Wellness Through Water

AN INTRODUCTION TO HOUSEHOLD WATER TREATMENT AND SAFE STORAGE

A CAWST TRAINING MANUAL
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CAWST is a Canadian humanitarian organization focused on the principle that clean water changes lives. Safe water and basic sanitation are fundamentals necessary to empower the world's poorest people and break the cycle of poverty. CAWST believes that the place to start is to teach people the skills they need to have safe water in their homes. CAWST transfers knowledge and skills to organizations and individuals in developing countries through education, training and consulting services. This ever expanding network can motivate individual households to take action to meet their own water and sanitation needs.

One of CAWST's core strategies is to make knowledge about water common knowledge. This is achieved, in part, by developing and freely distributing education materials with the intent of increasing its availability to those who need it most.

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Acronyms

CAWST	Centre for Affordable Water and Sanitation Technology
CBO	community based organization
HIV	human immunodeficiency virus
HWTS	household water treatment and safe storage
MDG	Millennium Development Goal
NGO	non-governmental organization
PAC	polyaluminium chloride
POU	point of use
SODIS	solar water disinfection
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UNICEF	United Nations Children's Fund
UV	ultraviolet
WHO	World Health Organization
JMP	Joint Monitoring Programme for Water Supply and Sanitation

1 The Need for Safe Drinking Water and Sanitation

Having safe drinking water and basic sanitation is a human need and right for every man, woman and child. People need clean water and sanitation to maintain their health and dignity. Having better water and sanitation is essential in breaking the cycle of poverty since it improves people's health, strength to work, and ability go to school.

Yet 884 million people around the world live without improved drinking water and 2.5 billion people still lack access to improved sanitation, including 1.2 billion who do not have a simple latrine at all (WHO/UNICEF, 2008). Many of these people are among those hardest to reach: families living in remote rural areas and urban slums, families displaced by war and famine, and families living in the poverty-disease trap, for whom improved sanitation and drinking water could offer a way out.

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The World Health Organization (WHO) estimates that 88% of diarrheal disease is caused by unsafe water, inadequate sanitation and poor hygiene. As a result, more than 4,500 children die every day from diarrhea and other diseases. For every child that dies, countless others, including older children and adults, suffer from poor health and missed opportunities for work and education.

The global water crisis claims more lives through disease than any war claims through guns (UNDP, 2006).

In 2000, the United Nations created the Millennium Development Goals (MDGs) to improve the quality of life for people all over the world. The following are the eight MDGs that are to be achieved by the year 2015:

1. Eliminate extreme poverty and hunger.
2. Achieve universal primary education.
3. Promote gender equality and empower women.
4. Reduce child mortality.
5. Improve maternal health.
6. Combat HIV/AIDS, malaria and other diseases.
7. Ensure environmental sustainability.
   (c) Reduce the proportion of people without sustainable access to safe drinking water and basic sanitation by half.
8. Develop a global partnership for development.

The WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (JMP) is the official United Nations organization responsible for monitoring progress towards the MDG drinking water and sanitation target.

The JMP publishes updated estimates every two years on the various types of drinking water sources and sanitation facilities being used worldwide. In 2008, the JMP published a report that presents global, regional and national estimates of the use of improved drinking water sources and improved sanitation facilities for the year 2006.

According to the JMP, **the world is on track to meet the MDG drinking water target:**

- The number of people without an improved drinking water source is now below 1 billion, 884 million compared to 1.1 billion people previously
- Progress is slowest in sub-Saharan Africa, home to a third of the global population using unimproved drinking water sources
- 8 out of 10 people without improved sources of drinking water live in rural areas

However, the **world is not on track to meet the MDG sanitation target**:

- 2.5 billion people, 38 per cent of the world's population, remain without improved sanitation facilities, mostly in sub-Saharan Africa and Southern Asia
- 1.2 billion people still practice open defecation, the riskiest sanitation practice of all
- At the current rate, the MDG sanitation target will be missed by over 700 million people
- 7 out of 10 people without improved sanitation live in rural areas

What Does Improved Drinking Water and Sanitation Mean?

- **Improved drinking water source** is defined as a drinking water source or delivery point that, by nature of its construction and design, is likely to protect the water source from outside contamination, in particular from fecal matter.
- **Safe drinking wate*r*** is water with microbiological, chemical and physical characteristics that meet WHO guidelines or national standards on drinking water quality.
- **Improved sanitation facility** is defined as one that hygienically separates human excreta from human contact. However, sanitation facilities are not considered improved when shared with other households, or open for public use.

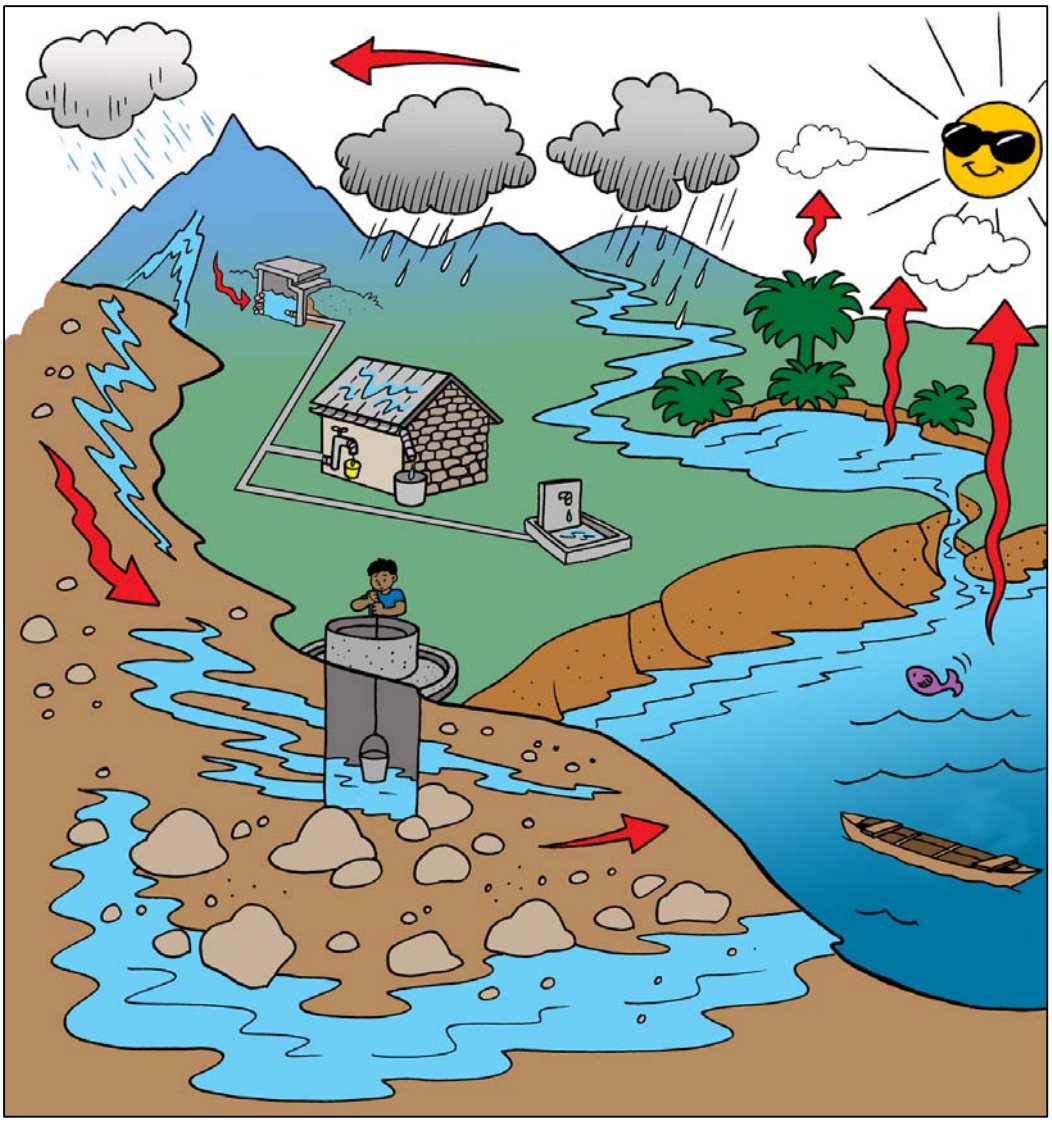
What are Improved Technologies for Drinking Water and Sanitation?

Improved Technologies		**Unimproved Technologies**	
Drinking Water	• Piped water • Public tap/standpipe • Tubewell/borehole • Protected dug well • Protected spring • Rainwater collection • Bottled water[1]	**Drinking Water**	• Unprotected dug well • Unprotected spring • Vendor-provided water • Tanker truck water • Surface water (e.g. river, stream, dam, lake, pond, canal)
Sanitation	• Flush or pour-flush to a piped sewer system, septic tank or pit latrine • VIP latrine • Pit latrine with slab • Composting toilet	**Sanitation**	• Public or shared latrine[2] • Open pit or pit latrine without a slab • Hanging toilet or latrine • Bucket latrine • No facilities at all

[1]The JMP considers bottled water a source of improved drinking water only when another improved source is also used for cooking and personal hygiene.
[2]Shared or public facilities are not considered to be improved. (WHO/UNICEF, 2008)

2 The Water Cycle

The water cycle is the natural movement of water between land and air. There is no beginning or end to the water cycle – it is always happening. Water in the air makes clouds and rain. The **rain water** falls to the ground and flows into streams, rivers, ponds and lakes. Some of the rain will get into the soil and become **ground water**. All of the **surface water** will eventually flow to the oceans. Water evaporates from oceans and land back to the air and the whole cycle begins again.



