy periods, at least once a week.
- Given below is a table showing the amount of bleach to use for the different volumes of water:

Water Volume	Regular Bleach
4.5 litres	3 Drops
23 litres	10 Drops or ¼ teaspoon
250 litres	2 teaspoons
450 litres	1 tablespoon
900 litres	2 tablespoons
2300 litres	5 tablespoons or $^1/_3$ cup
3900 litres	10 tablespoons or $^2/_3$ cup
4500 litres	12 tablespoon or ¾ cup

- The above table is based on the assumption that the water tank is full, clean and has a cover.
- If your tank is not clean, you must clean it out in order for the bleach to be effective; otherwise your tank will remain contaminated.
- To add bleach to your tank, measure it with a measuring cup and **pour it into a bucket of clean water,** then pour the bucket into the tank. This will result in an even distribution of the bleach.
- The tank must be covered and **not used for at least 2 hours** for the bleach to be effective.

- To **get rid off the smell of bleach** before drinking the water, pour the water into a clean container, filling it to the top. Put a lid on it (or cover it), leaving a small amount of air in the container and let the container sit at room temperature or leave it in the fridge overnight. By the next day, the smell of chlorine will have left the water.

BOILING WATER

- Boiling is the best way to kill bacteria, viruses and parasites.

Proper Boiling Water Procedures:

1. Choose a clean pot that is big enough to hold water and a lid that fits
2. Don't fill the pot all the way up as you need more room for water to bubble
3. Place the pot on the stove and turn the heat to high. If you want to speed the process cover the pot with the lid
4. Keep checking the pot to see how the water is doing
5. Check to see if the water is boiling and leave it to **boil for another 1 minute until you see big air bubbles.** Wait for bubbles that rise to the top of the pot
6. After boiling let it stand to cool down before pouring into a jug ready to be used.

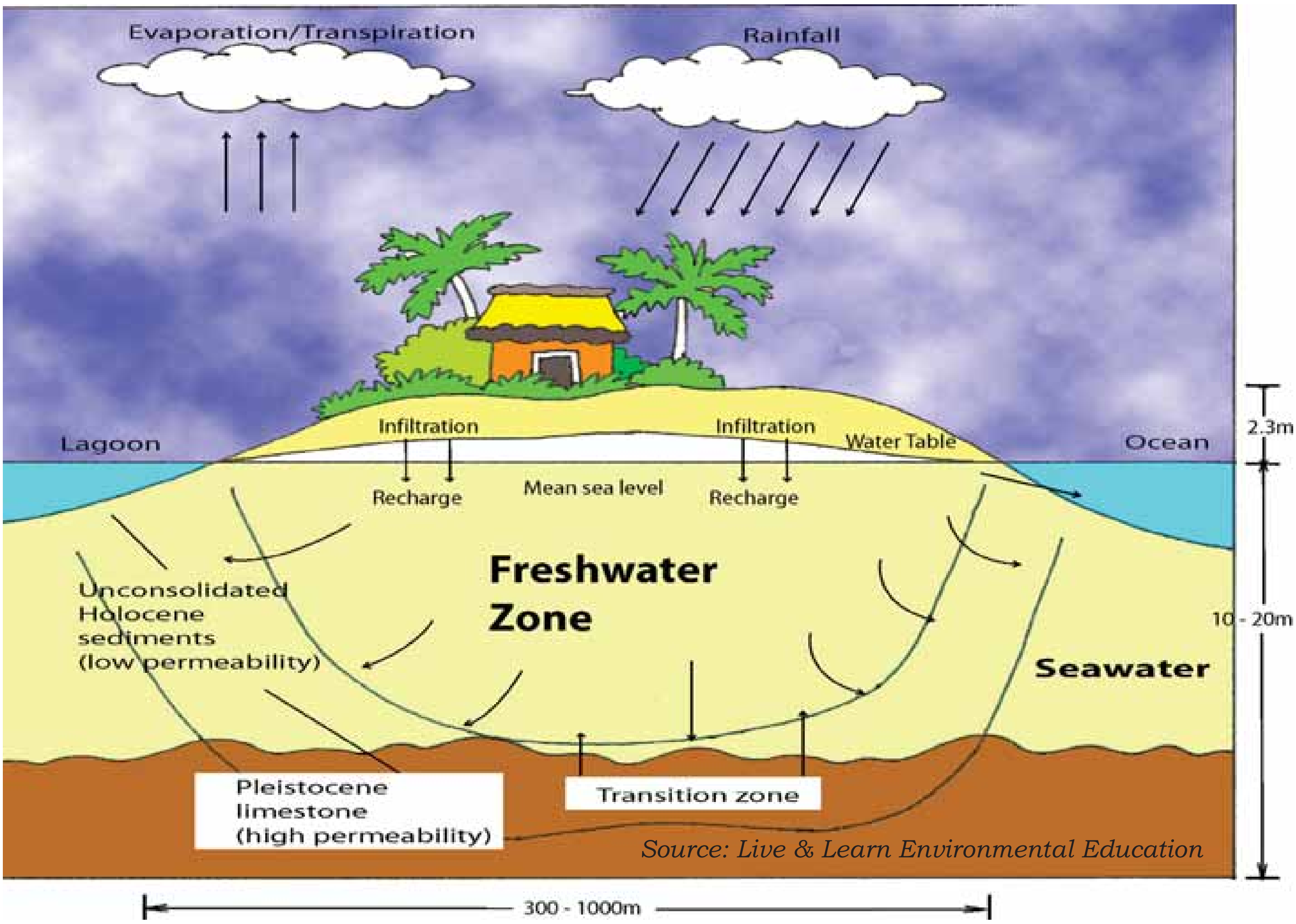
ADVANTAGES OF BOILING WATER

- Pathogens that might be lurking in your water will be killed if the water is boiled at least 1 minute at full boil.
- Boiling will also drive out some of the Volatile Organic Compounds (VOCs), bacteria and pathogens that cause water borne disease.

Maintaining Freshwater in Wells

Why Is There Freshwater In The Ground?

All small islands are surrounded by the sea that is salty. The rain, which falls on the island, is fresh. About a third of this rainfall will soak into the ground and infiltrate into the coral sand. This water collects in the sand and forms a body of freshwater. The freshwater is not very thick however (typically 2-7m on smaller islands) and floats on salt water that is underneath it, that has entered the sand below the sea level. The infiltrated freshwater eventually flows out to the sea.



Source: Live & Learn Environmental Education

Why Does The Groundwater Salinity Vary?

The freshwater body or lens is surrounded by the sea. The seawater also tries to get into the islands coral sand, but is pushed out by the freshwater entering from the rainfall. However the nearer you get to the coast the closer you are to the sea, and the easier it is for seawater to come into the land. At the coast there is a thinner freshwater lens so the groundwater becomes brakish. In general, the further inland a well is located, the greater the thickness of the freshwater lens and the fresher the water.

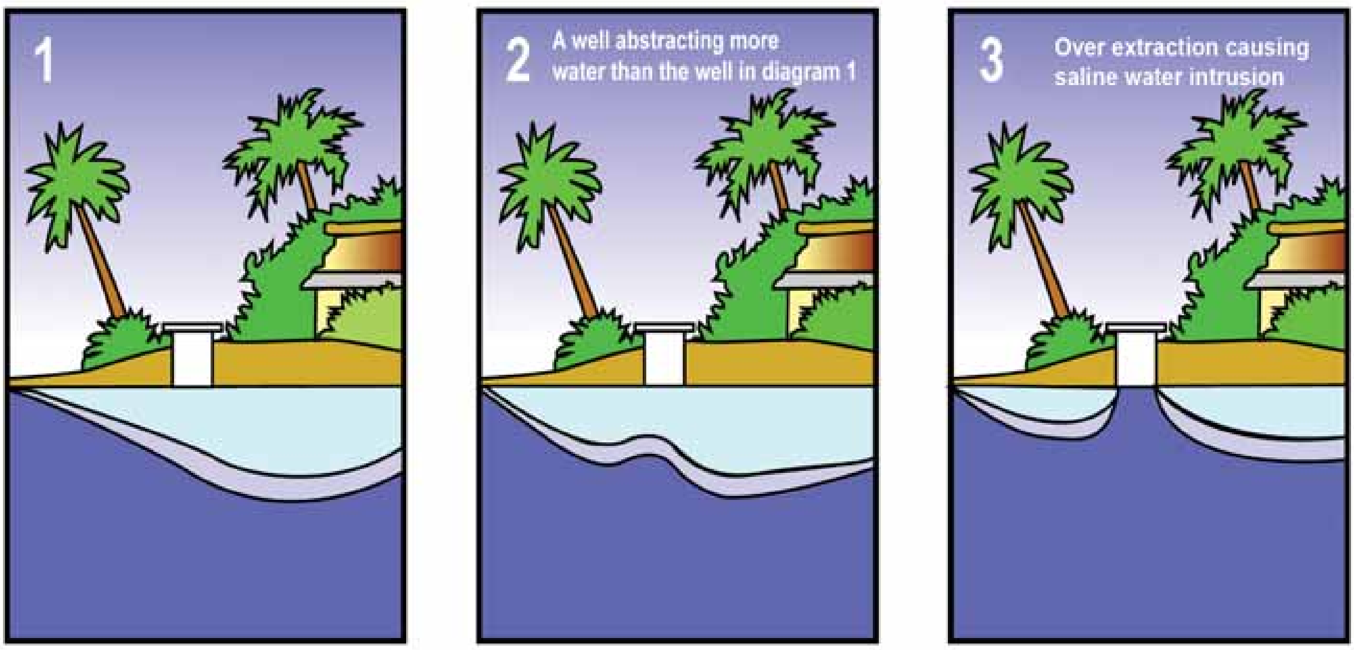
Why Does My Well Water Get More Salty During The Dry Season?

During the dry season the amount of rainfall is reduced and the amount of freshwater entering the freshwater lens becomes less. This means the freshwater flows within the groundwater are reduced and that more seawater can enter the island. The freshwater lens then gets thinner. If you live towards the edge of your island, you will notice your well water getting saltier during the dry season.

A pumped well abstracts more groundwater than a well with a bucket. This reduces the amount fresh groundwater available to push out the seawater, and so pumped wells tend to be more prone to salt water intrusion. There is a relationship between the height of the freshwater level above the sea level and the amount of freshwater in the lens below sea level. Generally for every 1cm of freshwater above mean sea level there is 20 cm of freshwater below it. So when a pumped well lowers the water level in the well by too much, the freshwater lens thickness below the well reduces and saline water comes up and into the well. This is known as saline up-coming.
The more water you take from your well, the more likely it will become saltier.

How Can I Make My Well Water Less Salty?
There are several simple things you can do to make your well water as fresh as possible. These are listed below:

- Direct your rainwater tank overflow either directly into your well or into the ground next to your well. If you are not collecting all the water off your roof for rainwater harvesting then catch the rest and route it into the well.
- Construct your well with small holes in the side of your well wall lining below the water level. This allows very shallow fresh water to enter the well. This will be fresher than water entering the well through its base alone.
- Make sure your pump is of as low an abstraction rate as possible. Large pumps will provide your water more quickly but reduce the water level in the well by a greater amount too.
- Ideally get your pump to feed a water storage tank next to your roof, and pump to it at a constant and low rate day and night. The storage tank can then provide your daily supply under gravity. This will minimize water the lowering of the well water level.
- Only take the water you need. Do not waste water.
- If you have a flush toilet, use smaller flush tanks (small 6 L tanks) as less water is required for flushing than if you use a 12 L tank.