We often call Earth the “blue planet” because about 70% of its surface is covered by water. However, most of the water is salty (about 97%) and only a small amount is fresh water (about 3%). Most of the fresh water is buried too deep underground for us to reach or is frozen in glaciers and polar ice caps. **So only a very small amount (about 0.3%) of the total water found on Earth is fresh water that is available for us to use.**

From a global perspective, there is more than enough fresh water to go around and meet all of our needs. However, we are facing issues of water stress and scarcity. Why do we have this problem? The issue is not from an overall lack of water. **Rather there is an unequal distribution of water around the world to meet everyone's needs at particular times and place**s. Some regions have plenty of water to enjoy, while others suffer through continuous droughts. In other areas, most of the rain will fall in a few months, but they receive very little during the rest of the year. When we look at the whole population, the areas where 4 billion people live get only about a quarter of the world's rainfall (Wood, 2008).

According to Population Action International, more than 2.8 billion people in 48 countries will face water stress or water scarcity conditions by 2025. Of these countries, 40 are in West Asia, North Africa or Sub-Saharan Africa. **Water scarcity** occurs when the amount of water withdrawn from lakes, rivers or groundwater is so great that water supplies are no longer adequate to satisfy all human or ecosystem requirements, resulting in increased competition between water users and demands (UNEP, 2002).

What is the Difference between Water Stress and Scarcity?

Water Stress – annual water supply is below 1700 m^3 per person.

Water Scarcity – annual water supply is below 1000 m^3 per person.

(UNEP, 2002)

Global warming and climate change will also affect the availability of water. It is predicted that many of the world's most water stressed areas will get even less water, and water flows will become less predictable and more subject to extreme events.

Another issue in addition to the unequal distribution of water is that some people – usually the poor in developing countries – are denied their right to use water. This may be due to their poverty, lack of legal rights, or by government policies that limit their access to community water systems (UNDP, 2006).

3 Where Do We Find Water?

We find our drinking water from different places depending on where we live in the world. Three sources that are used to collect drinking water are:

1. **Ground water** – Water that fills the spaces between rocks and soil making an aquifer. Ground water depth and quality varies from place to place. **About half of the world's drinking water comes from the ground.**

2. **Surface water** – Water that is taken directly from a stream, river, lake, pond, spring or similar source. **Surface water quality is generally unsafe to drink without treatment.**

3. **Rainwater –** Water that is collected and stored using a roof top, ground surface or rock catchment. The quality of rain water collected from a roof surface is usually better than a ground surface or rock catchment.

The following criteria are often used to help us choose an appropriate source of water:

- Quality – How good is it?
- Affordability – What does it cost?
- Adequacy – Is there enough?
- Reliability – How long will it last? Does it change between seasons?
- Convenience – How easy is it to get to?

However, many people do not have a choice in what they can drink. When we look at all the people living in the world, it is found that of every 10 people:

- 5 people have a household connection to a piped water supply
- 3 people use some other sort of improved water supply, such as a protected well or public tap
- 2 people have no choice but to use surface water, groundwater from an unprotected well or purchase their water from vendors

(WHO/UNICEF, 2004)

4 How Much Water Do We Need?

There are basic things that we all need water for: drinking, personal hygiene, cooking, laundry and cleaning. There is no rule about how much water is enough for each person. People need to drink between 2 to 4.5 litres of water per day just to survive; the higher number being for people who do manual work in hot climates. As well, most people need at least 2 litres per day for cooking. More water is also needed for other household activities, including personal hygiene, laundry and cleaning.

In total, every person should have at least 20 litres of water each day to meet their basic needs. People living in North America and Europe use much more water than those living in developing countries. North Americans use about 350 litres per person per day and Europeans use about 200 litres per person per day. People living in sub-Saharan African countries typically use only 10 to 20 litres of water daily.

Every person should have at least 20 litres of water each day to meet their basic needs.

5 What is Safe Drinking Water?

As water moves through the water cycle, it naturally picks up many things along its path. **Water quality will change from place to place, with the seasons, and with the kinds of rocks and soil which it moves through.**

For the most part, it is natural processes that affect water quality. For instance, water moving through underground rocks and soils may pick up natural contaminants, such as arsenic, fluoride, iron and manganese. Water can also be polluted by our activities, such as open defecation, dumping garbage, poor agricultural practices (e.g. use of fertilizers or pesticides near water sources), and chemical spills at industrial sites.

Even though water may be clear, it does not necessarily mean that it is safe for us to drink. It is important for us to judge the safety of water by taking the following three qualities into consideration:

1. **Microbiological** – bacteria, viruses, protozoa, and worms

2. **Chemical** – minerals, metals and chemicals

3. **Physical** – temperature, colour, smell, taste and turbidity

5.1 Microbiological Quality

Water naturally contains many living things. Some are harmless and others can make us sick. Living things that cause disease are also known as **pathogens**. We sometimes call pathogens other names, such as microorganisms, microbes or bugs, depending on the local language and country. There are four different categories of pathogens that will be explained later on: **bacteria, viruses, protozoa and helminths**.

Water contaminated with pathogens is the second biggest killer of children around the world. More than 4,500 children die every day from pathogens that cause diarrhea and other diseases. As well, almost half of all people in developing countries are sick at any given time from illnesses that are caused by poor drinking water and lack of proper sanitation (UNDP, 2006).

The minimum number of pathogens needed to make somebody sick is called the infectious dose. The presence of a pathogen in water does not always mean that it will make you sick. The infectious dose is different depending on the type of pathogen. Generally, bacteria have a higher infectious dose than viruses, protozoa and worms. This means that with some bacteria, only small amounts are needed to make us sick.

Infants, young children, the sick and elderly generally have a lower infectious dose than an average adult. This means that they are most at risk and more likely to die from water related diseases. Over 90% of deaths from diarrheal diseases in developing countries occur in children under 5 years old (WHO/UNICEF, 2005).

Water-Related Diseases

Type	How We Get Sick	Possible Diseases	How to Stop Getting Sick
Water-borne	Drinking water with pathogens	Diarrhea, cholera, typhoid, shigellosis, hepatitis A and E	Improve drinking water quality by removing or killing pathogens.
Water-washed	Pathogens touch the skin or eye	Trachoma, scabies	Provide enough water needed for basic hygiene. Improve basic hygiene practices.
Water-based	Pathogens go through the skin	Schistosomiasis, guinea worm	Do not bath or swim in water that is known to be contaminated. Improve water quality by removing or killing source of pathogens.
Water-insect vector	Pathogens are passed on by insects that breed or live in water, such as mosquitos	Malaria, dengue, yellow fever, filariasis, river blindness, sleeping sickness	Prevent insects from breeding in water. Use pesticides to control insects. Prevent insects from biting by using bed nets and wearing long clothes.

5.1.1 Bacteria

Bacteria are very small organisms that are present everywhere and are the most common living things found in human and animal feces. Drinking water that contains feces is the main cause of water-related diseases.

The most common water-related diseases caused by bacteria are **diarrhea** (also known as gastroenteritis), **cholera** and **typhoid**. About 1.5 million people die every year from diarrheal diseases, including cholera (WHO/UNICEF, 2008).

Cholera is no longer an issue in countries that have basic water, hygiene and sanitation standards. However, it is still a problem where access to safe drinking water and adequate sanitation practices are limited. Almost every developing country in the world has cholera outbreaks or the threat of a cholera epidemic (WHO, 2007).

Typhoid is also common in places that don't have safe drinking water and proper sanitation. There are an estimated 17 million cases of typhoid worldwide resulting in 600,000 deaths (WHO, 2007).

5.1.2 Viruses

Viruses are the smallest of the pathogens. Viruses are unable to reproduce by themselves and must use another living thing to make more viruses. It is difficult and expensive to study viruses so we know less about them than other pathogens.

Some viruses that are found in water can cause **diarrhea**, **hepatitis A** and **hepatitis E**. Hepatitis A is common throughout the developing world with 1.5 million people getting sick every year (WHO, 2004).

There are other viruses that are passed on by mosquitos that breed or live in water. For example, mosquitos can spread viral diseases such as **Dengue Fever**, **Japanese Encephalitis** and **West Nile Fever**. Most of these diseases occur in tropical places where there is open water for mosquitos to breed.

Water cannot spread the human immunodeficiency virus (HIV) and other viruses that cause the common cold. Water does not provide the environment needed for these viruses to survive.

5.1.3 Protozoa

Protozoa are a type of pathogen that is larger than bacteria and viruses. Protozoa are parasites that need a living host to survive. They weaken the host by using up their food and energy.

Amoeba, cryptosporidium and giardia are some of the protozoa that are found in water which can make you sick. They are found mainly in tropical countries. Amoebic dysentery is the most common illness and it affects around 500 million people each year.

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Some protozoa like cryptosporidium are able to form cysts which let them stay alive without a host and survive in harsh environments. The protozoa cysts become active once the environmental conditions are optimal for their development.

Malaria is another protozoa that is passed on by mosquitos. About 1.3 million people die each year of malaria, 90% are children under the age of five. There are 396 million cases of malaria every year, most of them happening in sub-Saharan Africa (WHO, 2004).

5.1.4 Helminths

Helminths are worms that can make you sick. They are another type of parasite and are bigger than the other pathogens. Helminths are generally passed through human and animal feces. They spend part of their life in hosts that live in water before being passed on to people through our skin. Many types of worms can live for several years in our bodies. The WHO estimates that 133 million people suffer from worms and about 9,400 people die each year (WHO, 2000).

Common types of helminths that cause illness in developing countries are **round worms**, **pin worms**, **hook worms** and **guinea worms**. **Schistosomiasis**, also known as bilharzia, is caused by the trematode flatworm. This disease affects about 200 million people worldwide and it causes severe symptoms. Schistosomiasis is often associated with large water resource projects, such as the construction of dams and irrigation canals, which provide an ideal breeding ground for the worm.

5.2 Chemical Quality

Water may also contain chemicals which can be helpful or harmful to our health. There are different ways that chemicals get into our drinking water. Some are found naturally in ground water, such as arsenic, fluoride, sulphur, calcium and magnesium. Human activities such as agriculture, industry and our daily lives can also add chemicals such as nitrogen, phosphorous and pesticides to water.

There are many chemicals that may be in drinking water, but only a few make people sick right away. The main problems are the chemicals that cause illness after drinking contaminated water over a long time. Arsenic and fluoride are usually the chemicals that are most concerning in developing countries. Other chemicals, such as nitrates and nitrites may also be an issue in certain situations (WHO, 2006).

5.2.1 Arsenic

Arsenic can naturally occur in ground water and some surface water. It is one of the greatest chemical problems in developing countries. High levels of arsenic can be found in water from deep wells in over 30 countries. In south Asia alone, it is estimated that 60 to 100 million people are affected by unsafe levels of arsenic in their drinking water. Bangladesh is the most severely affected, where 35 to 60 million of its 130 million population are exposed to arsenic contaminated water.

Melanosis is the initial health effect from drinking high amounts of arsenic over a few years. **Melanosis** is light or dark spots that show up on people's skin, often on the chest, back, or palms. Afterwards, keratosis and other lesions may occur. **Keratosis** is hardening skin bulges on palms and feet. Drinking arsenic contaminated water over the long-term may lead to lung, bladder, kidney, skin, liver, and prostate cancer. Arsenic is

also known to cause vascular diseases, neurological effects, and infant developmental defects.

There is currently no effective cure for arsenic poisoning, however the health effects may be reversed in the early stages by removing the exposure to arsenic. The only prevention is to drink water that has safe levels of arsenic.

5.2.2 Fluoride

Fluoride can also naturally occur in ground water and some surface water. Small amounts of fluoride are usually good for our teeth. But at higher amounts over time, it can damage people's teeth by changing colour and pitting. Eventually, fluoride can build up in people's bones and cause crippling skeletal damage. Infants and young children are most at risk from high amounts of fluoride since their bodies are still growing and developing.

5.2.3 Nitrate and Nitrite

Nitrate and nitrite are naturally occurring chemicals in the environment. Nitrate is commonly used in fertilizers and for agriculture and nitrite is used as food preservatives, especially in processed meat.

Nitrate in ground water and surface water is normally low but can reach high levels if there is leaching or runoff from agricultural fertilizers or contamination from human and animal feces (WHO, 2006).

High levels of nitrate in drinking water can cause methaemoglobinaemia, commonly called blue baby syndrome. This illness affects babies that are bottle fed using formula mixed with water. It causes them to have difficulty breathing and their skin turns blue from a lack of oxygen. It is a serious illness that can sometimes lead to death.

5.3 Physical Quality

The physical characteristics of drinking water are usually things that we can measure with our senses: **turbidity, colour, taste, smell and temperature**. In general, drinking water is judged to have good physical qualities if it is clear, tastes good, has no smell and is cool.

5.3.1 Turbidity

Turbid water looks cloudy, dirty or muddy. Turbidity is caused by sand, silt and clay that are floating in the water. An increase in turbidity means the water looks dirtier or muddier than it did before.

Drinking turbid water will not make you sick by itself. However, viruses, parasites and some bacteria can sometimes attach themselves to the dirt in water**. This means that turbid water usually has more pathogens so drinking it increases your chances of becoming sick.** It is also important to remember that clear water does not necessarily mean that it is free of pathogens and safe to drink.

5.3.2 Colour

Different things in water can make it change colour. Coloured water will not usually make people sick. Although, it may cause people to not use the coloured water and choose another, possibly contaminated, water source instead.

The following explain some of the different colours that you may find in water:

- Vegetation such as leaves, bark and peat can cause dark brown or yellow colour
- Sand, silt and clay usually cause brown or red colour
- Iron can cause orange or brown colour that can stain laundry and plumbing fixtures and gives water a bad taste
- Manganase can turn water black and cause the same problems as iron
- Bacteria growth can also turn water black. These bacteria can also make you sick.

5.3.3 Taste and Smell

Most people like to drink water that tastes and smells good. A bad taste or smell may indicate some sort of contamination, especially when a change happens quickly. In most cases, an unpleasant taste or smell will not make people sick. However, it is next to impossible to convince people that water is safe to drink if it tastes or smells bad.

The following explain some of the different tastes and smells that you may find in water:

- Algae and some bacteria may cause an unpleasant taste and smell
- Hydrogen sulphide causes a rotten egg smell
- Chlorine has a distinct taste and may be present in treated water
- Rain water has less taste than ground water or surface water

5.3.4 Temperature

We generally like to drink cool water instead of warm water. The most desirable temperature for drinking water is between 4^{o}C to 10^{o}C (39-50^{o}F). People generally do not like to drink water that has a temperature above 25^{o}C (77^{o}F). Some bacteria like to grow in warm water and may it may cause the water to taste, smell and look bad over time.

5.4 Drinking Water Quality Guidelines and Standards

What is the Difference between Guidelines and Standards?

Standard – a mandatory limit that must not be exceeded; standards often indicate a legal duty or obligation.

Guideline – a recommended limit that should not be exceeded; guidelines are not intended to be standards of practice, or indicate a legal duty or obligation, but in certain circumstances they could assist in evaluation and improvement.

The World Health Organization (WHO) is part of the United Nations (UN) and it focuses on international public health. The WHO writes the **Guidelines for Drinking Water Quality** (2006) to help make sure that people are drinking safe water around the world.

The WHO Guidelines explain that safe drinking water will not make people sick at any time throughout their life, including when they are young, old or sick. Safe drinking water should be good to use for all of our personal needs, including drinking, cooking, and washing.

The WHO Guidelines cover microbiological, chemical and physical qualities. However, it is stressed that microbiological quality is the most important since this is biggest cause of illness and death around the world.

> Although there are several contaminants in water that may be harmful to humans, the first priority is to ensure that drinking water is free of pathogens that cause disease.
> (WHO, 2006)

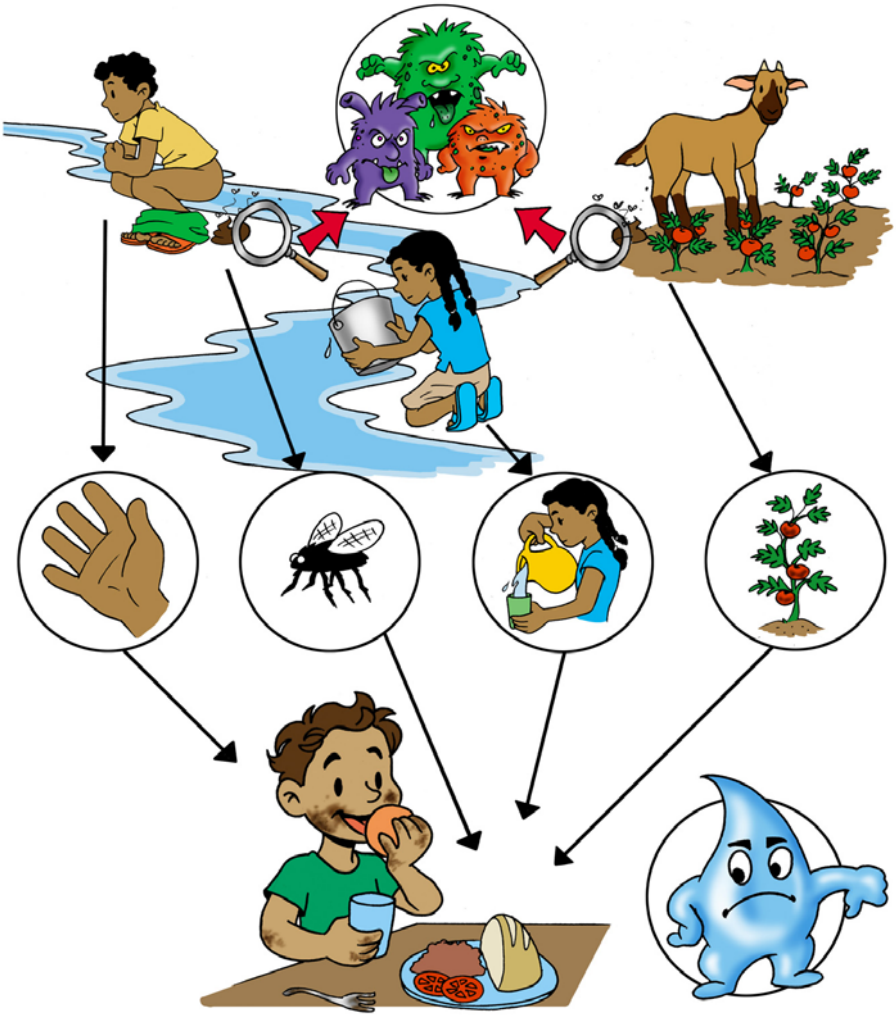
The implementation of the WHO Guidelines for Drinking Water Quality varies among countries. There is no single approach that is used worldwide. The Guidelines are recommendations to work towards and they are not mandatory limits.

Countries can take the WHO Guidelines into consideration along with the local environmental, social, economic and cultural conditions. This may lead to countries developing their own national standards that are quite different the WHO Guidelines.

There is an overwhelming need to increase the availability of safe drinking water in ways that are in line with the WHO Guidelines. To meet this worldwide demand, a variety of household water treatment and safe storage technologies are being promoted as effective, appropriate, acceptable and affordable practices to improve drinking water quality.

6 Disease Transmission

Pathogens are transferred from faeces to our faces and mouths in many ways.



88% of diarrheal disease is attributed to unsafe water supply, inadequate sanitation and poor hygiene. Improved drinking water quality, hygiene and sanitation practices break the transmission routes for pathogens. All three measures implemented together have a much larger effect than any single one implemented alone.

- Improved drinking water quality through household water treatment can lead to a reduction of diarrhea cases by 35% to 39%
- Improved sanitation reduces diarrhea cases by 32%
- Hygiene interventions including hygiene education and promotion of hand washing can lead to a reduction of diarrhea cases by up to 45%

(WHO, 2004)

There are many societies and cultures where the theory of pathogen disease transmission is not known, or if known is perhaps considered to be overly simplistic, and these societies have other traditional methods to explain disease and sickness. These methods may include other factors such as witchcraft, supernatural causes, natural, and environmental causes.