PREVENTING WELL CONTAMINATION

Health Risks From Drinking Contaminated Well Water

Many surveys of well water show that well water is generally of worse quality than rainwater. It usually has about 100 times more bacteria in it and is 100 times more salty than rainwater. Some wells also contain contamination from septic tanks.

If you drink well water that contains too much bacteria then it will make you sick, and give you diarrhoea and vomiting. This can lead to dehydration and for vulnerable people (children and the elderly) even death.

When people get infected with diseases such as diarrhoea, typhoid and hepatitis A, their excreta will contain large amounts of the germs, which cause the disease. When people defecate in the open, flies will feed on the excreta and can carry excreta on their bodies. When they touch food excreta and germs are passed on the food. Where there are germs there is always a risk of disease.

During the rainy season, excreta may be washed away by rainwater and can run into wells contaminating the wells.

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.

Many common diseases that can give diarrhoea can spread from one person to another. Disposing of excreta safely, preventing faecal contamination of water supplies and improving personal hygiene particularly hand washing with soap (at critical times such as after going to the toilet, before eating and food preparation) would greatly reduce the spread of diseases.

Risk Of Contamination At The Well

There are a number of factors that affect the vulnerability of your well and therefore the likelihood of your well becoming contaminated. These are:

Condition Of The Well

The well consists of a circular wall, rising above ground level, and penetrating usually 1.5-2.0m into the ground. The well is usually open at the base. Any cracks in the wall will enable water to enter the well without first passing through the ground. This means water contaminated at the ground surface from household activities can get rapidly into the well.

Water often gets spilt around the well, when pouring it into jugs and bowls. Water spilling onto the ground will infiltrate back into the well and may carry contaminants from household activities with it. The concrete floor around the well must be free from cracks to avoid contamination of the well from used water.

Water used after washing may cause ponding around the well if there is no proper drainage channel to direct water away from the well.

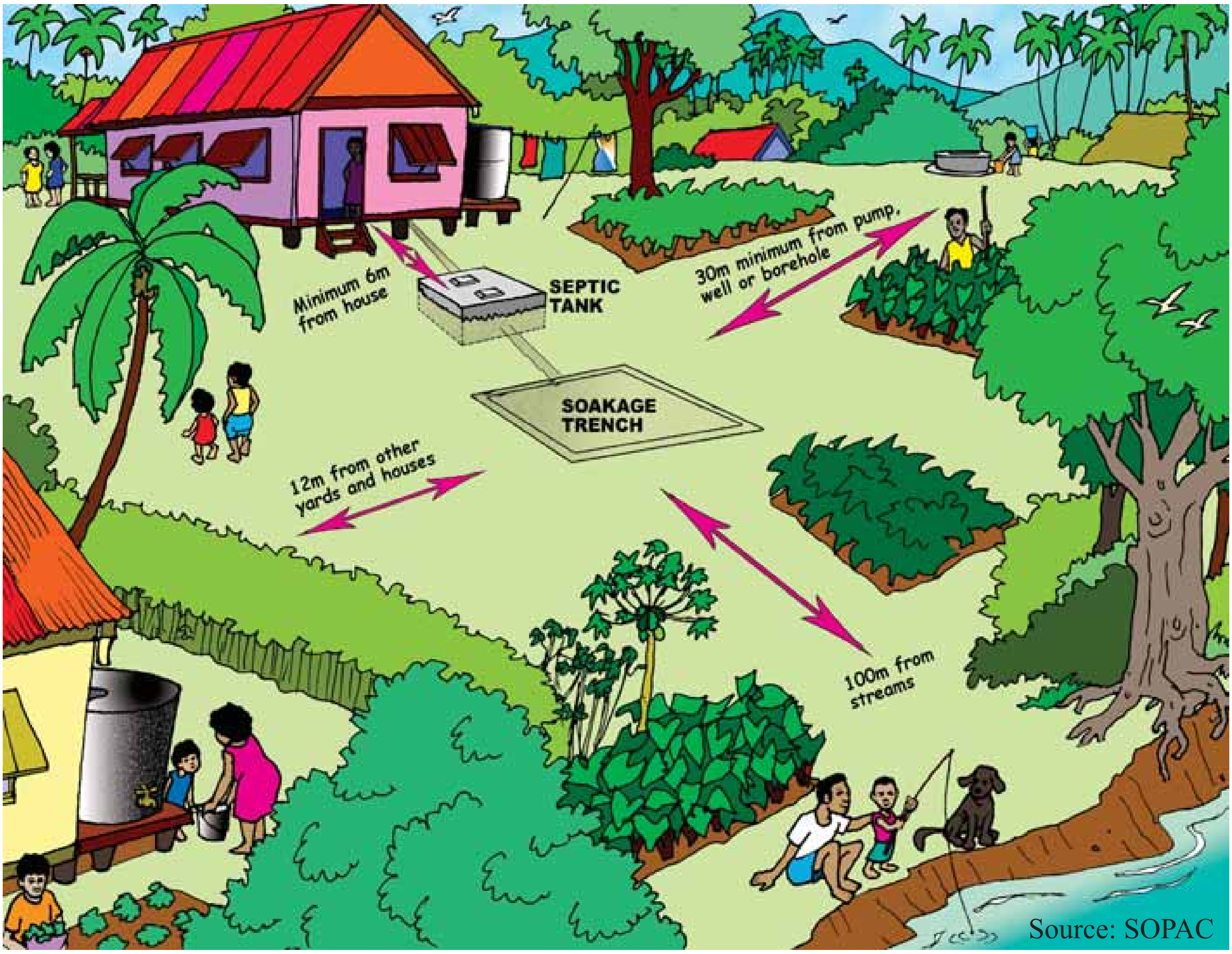
Many wells do not have a cover on them. This means insects (especially mosquitoes), small animals and debris can fall into the well.

As some people believe that children's faeces are safe and do not contain germs, proper attention is not given in disposing of children's faeces safely. Disposing of faeces or cleaning soiled clothes must not be done near the well.

Septic Tank Discharge

Surveys show that the main source of contamination of well water is septic tanks. Septic tanks discharge toilet effluent into the ground after some treatment, but the effluent that leaves the tank is still very rich in bacteria, nitrate and ammonia. These compounds contaminate groundwater.

The condition, size and maintenance of the household septic tank are contributing factors to affecting the water quality in your well. If the septic tank is cracked or broken, untreated effluent will leak from the tank into the ground. If the tank is too small for your household then the effluent will not stay in the tank long enough for it to be treated. If you don't clean out the sludge from your tank then it won't treat the effluent so effectively.

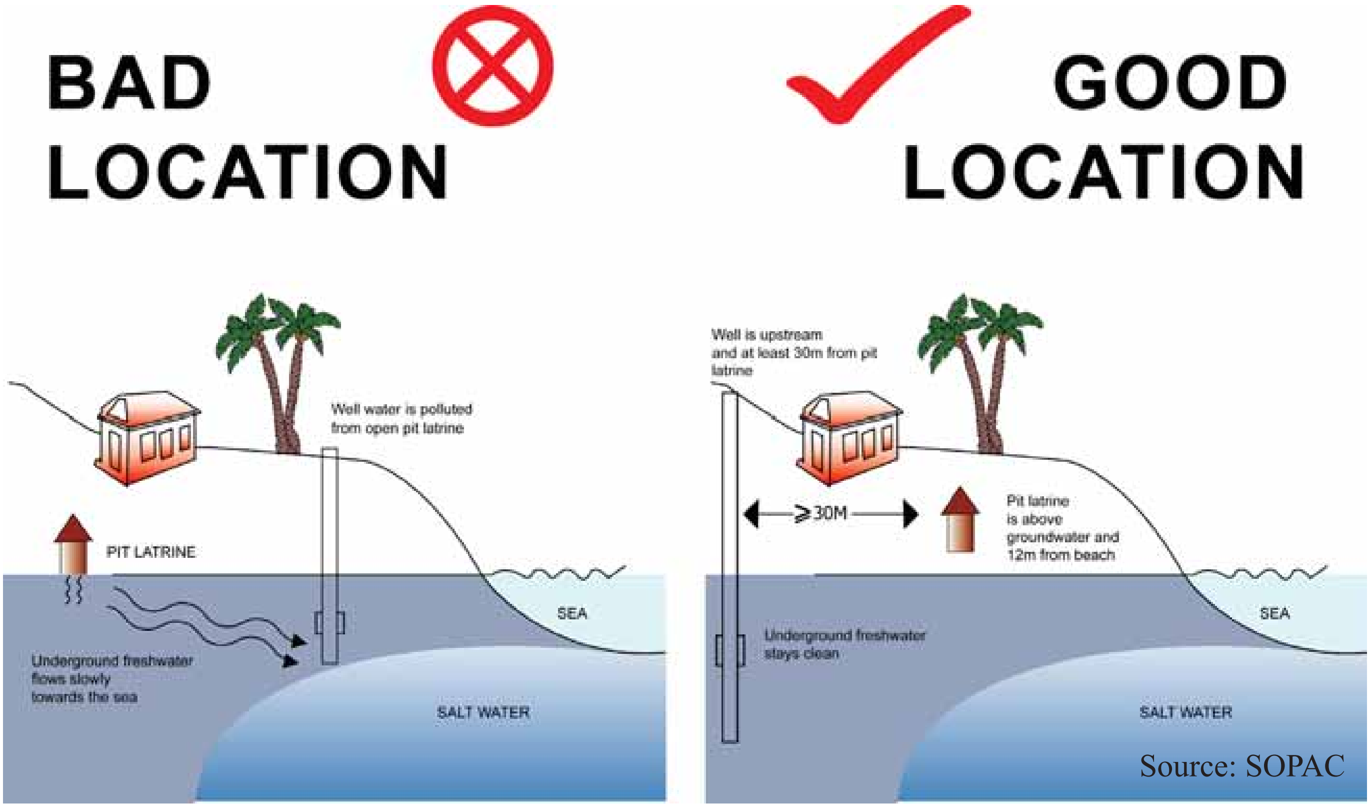


Location Of The Well

The distance your well is from sources of pollution will affect its likelihood of contamination. Any well close to the toilet/bathroom, septic tank, washing water soakage pit, rubbish pile or area of ponded water, will be more likely to be contaminated than one further away.

This means you should consider both the location of your well and the location of these sources of contamination. Wells located in the garden, near the house and away from the septic tank will be less polluted. Remember however that your neighbours will also consider these issues. You should talk to your neighbours to agree on the best location for all your septic tanks.

Ideally the septic tank should be more than 20metres from your well. The further away the better.



Additional Sources Of Contamination

There are other sources of potential contamination such as fuel oils and chemicals. Such fluids in the house should never be stored near the well (even if used for a well pump) and ideally should be stored both under a roof and on top of a concrete base. This will stop spillages getting into the groundwater. Once groundwater is contaminated with oils it is very difficult to clean up.

When fuel and chemicals have been finished with they must never be poured into the septic tank systems, but should be taken to the island waste site. Fuels and chemicals will damage the treatment provided by the septic tank and enter the groundwater.

Significant fuel stores should be stored under roofing, and on a concrete slab covered by the roofing. The slab should have a bounded edge that would enable all the fuel to be held within it should the fuel store leak. Any leak can then be cleared up and removed to the island waste site for incineration. Washing water will contain detergents. The washing water catch pit can also contaminate your groundwater but to a much lesser extent than the septic tank.