Kauchali et al. (nd) conducted a study of local beliefs related to childhood diarrhea in Kwa Zulu/Natal, South Africa found eleven distinct local names for different types of childhood diarrhea. Each of the eleven types of diarrhea was perceived to have its own signs, symptoms, causes, and treatment. The different types were classified into three categories according to the perceived causation:

- natural causation
- supernatural causation
- caused by “germs” or change in diet

This is an example of a sophisticated disease explanation model which takes into consideration the many perceived effects and influences that the “world” can have on a child. It takes account of the different symptoms that may arise, and it prescribes treatment according to the type of diarrhea diagnosed and its perceived cause.

Traditional disease explanation models can impact the way that conventional health and hygiene activities may work, how they are perceived and whether they are accepted, for example:

- Health seeking behavior – a mother may be reluctant to seek medical assistance for a sick child until all the traditional cures have been attempted.

- Health and hygiene surveys – if people are asked about incidents of diarrhea they may not report incidents where the diarrhea is perceived to be a sign of another ailment, e.g. a supernatural incident where a person was cured by traditional means (one person’s diarrhea is another person’s expulsion of a bad spirit).

- Health and hygiene promotion activities – promotion activities which rely solely on germ theory to explain disease and transmission may appear very crude and simplistic, and perhaps even ridiculous in such cultures and societies.

It must be remembered that many traditional explanations and treatments are very useful and very beneficial. However there are some, particularly those linked to the supernatural that can be dangerous; either the treatment itself is dangerous, or medical treatment is delayed unduly.

It is essential to take account of the local understanding and explanations of water related diseases; the words and terminology commonly used; the possible signs and symptoms; and the perceived causes. Avoid contradicting traditional beliefs but rather try to integrate and incorporate these beliefs into any messages, also try to emphasize beliefs and explanations that are positive and useful.

7 Improved Hygiene

Hygiene can be defined in many ways depending on the particular culture; however, the common understanding is to encourage individuals to practice behaviours that will allow themselves and others to live in a clean environment.

Most people practice personal hygiene to a certain degree. Good personal hygiene practices include:

- Hand washing
- Bathing regularly
- Washing children's hands and face
- Washing hair
- Cleaning teeth

The following seven key hygiene messages should be focused on during a promotion program to change behaviour and improve the health of the household.

1. All feces should be disposed of safely. Using a toilet or latrine is the best way.
2. All family members, including children, need to wash their hands thoroughly with soap and water or ash and water after contact with feces, before touching food, and before feeding children.
3. Washing the face with soap and water every day helps to prevent eye infections. In some parts of the world, eye infections can lead to trachoma, which can cause blindness.
4. Only use water that is from a safe source or is purified. Water containers need to be kept covered to keep the water clean.
5. Raw or leftover food can be dangerous. Raw food should be washed or cooked. Cooked food should be eaten without delay or thoroughly reheated.
6. Food, utensils and food preparation surfaces should be kept clean. Food should be stored in covered containers.
7. Safe disposal of all household refuse helps prevent illness.

Of these seven activities, hand washing with soap is the single most important hygiene measure in preventing the spread of pathogens. The evidence suggests that soap – any soap – and water adequately removes microbe-containing dirt from our hands. Antibacterial soaps or other hand-sanitizing technologies have no additional advantage. In studies around the world, the main reason given why rates of hand washing with soap are so low is that it is simply not a habit (World Bank, 2005).

Directions for Proper Hand Washing (3 x 3 Method)

The three times when we should wash our hands are:
- Before cooking or preparing food.
- Before eating or before feeding children.
- After defecating and after changing or cleaning babies.

The three steps to wash our hands are:
- Wash both hands with water and soap or ash.
- Rub the front and back of your hands and in between your fingers at least three times.
- Dry hands with a clean towel or air dry your hand

Domestic hygiene practices around the house include:

- Washing clothes and bedding
- Sweeping the floors
- Proper food storage, preparation and handling
- Proper disposal of household garbage

Ample water is needed on a daily basis to practice all of these hygiene requirements. Where water is scarce or when too much time is consumed in hauling or treating water, some hygiene practices will be sacrificed. The easier and less time consuming these activities are made, the more likely the hygiene practices are to be adopted. Cultural norms must also be considered. Everyone is used to doing things in a certain way, and people will be reluctant to adopt methods that are too different from what they are used to. Local knowledge is essential in developing an appropriate hygiene program. Some things to consider include:

- Religious traditions or taboos
- Women's and girls' privacy requirements (for bathing and latrines)
- Current laundry methods

Many hygiene projects are effective in the short term, but people's behaviour often reverts to their old habits soon after the project ends. For improved hygiene to become a sustained behaviour change over the long term, any project must have an effective strategy for hygiene promotion.

8 Improved Sanitation

Sanitation is a term for the hygienic disposal or management of waste materials, particularly human excrement. Sanitation is an important public health measure which is essential for the prevention of disease.

From a public health point of view, the main objective of sanitation is to reduce the transmission of diseases. However, people often give other reasons for wanting improved sanitation, such as privacy, dignity, convenience, safety and social status.

There are several different and relatively simple technical solutions to properly dispose of human waste, including:

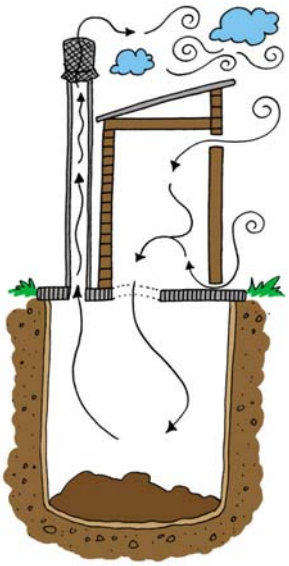
- simple pit latrine
- ventilated improved pit (VIP) latrine
- pour flush latrine
- ecological sanitation

The choice of method will be decided more by local conditions and practices than by technical considerations. In general the technical choice depends on the following factors:

- Culture, particularly local attitudes and acceptable practices
- Physical nature of the site, such as soil type and water drainage
- Available space for construction
- Locally available materials and skills

It is important to inform households and communities about the choices available and encourage people to construct something that is suitable, affordable, easily maintained and made from locally available materials. Without local interest, involvement and commitment, latrines may not be properly used or maintained, or even worse, not used at all.

Any efforts to improve sanitation should also be combined with an education program that also includes hygiene promotion.



9 Improved Drinking Water Quality

Water can be treated at a central location, in large volumes, and then supplied to households through a network of pipes. This is often called **centralized or community water treatment**. Smaller volumes of water can also be treated at the point of use (POU), such as in a home. This is commonly called **household water treatment and safe storage (HWTS)** since the family members gather the water, and then treat and store it in their home.

Most people around the world wish to have safe water piped directly to their homes through a community water treatment system. Unfortunately, the money and resources needed to construct, operate and maintain a community system are not always available in most developing countries.

The main advantage of HWTS is that it can be used immediately in the homes of poor families to improve their drinking water quality. It is proven to be an effective way to prevent diseases from unsafe water. HWTS lets people take responsibility of their own water security by treating and safely storing water themselves.

HWTS is also less expensive, more appropriate for treating smaller volumes of water, and provides an entry or starting point for hygiene and sanitation education. There are a wide range of simple HWTS technologies that provide options based on what is most suitable and affordable for the individual household.

Some limitations of HWTS are that it requires families to be knowledgeable about its operation and maintenance, and they need to be motivated to use the technology correctly. As well, most HWTS technologies are designed to remove pathogens rather than chemicals.

Household Water Treatment and Safe Storage Advantages and Limitations

Advantages	Limitations
• Can be implemented faster than a community system • Relies on individual motivation rather than community consensus • Relatively inexpensive and cost effective • Provides an entry point for hygiene and sanitatio education • Wide range of simple technologies are available based on what is most suitable and affordable f the household • Reduces the contamination risk between treatment and use	• Requires all households to be knowledgeable about operation and maintenance • Most technologies are designed to remove pathogens rather than chemicals • Treated water may be lower quality than that offered by a well designed, operated and maintained community system

10 The Multi-Barrier Approach for HWTS

Using the **multi-barrier approach** is the best way to reduce the risk of drinking unsafe water. We need to follow a process and not just rely on a single technology to improve water quality. Both community and household water treatment systems follow the same water treatment process. The only difference is the scale of the systems that are used by communities and households.

Step 1 – Water source protection
Step 2 – Sedimentation
Step 3 – Filtration
Step 4 – Disinfection
Step 5 – Safe water storage

Step 1 – Water Source Protection

There are many pollution problems which may threaten drinking water quality at the source, or point of collection. These risks include the following:

- poor site selection
- poor protection of the water supply against pollution
- poor construction
- deterioration or damage to structures
- lack of hygiene and sanitation knowledge in the community

Protecting the water source reduces or eliminates these risks and can lead to improved water quality and health. Actions that can be taken at the community level can include some of the following:

- regularly cleaning the area around the water source
- moving latrines away from and downstream of water sources
- building fences to prevent animals from getting into open water sources
- lining wells to prevent surface water from contaminating the ground water
- building proper drainage for wastewater around taps and wells

Step 2 – Sedimentation

Sedimentation is a physical treatment process used to reduce the turbidity of the water. Remember that turbid water looks cloudy, dirty or muddy and is caused by sand, silt and clay that are floating in the water. Turbid water usually has more pathogens so drinking it increases your chances of becoming sick.

Some of the turbidity can be reduced by simply letting the water settle for some time. This can be done in a small container such as a bucket or pail.

The sedimentation process can be quickened by adding special chemicals or native plants, also known as **coagulants**, to the water. Coagulants help the sand, silt and clay join together and form larger clumps, making it easier for them to settle to the bottom of the container.

Three common chemicals used are aluminium sulphate, polyaluminium chloride (also known as PAC or liquid alum) and ferric sulphate.

Native plants are traditionally used in some countries in Africa and Latin America to help with sedimentation. For example, prickly pear cactus, moringa seeds and fava beans have all been used to help sediment water.

You can read more about different sedimentation methods in **Appendix 1: HWTS Fact Sheets**.

Step 3 – Filtration

Filtration is commonly used after sedimentation to further reduce turbidity and remove pathogens. Filtration is a physical process which involves passing water through filter media.

Sand and ceramic are the most common filter media, although cloth and membranes can also be used. There are various types of filters that are used by households around the world.

- Cloth filter
- Biosand filter
- Kanchan™ arsenic filter
- Ceramic pot filter
- Ceramic candle filter

You can read more about each of the filters in **Appendix 1: HWTS Fact Sheets**.

Step 4 – Disinfection

The next step in household water treatment is to remove or kill any remaining pathogens through **disinfection**. The most common methods used by households around the world to disinfect their drinking water are:

- Chlorine disinfection
- Solar disinfection (SODIS)
- Boiling

Turbid water helps pathogens to “hide” from chemical, SODIS and UV disinfection. Reducing turbidity by sedimentation (see Step 2) and filtration (see Step 3) is necessary to improve the effectiveness of these disinfection methods.

You can read more about different disinfection methods in **Appendix 1: HWTS Fact Sheets**.

Step 5 – Safe Water Storage

Households do a lot of work to collect, transport and treat their drinking water. Now that the water is safe to drink, it should be handled and stored properly to keep it safe. If it’s not stored safely, the treated water quality could become worse than the source water and may cause people to get sick.

Safe storage means keeping your treated water away from sources of contamination, and using a clean and covered container. It also means drinking water from the container in a way so that people don’t make each other sick. The container should prevent hands, cups and dippers from touching the water, so that the water doesn’t get recontaminated.

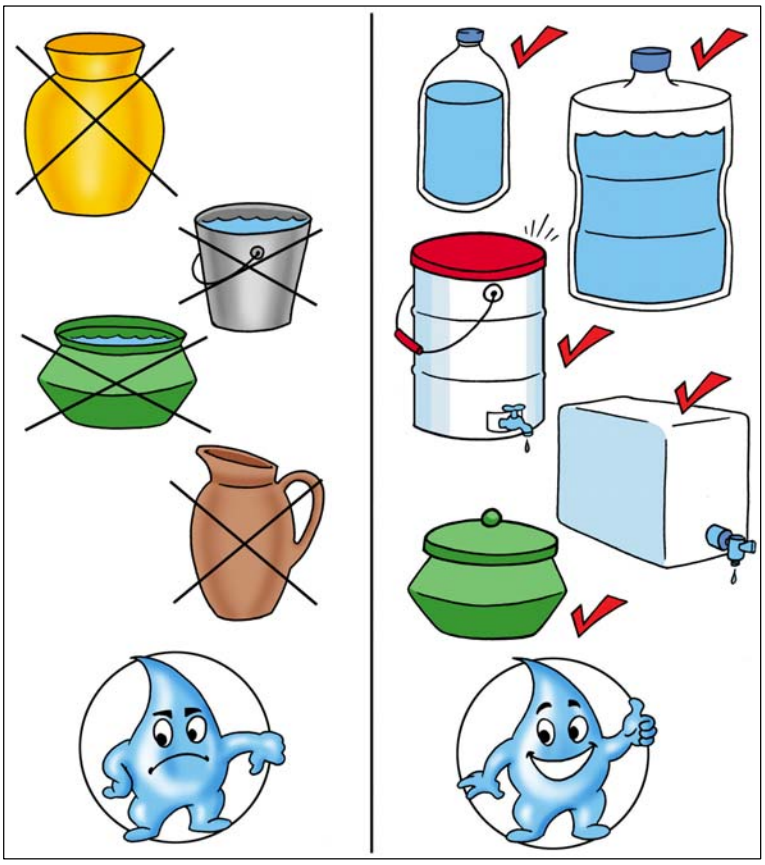
There are many designs for water containers around the world. A safe water storage container should have the following qualities:

- Strong and tightly fitting lid or cover
- Tap or narrow opening
- Stable base so it doesn't tip over
- Durable and strong
- Should not be transparent (see-through)
- Easy to clean

Other safe water handling practices include:

- Using a container to collect and store untreated water and using it only for untreated water
- Using a different container to store treated water - never use this container for untreated water
- Frequently cleaning out the storage container with soap or chlorine
- Storing treated water off the ground in a shady place in the home
- Storing treated water away from small children and animals
- Pouring treated water from the container instead of scooping the water out of it
- Drinking treated water as soon as possible, preferably the same day

Sometimes it is difficult to find or buy a good storage container. **The most important things are to make sure that it is covered and only used for treated water.**



11 How to Choose Appropriate HWTS Technologies

As discussed earlier, we need to follow a process (also called the multi-barrier approach) and not just rely on a single technology to improve water quality. It is not easy to know which combination of HWTS technologies is the most appropriate for a community. There are a many different technologies that are being used around the world. Each technology has advantages and limitations depending on the social, economic and environmental conditions of the local community and the capacity of your organization.

Several decision making tools have been provided in Appendix 2 to help your community to compare different HWTS technologies and processes against the criteria which are important to them.

The tools are participatory activities which encourage the involvement of different stakeholders in a group process. Participants can actively contribute to decision making, rather than passively receive information from outside experts, who may not have local understanding of the issues.

Participatory activities are designed to build self-esteem and a sense of responsibility for one's decisions. Experience shows that when everyone contributes to the decision making process, then people feel more ownership of the problem and develop more appropriate solutions for their situation. Participatory decision making can empower communities to implement their own HWTS improvements.

One way to select the most appropriate HWTS process is to take the following steps with your community:

1. Determine which criteria (see below) are most important to the community.
2. Compare different HWTS technologies based on those criteria.
3. Select the HWTS process which best satisfies the criteria.
4. Start a small demonstration project to before committing to a large program. This will let you test that the process is effective, appropriate, acceptable and affordable for the community.

12 Criteria Influencing HWTS Technology Choice

There are four major criteria to consider when deciding which HWTS technologies are most appropriate for the community:

1. **Effectiveness** – How well does the technology perform?
2. **Appropriateness** – How well does the technology fit into the community and people's daily lives?
3. **Acceptability** – What will people think of the technology?
4. **Cost** – What are the costs for the household and project?

Each of these criteria is described in the following sections. You can also add any other criteria which are important to the community and your organization.

12.1 Effectiveness

Effectiveness is the ability of the technology to provide good water quality and quantity. There should be enough safe drinking water for a household to meet their basic needs. Criteria that show the technology's effectiveness include the following:

- **Water quality:** What microbiological, physical and chemical contaminants can be removed?
- **Water quantity:** How much water is provided?
- **Local water source:** Is the technology able to treat the specific microbiological, physical and chemical contaminants of the local water source? Can it treat water from different sources to the same level?

12.2 Appropriateness

Some **HWTS** technologies will be more suitable than others depending on the needs and conditions of the community. Answering the following criteria can help to match a technology with a particular community:

- **Local availability:** Can the technology be manufactured in or near the community using local materials and labour? Does the technology need foreign spare parts and replacement? Is possible to buy spare parts or replacement locally? Is there a reliable supply chain?
- **Time:** How long does it take for a household to treat enough water to meet their basic needs?
- **Operation and maintenance:** What are the household's responsibilities to operate and maintain the technology? Is it easy and convenient for women and children to use the technology?
- **Lifespan:** How long will the technology last before it needs to be fixed or replaced?

12.3 Acceptability

People's opinion about the technology will affect its wide spread adoption in a community. It is difficult for many people to accept a new technology until they personally experience the benefits. People's acceptance of a technology is affected by the following criteria:

- **Taste, smell and colour:** How does the treated water look, taste and smell?
- **Needs and motivations:** What benefits does the technology give to people? For example, does it provide convenience, health improvement, social status, time or money savings?

12.4 Cost

Most HWTS technologies are not free. You will need to think about what costs need to be recovered to encourage sustainability of your project. Typical HWTS costs include the following criteria:

- Initial purchase
- Transportation
- Operation and maintenance
- Potential repair and replacement
- Cost to raise awareness in the community
- Cost to educate people about how to use the technology
- Cost to provide on-going support for households

13 Putting Your Project Into Action

After you work with the community to determine which HWTS process is the most appropriate, you will then need to decide how your organization is going to put the project it into action.

As we mentioned earlier, it is usually a good idea to start with a small demonstration project to before committing to a large program. This will let you monitor and evaluate whether or not the project is effective, appropriate, acceptable and affordable for the community.

Unfortunately, there is no standard approach for getting HWTS into people's homes. A way that works well in one community may not necessarily have the same impact in another. Your project should be customized to the conditions of both your organization and the local community.

The main things that need to be considered when getting your demonstration project started are:

- How are your costs going to be recovered?
- How is the technology going to be manufactured and distributed to the households?
- How is the community going to be educated about HWTS?
- How is the project going to be monitored?
- What support do you need?

Why Do a Demonstration Project?

- Get started!
- Build your confidence
- Determine appropriateness and acceptability of the technology by the community
- Identify people's needs and motivations
- Create demand in the community
- Build your experience in logistics, quality control, production, project management, schedule, and budgeting
- Gain knowledge and experience in troubleshooting
- Develop a good relationship with your local partners
- Learn lessons and incorporate feedback to improve your project
- Demonstrate your results and capability to potential funders

13.1 Cost Recovery

Successful cost recovery is an important part of sustainability.You will need to think about how your costs can be recovered - whether from households, donors, government or others. It is important to figure out who is financially responsible for which costs, and over what period time.

It is generally agreed and widely accepted that households should, in most cases, pay for continuing costs. An example would be the need for people to buy chlorine on a regular basis as they use up their supply. There are varying opinions about whether people should pay the initial purchase price of items that are going to last them a long time, like a biosand filter. If they are expected to pay, then you need to think about what is reasonable price and how it might be paid. The full cost is often impossible for the poorest of families to afford and some form of cost sharing may be required.