Actions To Reduce Well Contamination And Improve Well Water Quality

There are some easy steps you can take to improve the protection of your well and therefore improve its water quality. These are listed below:

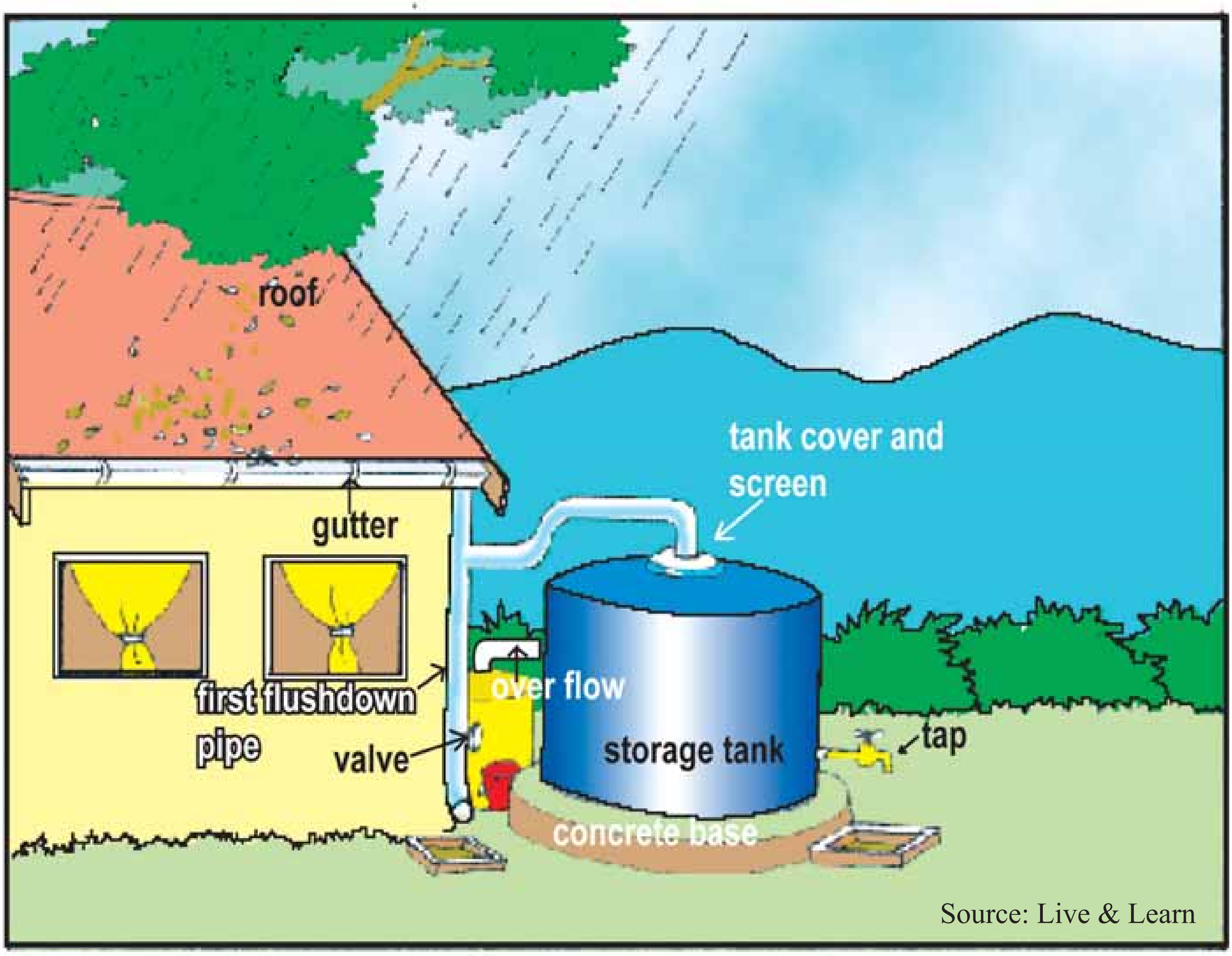
- Repair all cracks to the well walls regularly and make sure it is adequately sealed.
- Remove all debris from around the well.
- Put a metal well cover with a hinged lid on the top of the well.
- Build a concrete apron around the well, which will direct spills and rainwater away from the well. These can be channeled into pipe and flow further away from the wellhead.
- Make sure the water bucket does not stand on the floor and has a hanger to keep it in the air.
- Clean the water bucket, ideally with bleach, once a week.
- Repair any cracks seen on the septic tank.
- Empty the septic tank at least once a year of its sludge and dispose correctly.
- If you build a new septic tank make sure it is big enough for your household. Get advice from health offices on the design of your septic tank.
- If you build a new septic tank locate it as far away from your well as possible. Check with your neighbours on the locations of their wells as these might be close to where you intend to put your septic tank.
- Move the washing water catch pit away from the well area.
- Store fuel oils and chemicals away from the well area.
- If you dig a new well make sure it is near to the house and far away from the septic tank.
- Put the rainwater tank overflow pipe into the well. Rainwater has less salt and bacteria than groundwater and contains no nitrate and ammonia. The rainwater will dilute the groundwater and improve the well water quality. It will also help keep the septic tank effluent in the groundwater away from the well.
- Do not dispose garbage or excreta near the well (at least 15m).
- Repair any cracks in the concrete floor around the well.

SECURING RAINWATER DRINKING SUPPLIES

Many surveys confirm rainwater is 100 times fresher than groundwater, and 100 times cleaner than groundwater from bacteria. This is because sea water and pollution from septic tanks, fuel cans, and household chemicals cannot get into your tank, but they can and do get into your water well. Drinking rainwater from a clean protected rainwater tank will keep you healthy. Drinking well water may make you sick.

It is important therefore to make sure your rainwater harvesting is correctly sized to provide water throughout the dry season, and that you keep the roof and rainwater tanks clean. This fact sheet tells you how to improve the amount and the quality of the rainwater you collect off your roof. Maintaining this water supply is the responsibility of the household and community.

Health Risks From Drinking Contaminated Rainwater
When rain falls it is very clean and contains no bacteria and very little salt. But when it lands on your house it flows over the roof into the gutters, down the down-pipe and into the tank, and can pick up dirt and bacteria.

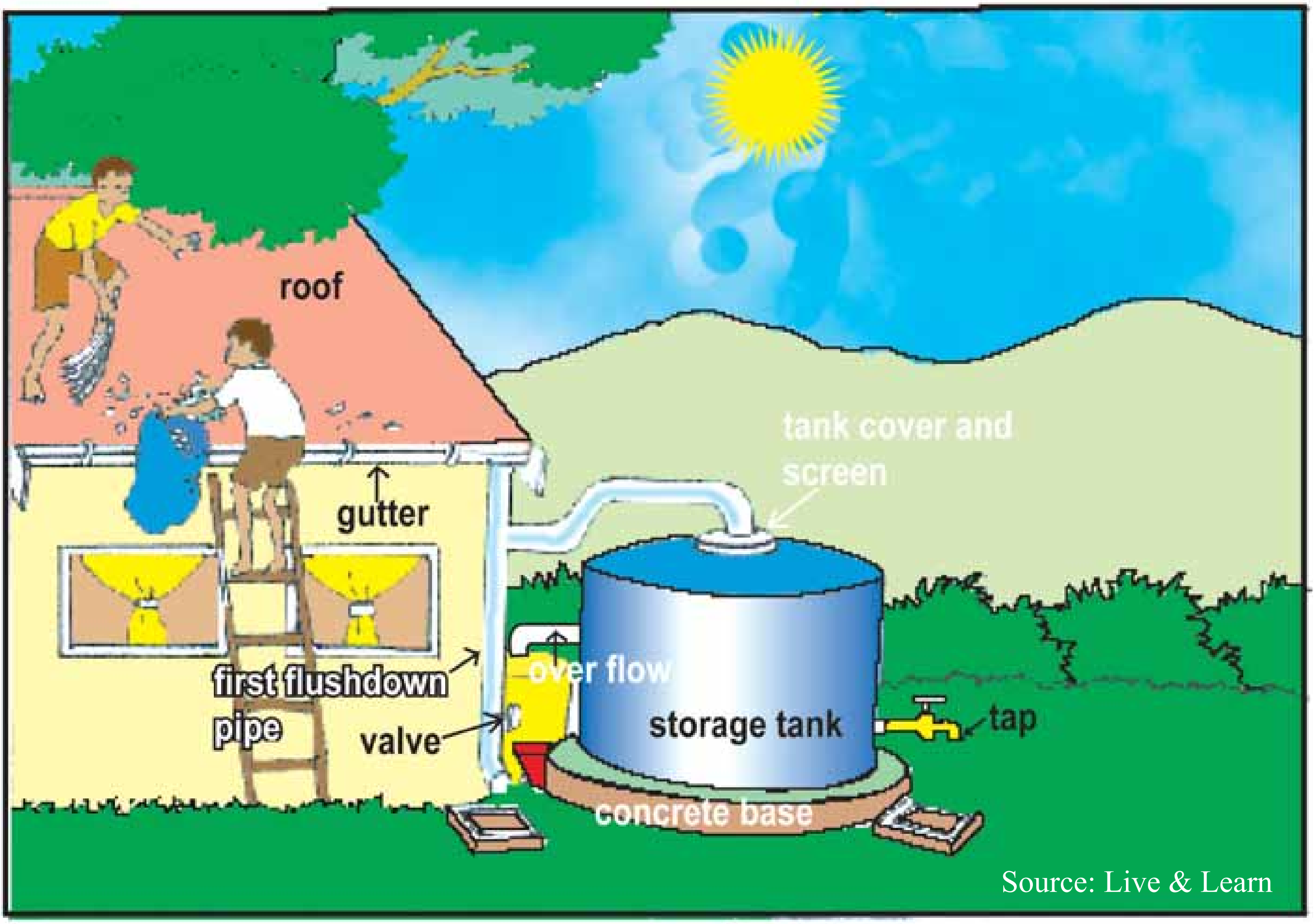


Source: Live & Learn

WHAT SHOULD BE CONSIDERED WHEN HARVESTING RAIN WATER?

Clean The Roof And Gutters

- If you keep your roof and gutters clean you will reduce the amount of dirt and bacteria going into your tank.
- You should clean your roof once a month, and your gutters once a week.
- Make sure the first flush valve is open before you wash the roof – as you don't want wash water in the tank.
- It is easier to stop the roof from getting dirty than cleaning it. Make sure no branches overhang the roof as these will attract birds, bats and insects, and allow rats to jump onto the roof. All these creatures may defecate on the roof, which will make the rainwater dirty.



Source: Live & Learn

Put On A Down pipe Filter

- Where your gutters empty into the down pipe, pests can also crawl. Put a small grill over the entrance to the down pipe. If you can afford some wire mesh, this will work well and also stop larger pieces of debris being washed into the tank.
- A filter that allows water to run through (but no mosquitoes) will be even better.
- Clean the filter each time you clean the gutter.

Use A 'First Flush' Valve

- Use a first flush valve- this is a valve which when open prevents the water from entering the tank. You should leave this valve open, when it is not raining. When it starts to rain, let the water flow off the roof and past the open-valve for 5 minutes. This prevents the dust and dirt that may be on the roof entering your tank.
- After 5 minutes close the valve and the water will flow into the tank. This water will be much cleaner than if you hadn't used the First Flush technique.
- You may also like to put another filter (or cloth gauze) on the pipe just before it enters the rainwater tank. This will stop mosquitoes and other insects getting into the tank through the open end of the first flush down-pipe.