It is important to consider both the ability and the willingness of the households to pay. The poor do not generally have steady incomes, and are often unable to pay all at once in a large, lump sum. Research has shown that the poor will pay, but payment needs to be flexible to their situation. For example, it may be helpful for households to pay more frequently in smaller amounts or for agricultural communities to make payments after the harvest.

You may also set different prices for the technology depending on the wealth of the household in the community. This way, richer households pay more and help cover the costs for poorer families. Another option is for households to pay part of their contribution in kind, by providing voluntary labour for construction or transport, or by providing local materials, such as gravel and sand. Contributing in kind instead makes HWTS more affordable to a larger number of households than when all the payments have to be made in cash.

Community-led discussions can help determine the best way to pay for the chosen HWTS. If the community is involved in the decision making process, then people feel more ownership of the project and develop solutions that are more appropriate.

Some cost recovery options are listed below:

- **Fully subsidized**
  Households receive the technology without paying any money.
- **Partially subsidized**
  Households pay for a portion of the technology cost. The amount should be related to the household's ability and willingness to pay.
- **Cost recovery – manufacture only**
  The household only pays for the cost of manufacturing and distributing the technology.
- **Cost recovery – full project cost**
  The household pays for the full cost of the technology including manufacture, distribution, training and education.
- **Cost recovery – with profit**
  The household pays for the full cost of the technology as well as profit allowing your project to function as a business.

13.2 Manufacturing and Distribution

Manufacturing and distribution of HWTS to households depends on the technology, as well as the local availability of materials and labour. Doing it yourself gives you more control over the technology's quality, but may require your staff to have special skills and training. However, purchasing the technology from another organization can reduce the size of your staff and provide business opportunities for local entrepreneurs. Some options are listed below:

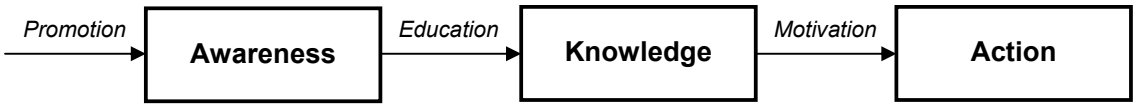
- **International or national manufacturer**
  You may be able to purchase some technologies directly from national or international manufacturers. In this case, you will need to distribute the technology yourself.
- **Your organization**
  Your organization directly controls the manufacture and distribution of the technology.
- **Partner organization**
  A partner organization working under contract manufactures and distributes the technology on your behalf. These may be local NGOs, CBOs or a business. They may be paid directly by your organization or by the community for the technology they provide.
- **Education only**
  The technology may be available in the market or the household already has the necessary materials, for example plastic bottles for SODIS or stove and pot for boiling. In this case it may only be necessary to educate people about the technology and encourage them to start using it.

13.3 Awareness and Education

There are many projects around the world to improve drinking water. However, these projects are often not successful in changing behaviour over the long term.

Why do they not succeed? The emphasis is often placed on the technology, rather than educating people on how to use and incorporate the technology into their lives. Public awareness and education are usually an after thought. By the time their importance is recognized, the project money has already been spent. As well, the communication methods used by many projects can be ineffective and they don't reach the right people.

People need to be **aware** that they get sick from unsafe drinking water before **knowledge** about HWTS can be introduced. Having knowledge then leads to people being motivated to take **action** and change their behaviour.



Promotion and education are more than just a single event or activity in the community; it is an on-going and long-term process. It is important to consider the need for on-going support to households after the project has officially ended. Who will help a household if they have a problem or question? How will promotion and education continue after your project?

There are different people who may contribute to HWTS awareness and education during and after your project. Some of them are listed below:

- **Community health promoters**
  Individuals selected from the local community who receive training about safe drinking water, health and HWTS. They can be volunteers or paid positions.
- **Local health staff**
  Existing local health workers who receive training about safe drinking water, health and HWTS. These workers can be volunteers, government staff, or paid by the project for their activities.
- **Local entrepreneurs**
  Local entrepreneurs have a vested interest in promoting HWTS since it leads increased production and profits. Entrepreneurs generally focus on the particular technology that they are trying to sell, and may not raise awareness about safe drinking water and health or provide education about other options.
- **Social marketing company**
  Commercial social marketing company often as part of a large program. Often social marketing focuses on a particular technology and may not raise awareness about safe drinking water and health or provide education about other options.
- **Government staff**
  Local government staff is responsible for raising awareness on safe drinking water and health as part of a regional or national program. They could also be trained to educate people about HWTS options.

13.4 Monitoring Your Project

The specific purpose of monitoring is to collect and analyze information for regular and periodic assessment of your project's relevance, performance, efficiency, and progress in terms of the timeline for completing the stated objectives. A HWTS project often monitors management, distribution systems, effectiveness of the technology, quality of education materials, and general procedures.

A HWTS project should be monitored at regular intervals based on staff availability, budget, and the nature of the project activities. Monitoring methods will vary depending on the nature of the project activities; there is no specific formula for monitoring.

Monitoring the proper use of technologies by the households is a periodic process which can be initiated by your organization, but ideally it is transferred over to the local community so that it can continue beyond the length of your project.

The results provide feedback for to improvement your project activities. The time required to correct an action can be determined by a monitoring review meeting and project management. Monitoring needs to be conducted in such a way that it provides sufficient and meaningful information to support the recommendations.

The following are characteristics of a good monitoring system:

- Fully integrated by including monitoring in the project cycle
- Designed with a participatory process that emphasizes stakeholders' and end users' involvement and ownership
- Simple and completed as a periodic activity without being burdensome to staff
- Collects specific information in relation to project inputs, outputs and process

13.5 What is a Successful Demonstration Project?

The following are characteristics and lessons learned that CAWST has observed of successful demonstration projects. Incorporating these characteristics into your HWTS project will improve your chances for success.

- You have a committed local individual within your organization to lead and manage the project with the time, capacity and interest to do so
- You have support from your organization, including funding and resources
- You have realistic objectives in terms of both time and scope of the project; CAWST recommends starting with 30 to 50 households
- Monitoring is in place and record-keeping forms are used to ensure quality control in manufacturing, distribution and follow-up with households
- Your project has trained community health promoters to conduct household visits
- Households contribute something towards the purchase price of the technology, it can be it monetary or in-kind
- Safe water storage is emphasized; CAWST recommends that you provide safe storage containers or help households to create safe storage containers to prevent recontamination of treated water.
- HWTS technologies are acceptable to the households and they have adopted them – usually in terms of water looking, tasting, and smelling better, and ease of use
- HWTS technologies are being used and maintained properly by the households to provide improved drinking water
- Your project takes place in a community where there is a need for clean water
- Your project creates demand in the community
- You incorporate feedback and lessons learned into current and future plans.

At their most successful, HWTS demonstration projects help to break the cycle of poverty by improving people's health, strength to work, and ability go to school.

13.6 CAWST Training and Consulting Support

CAWST provides training and on-going consulting support to individuals and organizations who are implementing HWTS projects that serve the poor in developing countries. Our clients include local NGOs, multinational NGOs, governments, research institutions, private sector organizations and individuals in over 50 countries.

13.6.1 Training Workshops

CAWST delivers training around the world on the following topics:

- Introduction to Household Water Treatment and Safe Storage
- Project Implementation for the Biosand Filter
- Community Health Promotion for Trainers
- Community Health Promotion for Field Workers
- Project Planning
- Monitoring and Evaluation
- Introduction to Drinking Water Quality Testing
- Household Rainwater Harvesting
- Low Cost Sanitation

You can see CAWST's upcoming training schedule and register for a workshop at our website: www.cawst.org

13.6.2 Consulting Support

CAWST's workshops are just the beginning of the knowledge and skill transfer process. We provide on-going consulting and support via website, e-mail, telephone and site visits to support clients with their projects and continue to enhance their capabilities.

14 Additional HWTS Resources

Centers for Disease Control and Prevention (CDC)
Website: www.cdc.gov/safewater

Promotes the Safe Water System (SWS) – a water quality intervention that employs simple, robust, and inexpensive technologies appropriate for the developing world. The objective is to make water safe through disinfection and safe storage at the point of use. CDC provides various publications including the Safe Water System Handbook and fact sheets on their programs and various household water treatment options.

Centre for Affordable Water and Sanitation Technology (CAWST)
Website: www.cawst.org

CAWST is a Canadian humanitarian organization focused on the principle that clean water changes lives. CAWST believes that the place to start is to teach people the skills they need to have safe water in their homes. CAWST transfers knowledge and skills to organizations and individuals in developing countries through education, training and consulting services. One of CAWST's core strategies is to make water knowledge common knowledge. This is achieved, in part, by developing and freely distributing education materials with intent of increasing its availability to those who need it the most. CAWST provides open content training manuals, posters, learning activities, and HWTS fact sheets. These materials are provided to workshop participants, interested organizations upon request, and will soon be available online.

International Network to Promote HWTS
Website: http://www.who.int/household_water/network/en/index.html

To accelerate health gains to those without reliable access to safe drinking water, the World Health Organization established a network aimed at promoting HWTS. The network format optimizes flexibility, participation and creativity to support coordinated action. Membership in the Network is open to all interested stakeholders that agree with the Network mission and guiding principles and who are willing to commit themselves to working toward achieving the objectives of the Network. The World Health Organization provides the Secretariat for the Network.

International Water and Sanitation Centre (IRC)
Website: www.irc.nl

IRC bridges the knowledge gap and joint learning with partners for improved, low-cost water supply, sanitation and hygiene in developing countries. IRC offers public access to a bank of information and interactive tools. In addition to more than 100 documents on water and sanitation, they provide the Source Water and Sanitation News Service, the Source Bulletin, a digital library, InterWater Thesaurus, and a question and answer service.

Massachusetts Institute of Technology (MIT)
Website: http://web.mit.edu/watsan/

This website offers information on HWTS and technologies, global water mapping, International HWTS Network, methods for water quality field testing, and open content courses on Water and Sanitation Infrastructure in Developing Countries.

Oxfam
Website: http://www.oxfam.org.uk/resources/learning/humanitarian/watsan.html

Oxfam is a humanitarian organization that acts as a catalyst for overcoming poverty. To achieve the greatest impact, they work on three fronts: saving lives by responding swiftly to provide aid, support and protection during emergencies; developing programmes and solutions that empower people to work their way out of poverty; and campaigning to achieve lasting change. Oxfam has developed emergency manuals and guidelines, as well as technical briefing notes on public health engineering topics, including Household Water Treatment and Storage.

Swiss Agency for Development and Cooperation (SDC)
Website: http://www.poverty.ch/safe-water.html

SDC's 2008 document "Marketing Safe Water Systems" provides unique insights – from the varied perspectives of users, disseminators, producers and retailers – into the marketing challenges of point-of-use treatment devices. It discusses the 5 Ps of marketing: Product, Price, Place, Promotion and People. As well, the document puts forward a mix of marketing and social marketing strategies which can raise the dissemination of household water treatment systems to the levels required for achieving the Millennium Development Goals.

United Nations Children's Fund (UNICEF)
Website: http://www.unicef.org/wes/
http://www.unicef.org/wes/files/Scaling_up_HWTS_Jan_25th_with_comments.pdf

UNICEF works in more than 90 countries around the world to improve water supplies and sanitation facilities in schools and communities, and to promote safe hygiene practices. In emergencies UNICEF provides urgent relief to communities and nations threatened by disrupted water supplies and disease. Their 2008 publication "Promotion of Household Water Treatment and Safe Storage in UNICEF WASH Programmes" summarizes some of the leading approaches for treating water in the home, provides evidence of their effectiveness and cost effectiveness in development and emergency settings and it outlines how promotion of HWTS can be incorporated with UNICEF programmes.

United States Agency for International Development (USAID)
Website: www.ehproject.org

USAID is the largest bi-lateral donor supporting HWTS. On their website, they have resources and materials developed by their implementers, as well as a comprehensive bibliography on point of use water disinfection at: www.ehproject.org/ehkm/pou_bib2.html. There is also a link to a Google group on household water treatment.

Water and Sanitation Program (WSP)
Website: www.wsp.org

WSP is a multi-donor partnership administered by the World Bank. The goal is to help the poor gain sustained access to improved water supply and sanitation services (WSS). WSP works directly with client governments at the local and national level in 25 countries through regional offices in Africa, East and South Asia, Latin America and the Caribbean, and in, Washington D.C. WSP focuses on five topics: Financing the Sector, Rural Water Supply and Sanitation, Strategic Communications, Sanitation and Hygiene, Urban Water Supply and Sanitation. WSP offers the Access Newsletter and news updates to subscribers.

World Health Organization (WHO)
Website: http://www.who.int/household_water/en/

WHO works on aspects of water, sanitation and hygiene where the health burden is high, where interventions could make a major difference and where the present state of knowledge is poor. WHO has produced several documents related to HWTS that are available on-line. As well, the WHO manages a water, sanitation and health listserve to subscribers.

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16 Self Assessment

1. Describe the situation of drinking water and sanitation in developing countries.

2. Identify ways that water becomes contaminated as it flows through the water cycle.

3. What is the main concern for water quality?

4. Define a pathogen.

5. List the four types of pathogens found in water.

6. Describe different ways that pathogens are transmitted.

7. _____ and _____ are two chemicals that are the greatest threat to drinking water supplies in developing countries.

8. List some good hygiene practices.

9. Describe the multi-barrier approach to improving water quality.

10. Describe the three steps in water treatment.

11. Identify different criteria that can be used by communities to help choose an HWTS technology.

Appendix 1: HWTS Fact Sheets

Centre for Affordable Water and Sanitation Technology

Household Water Treatment and Safe Storage Fact Sheet: Settling

The Treatment Process

Step 1 – Source Protection	**Step 2 - Sedimentation**	Step 3 – Filtration	Step 4 – Disinfection	Step 5 – Safe Storage

Effectiveness

Very Effective For:	Somewhat Effective For:	Not Effective For:
	• Turbidity • Bacteria • Protozoa • Helminths • Taste, smell, colour	• Viruses • Chemicals

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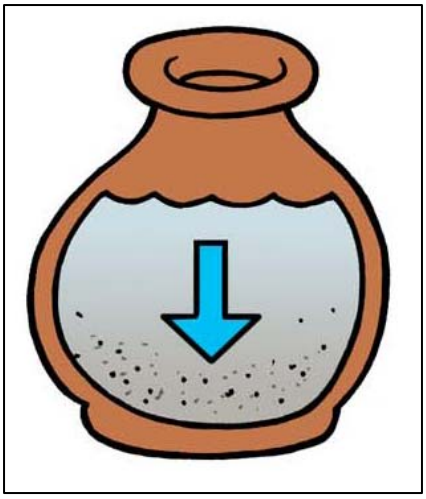
How Does it Work?

Natural settling can be used to help remove turbidity and some pathogens from water. Let a container of water sit without moving for 24 hours and then pour the clear water into a clean container. This process can repeated 2 to 3 times as needed.

Effectiveness

- Quality: Somewhat effective for removing turbidity and some pathogens
- Quantity: Depends on the size of container being used
- Local water: Can be used with any water source



Appropriateness

- Local availability: Can use any container
- Time: 24 hours
- Operation and maintenance: Simple; need to wash container afterwards
- Lifespan: Containers may need to be replaced

Acceptability

- Taste, smell, colour: May be improved
- Ease of use: Very easy

Cost

- Initial purchase cost: Free or low cost since households can use any container
- Operating cost: None

Centre for Affordable Water and Sanitation Technology

Household Water Treatment and Safe Storage Fact Sheet: Chemical Coagulants

The Treatment Process

Step 1 – Source Protection	**Step 2 - Sedimentation**	Step 3 – Filtration	Step 4 – Disinfection	Step 5 – Safe Storage

Effectiveness

Highly Effective For:	Somewhat Effective For:	Not Effective For:
	• Turbidity • Bacteria • Protozoa • Helminths • Taste, smell, colour	• Viruses • Chemicals

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How Does it Work?
The sedimentation process can be quickened by adding special chemicals, also known as coagulants, to the water. Coagulants help the sand, silt and clay join together and form larger clumps, making it easier for them to settle to the bottom of the container.

Three common chemicals used are aluminium sulphate, polyaluminium chloride (also known as PAC or liquid alum) and ferric sulphate.

Effectiveness
- Quality: Somewhat effective for removing turbidity and some pathogens; varies depending on the water
- Quantity: Depends on the size of container being used
- Local water: Can be used with any water source

Appropriateness
- Local availability: Chemical coagulants are not always available; can use any container
- Time: 2+ hours
- Operation and maintenance: Follow manufacturer's instructions for specific products; need to wash container afterwards
- Lifespan: 6 months in liquid form and 1 year in solid form; containers may need to be replaced

Acceptability
- Taste, smell, colour: May be improved
- Ease of use: Follow manufacturer's instructions for specific products

Cost
- Initial purchase cost: None
- Operating cost: On-going cost to buy chemical coagulants as they are used

Centre for Affordable Water and Sanitation Technology

Household Water Treatment and Safe Storage Fact Sheet: Natural Coagulants

The Treatment Process

Step 1 – Source Protection	**Step 2 - Sedimentation**	Step 3 – Filtration	Step 4 – Disinfection	Step 5 – Safe Storage

Effectiveness

Very Effective For:	Somewhat Effective For:	Not Effective For:
	• Turbidity • Bacteria • Protozoa • Helminths • Taste, smell, colour	• Viruses • Chemicals

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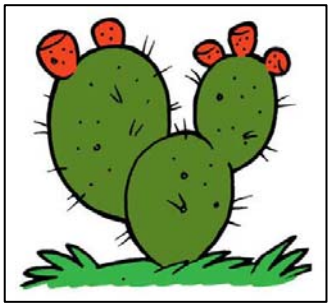
How Does it Work?

The sedimentation process can be quickened by adding natural **coagulants** to the water. Coagulants help the sand, silt and clay join together and form larger clumps, making it easier for them to settle to the bottom of the container.

There are a variety of natural products which have been used in Africa and Latin America to help with sedimentation, including moringa seeds, prickly pear and fava beans.

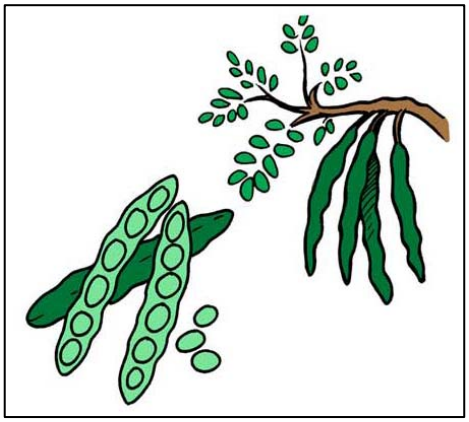


Effectiveness

- Quality: Somewhat effective for removing turbidity and some pathogens; varies depending on the water
- Quantity: Depends on the size of container being used
- Local water: Can be used with any water source

Appropriateness

- Local availability: Natural coagulants are not always available; can use any container
- Time: 2+ hours
- Operation and maintenance: Need to dry and grind seeds before adding them to water; need to wash container afterwards
- Lifespan: Dried beans and seeds can be stored for a long time; prickly pear cactus needs to be used before the sap dries; containers may need to be replaced



Acceptability

- Taste, smell, colour: May improve colour; may cause an objectionable taste
- Ease of use: Need to prepare natural coagulants beforehand; easy to add coagulants to water

Cost

- Initial purchase cost: None
- Operating cost: None

Centre for Affordable Water and Sanitation Technology

Household Water Treatment and Safe Storage Fact Sheet: Cloth Filter

The Treatment Process

Step 1 – Source Protection	Step 2 - Sedimentation	**Step 3 - Filtration**	Step 4 – Disinfection	Step 5 – Safe Storage

Effectiveness

Very Effective For:	Somewhat Effective For:	Not Effective For:
	• Turbidity • Bacteria • Protozoa • Helminths • Taste, smell, colour	• Viruses • Chemicals

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How Does it Work?