Using a first flush device can help to maintain the quality of your drinking water.

Put the Tank On A Concrete Base

- It is a good idea to raise the tank off the ground by 20-30cm. This not only provides a good solid base for the tank to sit on but also raises the tank up, making it easier to use the tap and put jugs under it.
- Raising the tap level also tends to keep the tap cleaner, preventing domestic animals and children from touching it.
- Do not have the tap at the very base of the tank, but 10-20cm above it. This prevents the tap providing water from the very base of the tank, where debris might sink and collect.
- A draining tap can be put at the base of the tank to drain off any sediment collecting at the base of the tank. The draining tap also makes it easier to remove water after cleaning the tank.

Use A Spill Collector

- It is very likely that water will get spilt when filling jugs from the tank. Water falling onto the ground next to the tank can either start to erode the sand around the base of the tank or pond and attract mosquitoes.
- Also taps can leak. Always fix a leaking tap to save water.
- It is a good idea to construct a small concrete trough under the tap, which collects the spilt water and channels it away from the tank. This will keep the area around the tank dry and clean.

Clean The Tank

- A small amount of bacteria will still get into your tank. It is necessary to clean the tank once a year. You will need to get inside the tank and scrub the walls. If you can afford bleach, then you can mix this with water to clean the tank. You should add half a bottle (about 125 ml) of 4% active chlorine bleach for every 1000 litres of water in the tank, and let the disinfected water remain in the tank for 24 hours. If the bleach is 8% you need add half the volume above. Once you have cleaned the tank you will need to drain out the dirty water before allowing the tank to refill.
- Also keep the top of your tank clear from debris, especially around the hatch area.

Put A Filter On The Overflow Pipe

- You should make sure your tank has an overflow pipe, so that when it is full it can fill a second tank or divert water to freshen your well. If the overflow pipe is open to the air (that is if it is not in the next tank) it should be fitted with a filter to prevent insects and small animals getting back into the tank.

Making Sure Your Tank Won't Be Empty During The Dry Season

Whilst it is important to ensure the water quality in you rainwater tank is of as good a quality as possible, if your tank goes dry you won't have any water at all. Given the importance of the rainwater to many Pacific Island communities, and the poor quality of most groundwater, it is important that rainwater collection is maximised. This can be done by:

Guttering The Entire Roof Area

- Adding gutter to the rest of the roof area is very simple and costs about 10% of the value of a new tank.
- Increasing the rainfall collection area reduces the time it takes for your tank to refill. It is particularly helpful therefore at capturing occasional rain showers in the dry season to replenish the tank.
- If you double the roof area collecting rainwater from your house you can more than half the number of days the tank will be empty.
- This does mean you will have to clean more roof area, but you'll have more rainwater.

Adding A Second Tank

- Adding a second rainwater tank can increase water storage from 2500 litres to 5000 litres per household.
- Having a second tank means you will have more water when the dry season starts, and are therefore likely to have water for longer into the dry season.
- However if you do not increase your guttering and roof catchment area as well, then the two tanks will only be replenished by the same amount as one tank being fed by the same roof area.

Establishing Community Rainwater Tanks

Community tanks can be used to harvest rainwater from communal buildings such as schools and government offices. Communal tanks can be large single structures (made of ferro-cement) or a row of smaller tanks (HDPE) linked by overflow pipes. This water is very valuable as it can help the community if the household tanks become dry.

Community rainwater tanks need to be looked after the same as household tanks. In fact because the water is used less, sometimes the water quality can be poorer. This means the roof and gutters need to be kept cleaner than households. The building staff should sweep the roof every week if possible, and try to clean the roof once a month.

Because the rainwater 'sits' in the tank for much longer than a household tank the condition of the tank is very important. Some communal tanks are sheltered from the weather under their own roofs, which keeps the tanks cooler, and helps reduce contamination in the tank.

Ferro-cement tanks can be difficult to clean adequately, especially old tanks. These tanks can be lined with special plastic paints, which re-seal the tank and effectively turn them into plastic tanks, which generally ensure better water quality.

Taking Care of Your Rainwater Tank

- If the tap leaks, fix it up so you do not lose water
- Use water sparingly, particularly during the dry season or when there is a drought
- Your Rainwater Tank will only give clean, safe water if you LOOK AFTER IT!
- Don't let trees grow over your roof as you want to try and keep leaves and bird droppings from fall onto your roof and washing into your rainwater tanks.
- Plant shady bushes near your tank to help keep the water cool in the tank
- Build a fence around your tank to keep pigs and other animals away
- Regularly clean away the leaves from the top of your tank
- Make sure that you buy some extra guttering to that the whole roof will give rainwater to your tank
- If a cyclone is coming, disconnect your down pipe from the roof to the tank to stop salt water getting into your tank.

How to Clean Your Water Tank

You will need:

- Liquid chlorine (such as Dash or Janola) or chlorine tablets
- Bucket
- Brush
- Eye and hand protection (glasses, rubber gloves)

1. Drain any water in the tank to level at the tap. Transfer water to clean contaminant free storage or temporary vessel.

2. Add 1 bottle of bleach or chlorine tablets (according to the instructions) to the remaining water in the tank.

3. Climb inside the tank. Using a brush thoroughly scrub the bottom and sides of the tank.

4. Remove the water and bleach solution with a bucket.

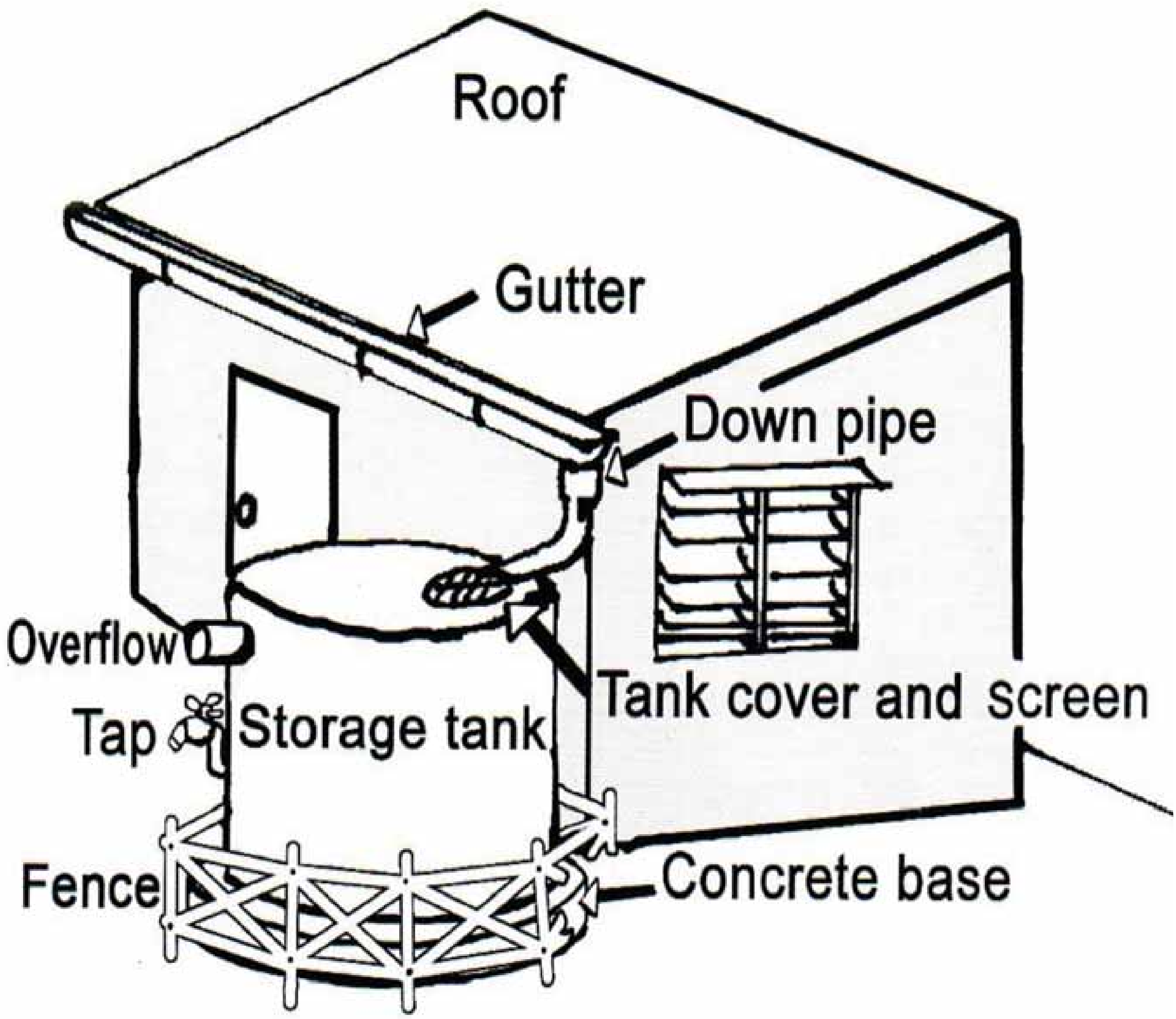
5. Refill the tank with water.

6. Leave the water to settle overnight before use.

7. Wear proper hand and eye protection when preparing and handling chlorine solutions to avoid burning skin and damaging eyes.

Remember to Clean Your Water Tank at Least Once a Year

Parts of a Rainwater Harvesting System



Adapted from Harvesting the Heavens- Guidelines to Rainwater Harvesting in Pacific Island Countries; South Pacific Applied Geoscience Commission (SOPAC); 2005

Rainwater and Health

HOW RAINWATER AFFECTS YOUR HEALTH

FAECAL-ORAL DISEASES
Organisms from human or animal faeces can reach the mouth and make a person ill and cause diarrhoea. These organisms can be spread by hands, clothes, food, as well as cups, glasses, plates and utensils used for eating and drinking.

Taps on rainwater tanks and containers used to collect and store rainwater can become contaminated and spread disease.

DISEASES SPREAD BY INSECTS
Diseases such as dengue and malaria are spread by insects.
Mosquitoes can breed inside rainwater tanks or in pools of water in gutters or beneath leaking tanks or taps and then spread disease.

DISEASES RELATED TO WATER SCARCITY
Proper bathing is necessary to stop skin diseases like scabies.
During droughts, infrequent bathing due to a lack of available water in rainwater tanks can make diseases get worse.

WATER-BORNE DISEASES
Disease-causing organisms can be present in drinking water and can cause diseases such as diarrhoea, cholera and typhoid.

Rainwater collected in the tank can become contaminated when leaves, bird or rat droppings get into the tank.

Adapted from Harvesting the Heavens- Guidelines to Rainwater Harvesting in Pacific Island Countries; South Pacific Applied Geosciences Commission (SOPAC); 2005

Contaminants Found In Rainwater Collection Systems

Contaminant	Source	Risk of entering rainwater
Dust and ash	Surrounding dirt and vegetation, volcanic activity	**Moderate:** can be minimized by regular roof and gutter maintenance and use of a first-flush device.
Pathogenic bacteria	Bird and other animal droppings on roof attached to dust	**Moderate:** bacteria may be attached to dust or in animal droppings falling on the roof. Can be minimized by use of a first-flush device and good roof and tank maintenance.
Heavy metals	Dust, particularly in urban and industrial areas, roof materials	**Low:** unless downwind of industrial activity such as a metal smelter and/or rainfall is very acidic (this may occur in volcanic island)
Other inorganic contaminants (e.g. salt from sea spray)	Sea spray, certain industrial discharges to air, use of unsuitable tank and/or roof materials	**Low:** Unless very close to the ocean or downwind of large-scale industrial activity.
Mosquito Larvae	Mosquitoes laying eggs in guttering and/or tank	**Moderate:** if tank inlet is screened and there are no gaps, risk can be minimized.

Adapted from Harvesting the Heavens- Guidelines to Rainwater Harvesting in Pacific Island Countries; South Pacific Applied Geoscience Commission (SOPAC); 2005

Maintenance & Repair of Rainwater Harvesting Systems

Parts	Ongoing maintenance and repairs	How Often?	Materials	Tools
Roof	Wash off roof with water when dust/dirt accumulates diverting runoff away from tank inlet. Trim and cut trees around tank. Replace rusted roofing. Fix holes for maximum runoff. Paint if rust is present using lead-free paint.	Check monthly and especially after long period of dry weather and cyclone and heavy wind. When required When required When required When required	o Roofing iron o Paint o Water	o Hand saw o Nails o Hammer o Brush
Gutters	Clean and washout bird droppings, leaves, etc. with water. Check and repair gutters. Add more guttering to increase water collected. Ensure guttering is slanted to ensure steady flow of water to avoid pooling of water, collection of dirt, debris, etc.	Check monthly and especially after a long period of dry weather and cyclone or heavy wind. When possible When possible	o Water o Guttering o Gutter hanger o Gutter fittings	o Brush o Screwdriver o Screws o Hammer o Nails o Level
Tank	Clean. Repair leaks. Disinfect. Cut nearby tree roots. Ensure lid is sturdy and secure to prevent animals and children from falling in.	Once a year When required When contaminated When required When required	o Water o Disinfectant o Cement o Sand o Gravel o Proper lid	o Brush o Shovel o Wheelbarrow o Saw o Trowel

Parts	Ongoing maintenance and repairs	How Often?	Materials	Tools
Tap	Fix leaking taps. If new taps are needed brass taps are stronger. Sponge out excess water to ensure it does not pool or collect under tap. Place stones or gravel on bottom of collection area to help drainage.	When required When required When required	○ Tap ○ Washer ○ Plumbing tape ○ Glue ○ Rubber ○ Stones / gravel	○ Spanner ○ Wrench ○ Pliers ○ Screwdriver
Downpipe	Repairing holes and replace if screen is damaged. Ensure there are no gaps where mosquitoes can enter or exit. Repair leaks at elbows.	When required When required When required	○ Stainless steel wire mesh ○ Twine ○ PVC pipe ○ Glue	○ Pliers ○ Tin snips
Overflow	Securely fasten mosquito screen over the end of the overflow pipe/valve. Ensure there are no gaps where mosquitoes can enter or exit. Repair screen if damaged.	When required When required When required	○ Wire mesh ○ Twine	○ Pliers ○ Tin snips
Fence	Ensure fence is high and strong enough around tank and collection area to keep out pigs, dogs and small children. Repair any gaps or damage to fence.	When required When required	○ Fencing wire ○ Poles	○ Nails ○ Hammer ○ Digging hoe
First Flush Devices	Remove downpipe from tan inlet to divert water. Securely replace the downpipe after first flush.	Before starting to collect water, and especially after a long period of dry weather, a cyclone or heavy wind.	○ PVC pipe ○ Pipe fittings	○ Pipe wrench

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Advantages And Disadvantages Of The Rainwater Harvesting Systems For Domestic Water Supply.

Advantages:	Disadvantages:
1. **Convenience** – Provides a supply at the point of consumption. 2. **Good Maintenance** – The operation and maintenance of household catchments systems are under the sole control of the tank owner's family. 3. **Low Running Cost** – These are almost negligible. 4. **Relatively Good Water Impact** – Better than traditional sources, especially for roof catchment. 5. **Low Environment Impact** – Rainwater is a renewable resource and no damage is done either to the environment or to future supplies through its introduction. 6. **Reliable Supply** – Rainwater is readily available, depending on how often it rains. 7. **Simple Construction** - The construction of rainwater catchments systems is simple and local people can easily be trained to build these by themselves. This reduces costs and encourages community participation. 8. **Flexible Technology** – Systems can be built to almost any requirement. Poor households can start with a single small tank and add more when they can afford it.	1. **Expensive** – When compared with alternative water sources, where these are available, the cost per litre for rainwater is frequently higher. 2. **Supply is Limited** – Both by the amount of rainfall and size of catchment area. 3. **High Initial Costs** – The main cost of rainwater catchment systems is always wholly incurred during the initial construction, when a considerable capital outlay is required. 4. **Unattractive to Policy Makers** – Rainwater projects are always far more bulky to administer than single large projects, e.g. dam. 5. **Supply is Easily Affected by Droughts** – Occurrence of long dry spells and droughts will adversely affect the performance of rainwater harvesting systems. 6. **Water Quality Vulnerable** – The quality of rainwater may be affected by air pollution in the surrounding areas of certain industries. Contamination from animals or bird droppings, insects, dirt and organic matter can also be a problem.

Adapted from Harvesting the Heavens- Guidelines to Rainwater Harvesting in Pacific Island Countries; South Pacific Applied Geoscience Commission (SOPAC); 2005

Checklist For Assessing The Appropriateness And Viability Of Rainwater Harvesting

Desirable pre-conditions for rainwater harvesting projects.	Check	Remarks
Technical Feasibility ▪ Is the rainwater and catchment area sufficient to meet demand? ▪ Is the design appropriate? ▪ Are skills or training potential available locally?		
Social and Economic Feasibility ▪ Is there a real need in the community for better water provision? ▪ Is the design affordable and cost – effective? ▪ Is the community excited and fully involved? ▪ Has the community experiences with previous projects been positive? ▪ Is the community united in supporting rainwater harvesting?		
Environmental Feasibility and Health ▪ Will the project have an acceptable level of environmental impact? ▪ Is the project designed to enhance the environment? ▪ Will the project improve both the quantity and quality of water available? ▪ Will the project have a positive impact on the health of the community?		
Alternatives Considered ▪ Have all reasonable alternatives means of water provision been investigated? ▪ Has consideration been given to using more than one alternative in combination?		
Institutional Arrangement ▪ Does the community have the capacity to manage the development and operation of the system? (structure, system, knowledge, skills, etc) ▪ Are there adequate local humans resources to ensure the project continues to function effectively once any external agency assistance is withdrawn?		
Traditional and Current Practices ▪ Has traditional rainwater harvesting practices been considered? ▪ Have existing approaches to rainwater utilization and possible upgrading been investigated?		

Guide To Sizing Of Gutters And Down Pipes For Rainwater Harvesting System In Tropical Regions & Lessons Learnt

Roof area (m^2) served by one gutter	Gutter width (mm)	Minimum diameter of down pipe (mm)
17	60	40
25	70	50
34	80	50
46	90	63
66	100	63
128	125	75
208	150	90

Lessons learned on system components and design.

- Select tank material based on comparison of price, durability, availability and community's preferences.
- To ensure that tanks are durable, good quality clean, construction material, which meets the required specifications, must be used.
- A solid foundation is essential for surface rainwater tanks and this can also double up as the tank floor. A 02-04 cm reinforced – concrete slab cast in two layers on the same day is normally sufficient.
- Tank walls can be constructed in several ways, including using bricks, blocks or concrete poured in situ, and Ferro-cement.
- Proper constructions of gutters are essential and these must slope evenly towards the tank.
- Apply simple-flush systems such as the manual or semi-automatic methods.
- Ensure the installation of an access manhole, screen, overflow and also a fence when required.

Lessons learned on operation & maintenance

- Rainwater harvesting systems that are well constructed, operated and maintained will provide good quality drinking water without the need for further treatment.
- Regular inspections of the system helps to maintain the water quality
- Integrate water quality testing in follow up activities.
- Identify the necessary tasks to maintain and repair rainwater-harvesting systems.
- Awareness should be raised on the relation between water, hygiene health.
- Perform simple absent-present tests like the H2S test and use results to raise awareness in the community
- Funding mechanism for ongoing maintenance and repair should be identified as part of rainwater harvesting projects.

Adapted from Harvesting the Heavens- Guidelines to Rainwater Harvesting in Pacific Island Countries; South Pacific Applied Geoscience Commission (SOPAC); 2005

Comparison Of Different Storage Tank Types

Tank type	Indicative price	Capacity	Life Expectancy	Notes
Ferro-cement (Demonstration project Tonga) Ferro-cement (Contractor Fiji)	\$2,500 FJD for $11m^3$ \$2,000 FJD for $11m^3$	Up to $150m^3$ but typically less than $12m^3$	If well built with good quality materials and maintained, can be 50+ years.	Tank built on site Larger sizes needs welded mesh or bars and roof supports Minimum 8 days for installation.
Concrete	\$5,000 FJD for $10m^3$	If well built with good quality materials and maintained can be 50+ years	Can be pre-fabricated or cast on site	
Corrugated galvanized steel	\$900 FJD for $10m^3$	Up to $25m^3$	Can be less than 2 years in corrosive environments but typically 5-8 years. Well maintained painted tanks can reach 20 years but this is not typical	Corrosion can be a problem galvanized tanks should be painted inside and out to prolong life and are not suitable for coastal areas.
Polymer – coated steel	\$1,300 FJD for $10m^3$	Up to $10m^3$	Tanks designed for rainwater storage have 10 – 20 year manufacturers warranties depending on location	
Plastic/HDPE	\$2,500 FJD for $10m^3$	Up to $25m^3$	15 – 25 years Limited experience past 15 years but some manufacturers now provide 25 years warranty	No joints, lightweight, non – toxic food grade PE

Fibreglass	$2,700 FJD for 10m³	Typically less than 20m³	Minimum 25 years claimed by manufacturers	Complete with inlet, outlet and overflow connections
Brick and Blockwork	$2,000 FJD for 10m³	Up to 6m³, if reinforced up to 175m³	Variable depending on design and local conditions and materials. Some designs have failed within 2 years while others have lasted more than 20 years	Constructions on site usually utilizing local skills and materials. Uses more cement than equivalent sized Ferro-cement tanks
Wood	$4,400 FJD for 11m³ (excluding freight ex-NZ)	Up to 100m³	Manufacturer claims 80 years for the tank and 25 years for the liner.	Constructed on site, can use local labour under supervision. Concrete ring – beam foundation required.
* These prices are estimates for Fiji in 2004. 1 FJD = USD 0.60. Costs for pre-fabricated tanks do not include transport to site or cost of any foundation requirements. Prices will vary greatly with time and location and cost estimates for individual projects should always be calculated based on local conditions.				

Adapted from Harvesting the Heavens- Guidelines to Rainwater Harvesting in Pacific Island Countries; South Pacific Applied Geoscience Commission (SOPAC); 2005

Managing Wastewater

Wastewater can be used to flush toilets, water gardens and even wash clothes. To reuse wastewater helps reduces water bills, uses less water resources, and cuts down the amount of pollution going into our waterway.

There are two types of wastewater

- **Blackwater** – is the term for sewage from toilets. It is best treated in septic tanks and directed to sewers.
- **Greywater** – is wastewater from showers, basins and taps. Greywater can require less treatment than blackwater. Greywater can be reused indoors for toilet flushing and outdoor for garden watering.

Greywater

The quality of your recycled water depends on your treatment system, the water's "first use" and which chemicals are used in the home. To reduce your treatments you need to:

1. Minimize use of cleaning chemicals and use natural cleaning products such as vinegar, salt or lemon.
2. Do not dispose of household chemicals down the sink.
3. Use a sink strainer in the kitchen to help prevent food scrap and other solid materials from entering your wastewater.
4. Use a lint filter on the outlet from your washing machines.
5. Use phosphate –free liquid or environmentally friendly detergents.
6. Pre-filter to remove solids by using plumbing features such as sinks or strainers.

Re-using wastewater for flushing of toilet will save approximately 65 liters of potable water in an average household a day.

Precautions

Greywater must be treated first and disinfected before storage and general reuse because:

- It contains significant amount of pathogens which spread disease;
- It can not be stored for longer than a few hours untreated as it begins to turn septic and smell.

Treated wastewater can be reused to water gardens. Avoid watering fruits and vegetables with re-cycled water if they will be eaten raw.

Banana Circles- A Practical Wastewater Management Activity

A Banana Circle is a simple composting method where several banana trees are planted around a hole filled with any plant or organic waste, for example weeds, cut grass, pieces of sticks, etc. Sometimes grey water from the kitchen and laundry is piped into the hole to feed the banana roots. This circle can result in the growth of a healthy supply of bananas.

Steps to Setting Up the Banana Circle

Step 1

Decide on the best place for your banana circle. The circle will be about 2 meters in diameter and will require a lot of water. It can be located at anyplace where there is an overflow of water (from rainwater tanks, washing machines, or any other waste grey-water that doesn't contain harsh chemicals.)

Step 2

Dig a large hole 2 meters in diameter and approximately 80cm deep.

Step 3

Find some bananas! Or more specifically, find some banana suckers. You can easily get these off from people who already have banana plants. You are looking for the small ones about 50cm in height. You will need 7. Don't be worried about pulling them out without soil around them. They are very hardy and will take to their new surroundings easily.

Step 4

Evenly distribute your banana suckers around the perimeter of the hole (and not inside of the hole) and plant them into the mound of soil you have created. Water them in well.

Step 5

Fill the hole with mulch, kitchen scraps, and any vegetation you can find. Spread these materials well around the bananas too, so that in the end you can't see a difference between where the bananas are planted, and the hole. Keep plenty of mulch in the hole always.

Step 6

Fill the hole with as much water as you can. The bananas will suck it up and grow according to how much they get! Put all your kitchen scraps, garden vegetation etc into the banana circle. It'll be used as fertiliser.

Step 7

Each banana plant will give you one bunch of bananas. It will never fruit again, so cut it down at the base, mulch all of it up, and feed it back into the hole. Each banana will throw suckers as it is growing. Cut them all off until it has fruited.

Once it has fruited, allow one sucker per plant to grow. Decide which direction around the perimeter you want your bananas to grow (it doesn't matter which way you go, but be consistent with all the plants) and allow one sucker per tree to grow.

Case Study on Wastewater Management

Rubbish Pits and Wastewater Pits

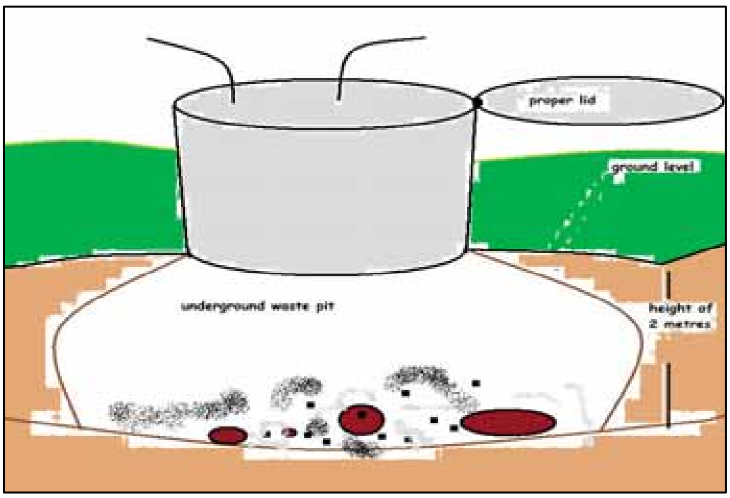
The community of Nailega in the District of Namalata, Tailevu was concerned with the growing number of people throwing bags of rubbish into the nearby river. Litter has been a major issue in the community. This was discussed in the monthly village meeting and the community decided to look into the matter and develop plans to minimize the problem.

It was realized in the meeting that some households do not have proper waste pits. The community developed a waste collection plan. Rubbish pits and wastewater pits were built for each household. They also built a rubbish pit for the community centre. The community centre rubbish pit has a lid and is only used when functions are held at the community center.

Construction of a Waste Pit:
When constructing a waste pit, communities used the model that was introduced to them by the Health Inspectors responsible for their communities. They used rejected drums and dug a two meter hole to install the drum. A lid made out of flat iron sheets was welded to the drums to protect flies from flying in and out of the pit. The drum was painted and a Waste Committee was formed to be responsible for the maintenance and care for the waste pits. The waste pit installed for the community hall had a lock to stop people from dumping their rubbish in it.

Construction of a Wastewater Pit:
Construction of the wastewater pit is similar to the waste pits except that the wastewater pits have pebbles and rocks placed at the bottom of the pit. This pit is designed for wastewater only that is discarded from kitchens. This includes wastewater from the sinks, water from cooked food like cassava and taro. Often, people would dispose wastewater into drains or the edge of the homes.

These are images of how the Wastewater (Banana Circle) and Waste Pit would look like.

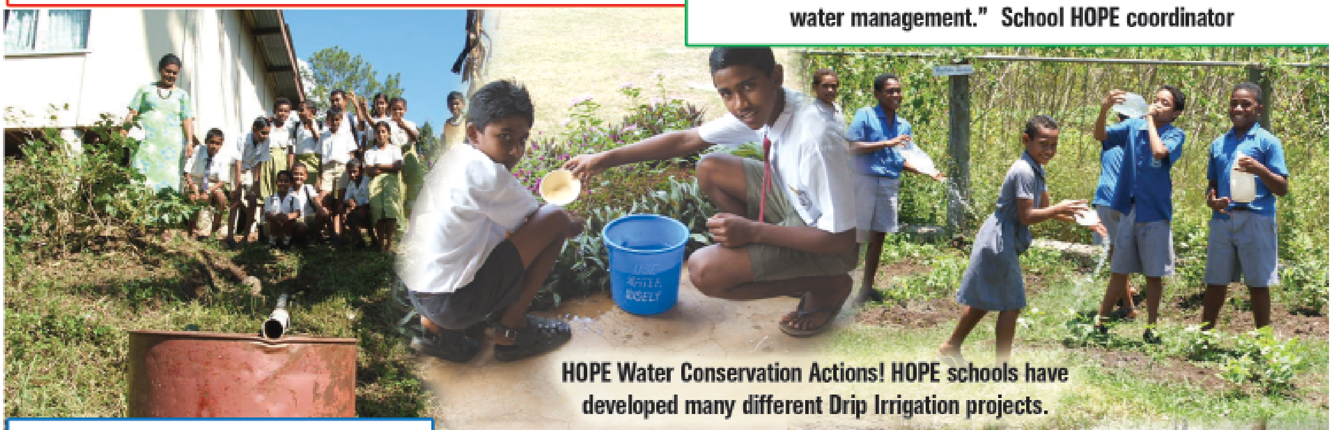


Snapshots From HOPE (Helping Our Planet Earth) FIJI

Water Saving schools!

Boubale Primary School success story is focused on wastewater management. According to school HOPE teacher, "as part of HOPE this year we made a trough using old drums to collect water. The children use this to water the flowers around the school compound. This has really helped to reduce our water bill! Children manage water and have been encouraged to practice this at home."

At Naduna Arya Primary School, a lily pond was constructed for HOPE 2005. The water from the gutters was channeled into the pond, which also has fish.
"Since HOPE began students have become more aware of the need to conserve water, particularly in dry season. Future plans for the school include more water conservation and waste water management." School HOPE coordinator



HOPE Water Conservation Actions! HOPE schools have developed many different Drip Irrigation projects.

At St. Augustine's Primary School used-- water from the taps flowed into a drum of sand which was filtered out into a separate drum and used for watering the gardens.

At Uluibau District School, drums have been placed under the taps collect waste water to use in the gardens. Water is also drained into nearby dalo plantations

Innovative efforts from HOPE schools to better manage water and waste water! Water conservation activities have created major changes in HOPE schools. Students are more aware of the need to protect their precious water resource!

Snapshots From HOPE (Helping Our Planet Earth)

HOPE Actions - promoting Water for Life

HOPE encourages students to practice good environmental stewardship!

Lily pond at Lomolomo Public School. Also like many other HOPE schools, Lomolomo students drained water from taps to gardens and planted vegetables on slopes to combat soil erosion.

Nagigi Indian School uses a bore hole as their water supply and students are taught to use their water wisely and every child has a water bottle which they use to wash their hands over their flower gardens so waste water goes directly to the taro patch.

- Stop all leaks! Check community water supply system from reservoir to taps in homes for leaks.
- Plant the right plants; use native plants, these are suitable to local climate and will have natural mechanisms to absorbing appropriate amounts of water.
- Water only what your plants need - do not water plants just after rain or on windy days
- Remove weeds and unhealthy plants so remaining plants can benefit from the water saved.
  In many cases, older, established plants require only infrequent irrigation. Look for indications of water need, such as wilting, change of color, or dry soils.
- Time watering, when possible, to occur in the early morning or evening when evaporation is lowest.
- Turn off unnecessary taps
- Repair dripping taps, showers and continuously running or leaking toilets (check washers).
- Reduce the water used in toilet flushing by installing toilet tank displacement devices - bottles, or bags. Use the half flush button on the tanks
- Recycle rinse water from the kitchen sinks in gardens.
- Do not use running water to melt ice or frozen foods. If necessary, use basins filled with water.
- Pre-soak utensils and dishes in ponded water instead of using a running water rinse
- Wash vegetables in basins of water; do not let water run!
- If using a washing machine, only wash full loads of clothes or change the machine settings to suit your load of clothes!

LIVE & LEARN ENVIRONMENTAL EDUCATION

World Health Organization

Australian Government
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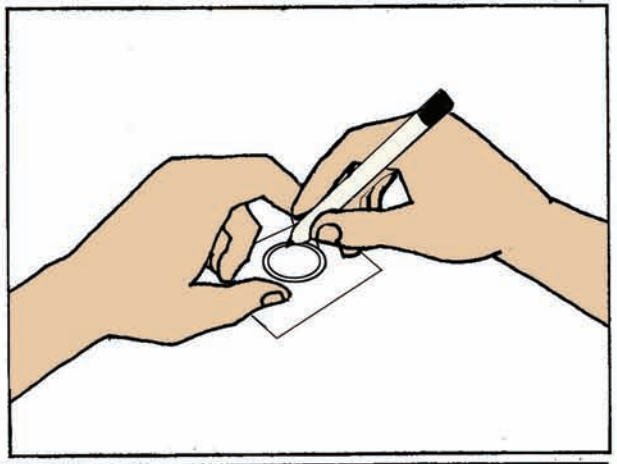
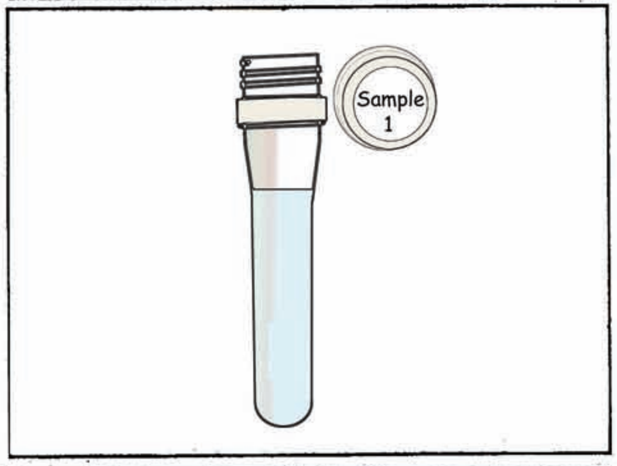
Water Education for Teachers

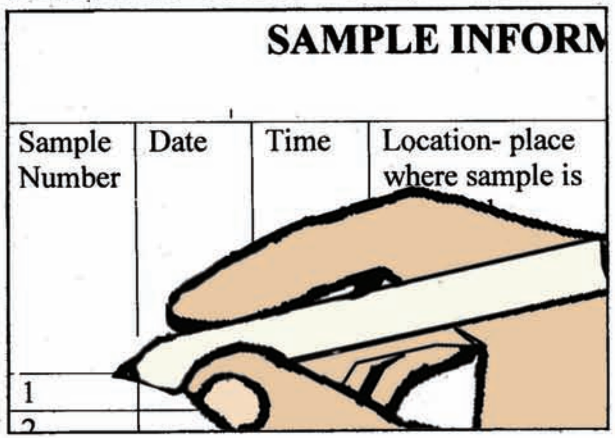
Step 1: Filling in the Details.



Fill in relevant information on the round sticker and ...



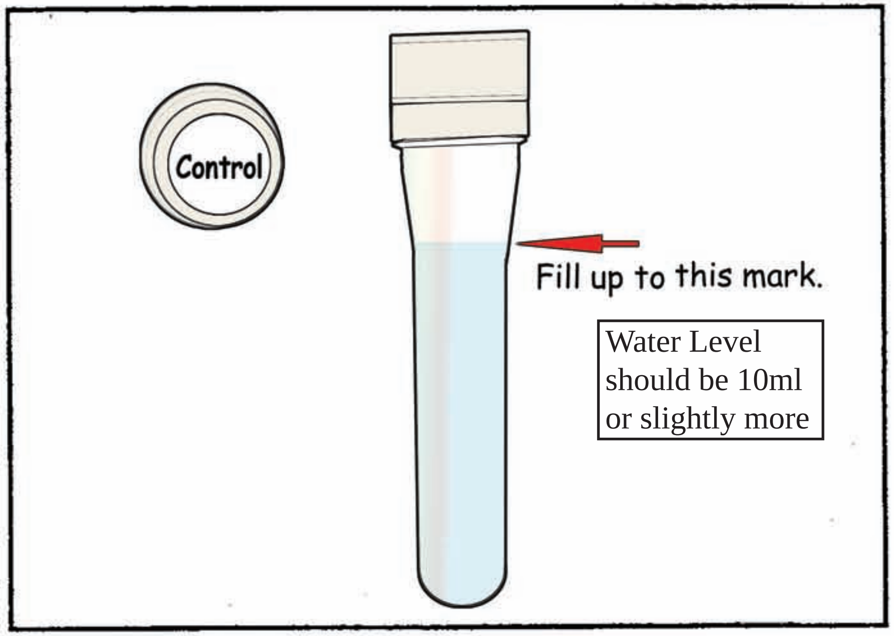
stick on the sample bottle. Be careful not to get the sticker wet.



Record your sample number, date, time, location and description of the water sampled on the Recording Sheet.

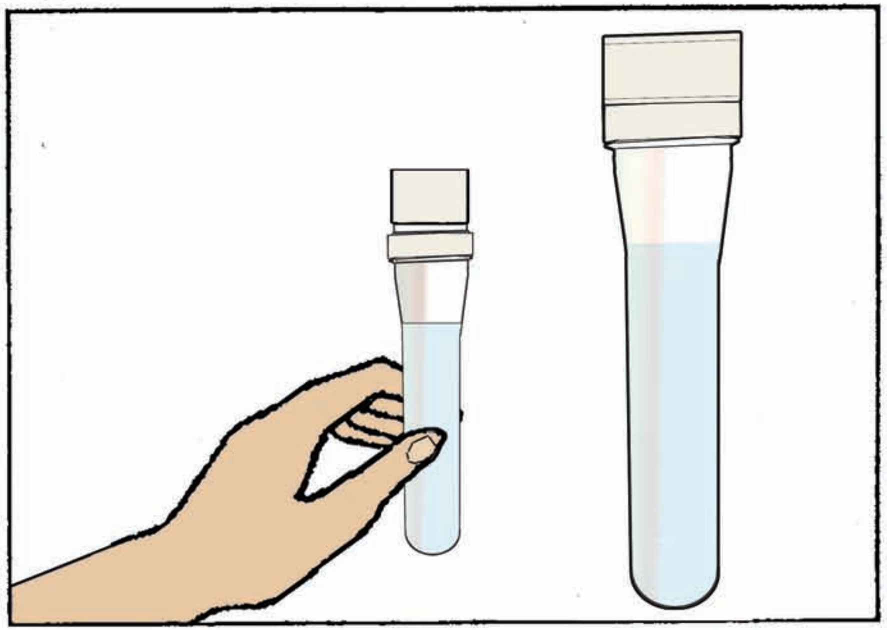
Record any other information e.g. turbidity, smell, source of pollution, faulty pump etc.

Step 2: Collecting the Control.



A control is used to compare the colour change in the test samples, and to ensure that the sample bottle is not contaminated before use.

You need to collect the control only once for each monitoring programme.



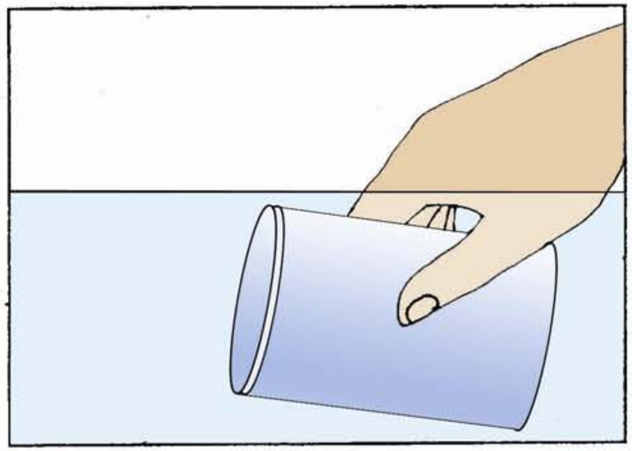
Collect a sample of uncontaminated water e.g. distilled water, bottled water, water treated with chlorine. This is to be used as the control.

There may be a slight change in the colour of the sample to a pale yellow or light brown due to the colour change of the reagent. This is normal.

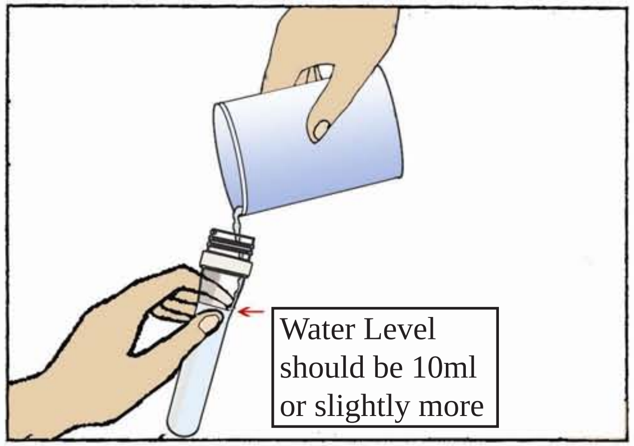
Note:
- *Do not open the test bottle until you are ready to fill it with your water sample.*
- *Make sure that no contamination occurs e.g. by touching the mouth of the bottle.*
- *Do not hold the bottle cap from the inside.*

Step 3a: Collecting the Water Sample

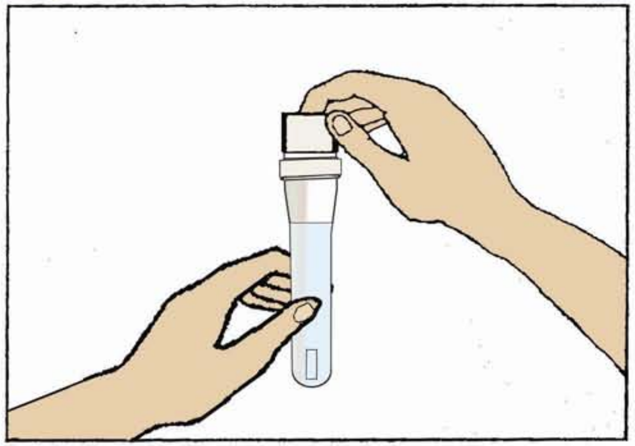
From storage containers, wells or rivers.



Rinse the container to collect the water several times



Collect the water sample from the container by filling the sample bottle up to the mark.

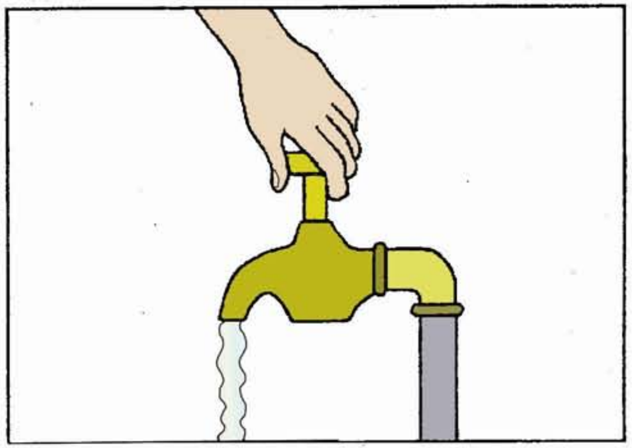


Close the sample bottle. Make sure that no contamination occurs.

If you do overfill the bottle, do not worry. Your result will still be valid.

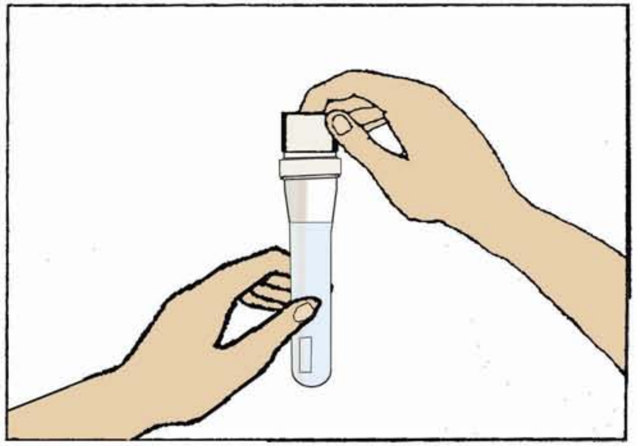
Step 3b: Collecting the Water Sample

From the tap.



Turn on the tap and allow the water to flow for 15 - 20 seconds.

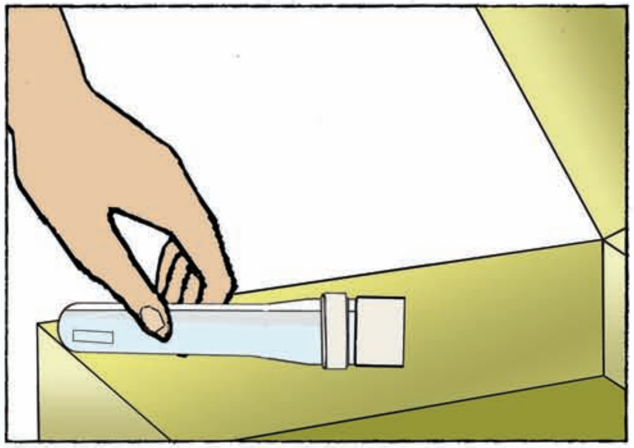
Collect sample water from the tap by filling the sample bottle up to the mark. Fill the sample bottle carefully, this is because the sample bottle will fill very quickly to the marked line and may overflow.



Immediately close the sample bottle. Make sure that no contamination occurs e.g. by touching the mouth of the bottle.
Do not touch the inside of the cap while handling it.

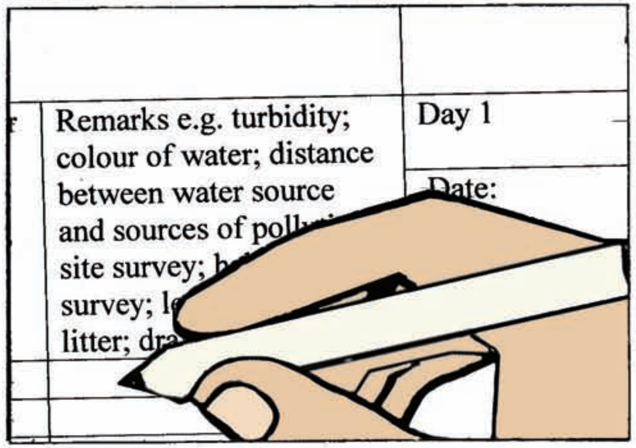
Do not worry if the water sample overflows. The result will still be valid.

Step 4: Checking the Results.

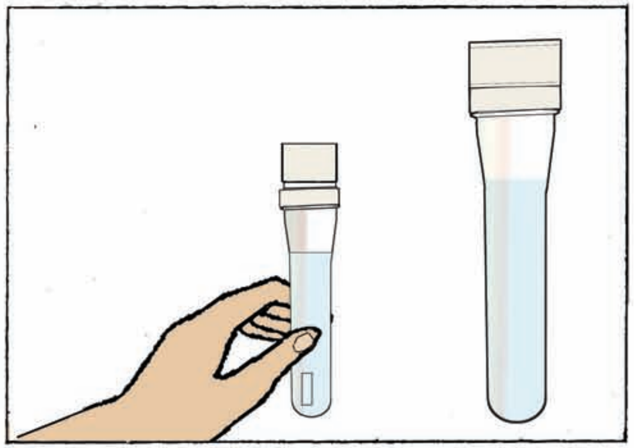


Place all the test samples in a dark place at room temperature.

Check the sample bottle at the same time each day for three days to see if any colour changes has occurred.



Record the date and time of each observation on the recording sheet and your result for each day.

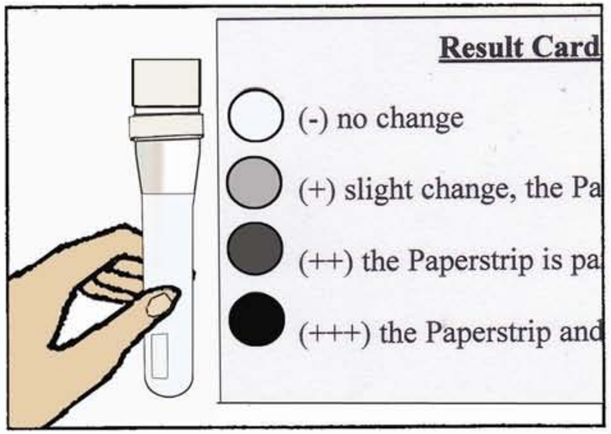


Compare the water in the sample bottle with that of the water in the control bottle to see if there is any colour change.

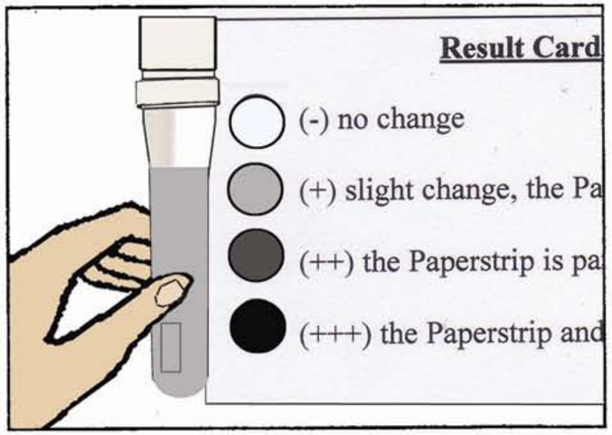
Use the H_2S Colour Code to indicate the degree of contamination.

Note: Do not expose the sample bottle to direct sunlight. The sun's rays can kill the bacteria inside and will affect the test result. Store in a dark place.

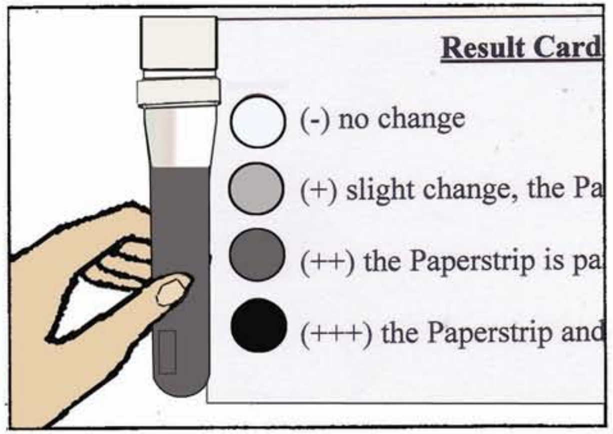
Interpretation of Results.



(-) If there is no colour change, this indicates that the water is clean and likely to be free from bacterial contamination.

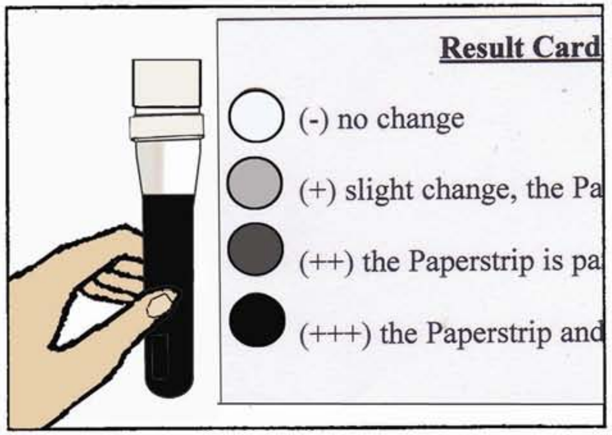


(+) If the water sample or the paper strip has turned grey, there is a possibility that bacteria, is present in the water. Wait for a few days and check again.



(++) If the colour change is partially black than there is some amount of bacterial contamination in the drinking water. You may want to set up a regular monitoring programme and boil your drinking water! Conduct a sanitary survey to check your water source!

Interpretation of Results (continued.)

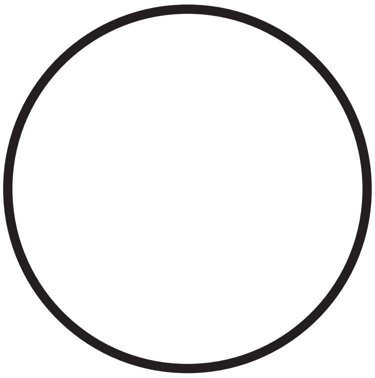


(+++) If the paper strip and the water are noticeably black then there is a very high risk of bacterial contamination in the drinking water, therefore, it is not safe for drinking. Take immediate action!

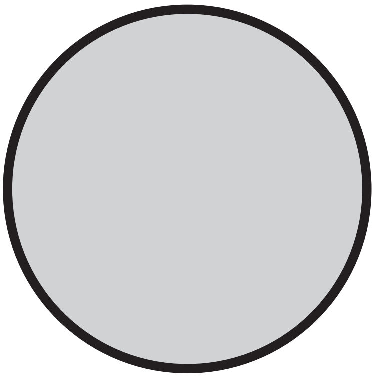
(+++) If there is a fast reaction - that is, the water solution and paper strip turned black overnight that means that, there is a high probability of bacteria present in the water! Your water is contaminated! You should clean out your water storage containers, tanks or well and boil the water before you drink it!
Check the sanitary survey for the source of contamination. Sample the water in your well, tanks and containers again after this to check if you have eliminated the contamination!

Note:
- *Keep the test bottles stowed away from children! Do not put in a place where a child can reach it!*
- *When you return the used test bottles, you will then get replacements.*
- *Do not open the used bottles!*

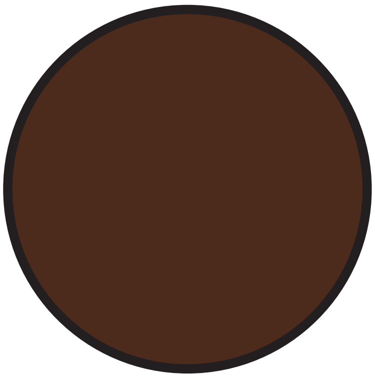
H_2S Colour Code



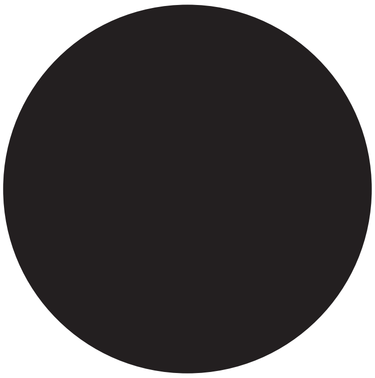
(-) No change



(+) Slight change, the paper strip or water sample has turned grey.



(++) The paper strip or water sample is partially black.



(+++) The paper strip and the water sample are noticeably black.

Developed by Live & Learn Environmental Education for the *Keeping Your Drinking Water Safe Community Toolkit*.

What do your results mean?

(-) If there is no colour change, this indicates that the water is clean and likely to be free from bacterial contamination.

(+) If the water sample or the paper strip has turned grey, there is a possibility that bacteria, is present in the water. *Wait for a few days and check again.*

(++) If the colour change is partially black than there is some amount of bacterial contamination in the drinking water. *You may want to set up a regular monitoring programme and boil your drinking water! Conduct a sanitary survey to check your water source!*

(+++) If the paper strip and the water are noticeably black then there is a very high risk of bacterial contamination in the drinking water, therefore, it is not safe for drinking. *Take immediate action!*

(+++) If there is a fast reaction - that is, the water solution and paper strip turned black overnight that means that, there is a high probability of bacteria present in the water! *Your water is contaminated! You should clean out your water storage containers, tanks or well and boil the water before you drink it! Check the sanitary survey for the source of contamination. Sample the water in your well, tanks and containers again after this to check if you have eliminated the contamination!*

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