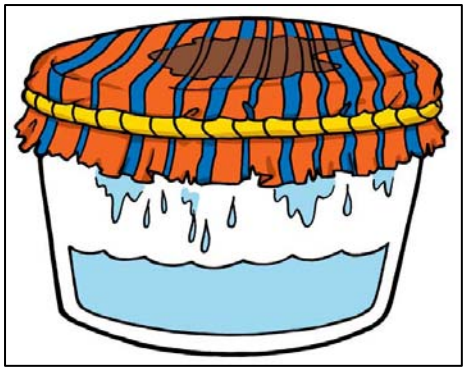
A clean piece of cloth can be used to strain sand, silt, clay and some pathogens out of water. You can use any cotton cloth that is fine and tightly woven, such as a sari cloth. The cloth should be folded into a few layers and tied over a clean container. Afterwards, you should wash the cloth with clean water before using it again.

Effectiveness

- Quality: Least effective filter for removing turbidity and pathogens
- Quantity: Depends on the size of container being used
- Local water: Can be used with any water source

Appropriateness

- Local availability: Cloth is available around the world, can recycle old clothes
- Time: Flow rate is fast
- Operation and maintenance: Simple; cloth needs to be washed with clean water
- Lifespan: Cloth may need to be replaced



Acceptability

- Taste, smell, colour: May be improved
- Ease of use: Very easy

Cost

- Initial purchase cost: Free or low cost since households can use old clothes as filters
- Operating cost: None

Centre for Affordable Water and Sanitation Technology

Household Water Treatment and Safe Storage Fact Sheet: Biosand Filter

The Treatment Process

Step 1 – Source Protection	Step 2 - Sedimentation	**Step 3 - Filtration**	Step 4 – Disinfection	Step 5 – Safe Storage

Effectiveness

Very Effective For:	Somewhat Effective For:	Not Effective For:
• Bacteria • Protozoa • Helminths • Turbidity • Taste, smell, colour	• Viruses • Iron	• Chemicals

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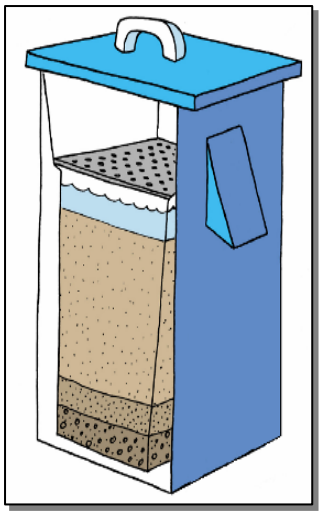
How Does it Work?

A biosand filter is a concrete or plastic box that is filled with layers of sand and gravel. Water is simply poured into the top of the filter and collected in a safe storage container. Pathogens and turbidity are removed by physical and biological processes in the filter sand.

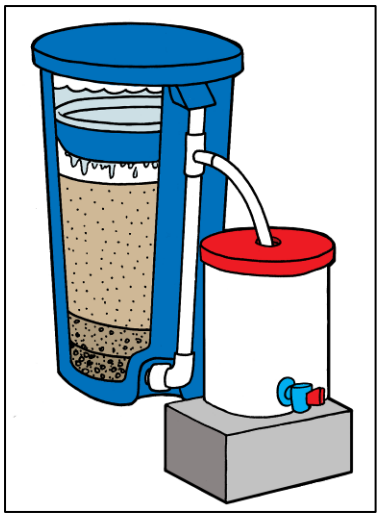


Effectiveness

- Quality: Very effective in removing turbidity and pathogens
- Quantity: Can filter 12-18 litres each batch; recommend to use 1-4 times each day to ensure effective pathogen removal
- Local water: Can be used with any water source, may need to sediment water before filtering

Appropriateness

- Local availability: Concrete filters can be constructed any where in the world; plastic filters are imported from the United States
- Time: Concrete filter flow rate is 0.6 litres/minute; plastic filter flow rate is 0.8 litres/minute
- Operation and maintenance: Simple maintenance to clean sand when the flow rate slows down
- Lifespan: Concrete filters 30+ years; plastic filters 10+ years; lids and diffusers may need to be replaced



Acceptability

- Taste, smell, colour: Usually improved
- Ease of use: Easy for adults; may be difficult for small children to pour water into the filter

Cost

- Initial purchase cost: US$12-30 for concrete filters; US$75 for plastic filters
- Operating cost: None

Centre for Affordable Water and Sanitation Technology

Household Water Treatment and Safe Storage Fact Sheet: Kanchan™ Arsenic Filter

The Treatment Process

Step 1 – Source Protection	Step 2 - Sedimentation	**Step 3 - Filtration**	Step 4 – Disinfection	Step 5 – Safe Storage

Effectiveness

Very Effective For:	Somewhat Effective For:	Not Effective For:
• Arsenic • Bacteria • Protozoa • Helminths • Turbidity • Taste, smell, colour	• Viruses • Iron	• Chemicals

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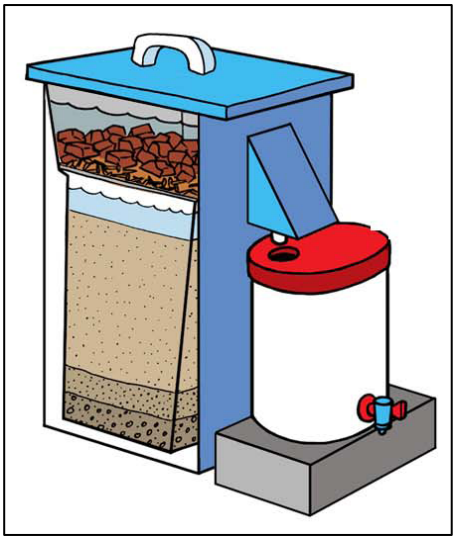
How Does it Work?

The Kanchan™ Arsenic Filter is an adaption of the biosand filter. It is a concrete or plastic box that is filled with layers of sand and gravel. There is also a layer of rusty nails, which remove the arsenic. Brick chips are used on top of the nails to keep them from moving around. Pathogens and turbidity are removed by physical and biological processes in the filter sand. Water is simply poured into the top of the filter and collected in a safe storage container.



Effectiveness

- Quality: Very effective in removing arsenic, turbidity and pathogens
- Quantity: Can filter 12-18 litres each batch; recommend to use 1-2 times each day to ensure effective arsenic removal
- Local water: Can be used with any water source; may need to sediment water before filtering

Appropriateness

- Local availability: Concrete filters can be constructed any where in the world; plastic filters are imported from the United States
- Time: Concrete filter flow rate is 0.6 litres/minute; plastic filter flow rate is 0.8 litres/minute
- Operation and maintenance: Simple maintenance to clean sand when the flow rate slows down
- Lifespan: Concrete filters 30+ years; plastic filters 10+ years; nails need to be replaced every 2-3 years to ensure effective arsenic removal; lids and diffusers may need to be replaced

Acceptability

- Taste, smell, colour: Usually improved
- Ease of use: Easy for adults; may be difficult for small children to pour water into the filter

Cost

- Initial purchase cost: US$12-30 for concrete filters; US$75 for plastic filters
- Operating cost: None

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Household Water Treatment and Safe Storage Fact Sheet: Ceramic Pot Filter

Treatment Type

Step 1 – Source Protection	Step 2 - Sedimentation	**Step 3 - Filtration**	Step 4 – Disinfection	**Step 5 – Safe Storage**

Effectiveness

Very Effective For:	Somewhat Effective For:	Not Effective For:
• Bacteria • Protozoa • Helminths • Turbidity • Taste, smell, colour	• Viruses • Iron	• Chemicals

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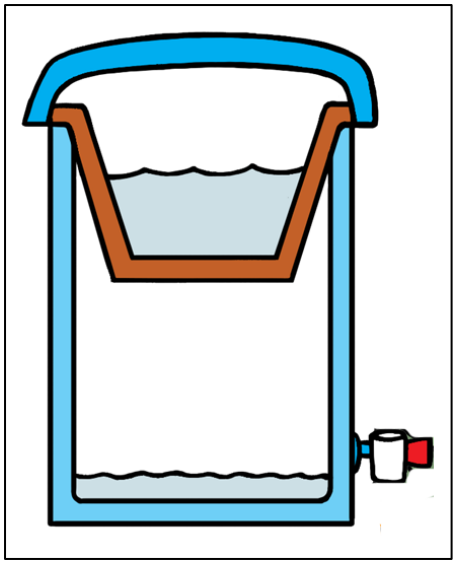
How Does it Work?

Ceramic pot filters are usually made from clay mixed with a combustible material like sawdust, rice husks or coffee husks. Colloidal silver is sometimes used to help with pathogen removal. Water is poured into a ceramic pot, and is collected in another container that has a tap at the bottom. This system also provides safe storage until it the water is used.



Effectiveness

- Quality: Very effective in removing turbidity and pathogens; provides safe storage to prevent recontamination
- Quantity: Can filter up to 8 litres each batch
- Local water: Can be used with any water source, may need to sediment water before using the filter

Appropriateness

- Local availability: Can be manufactured and purchased locally
- Time: Flow rate is 1-3 litres/hour
- Operation and maintenance: Simple maintenance to clean the pot when the flow rate slows down
- Lifespan: Up to 5 years, generally 1-2 years; needs to be replaced if there are visible cracks

Acceptability

- Taste, smell, colour: Usually improved
- Ease of use: Very easy

Cost

- Initial purchase cost: US$12-25
- Operating cost: None

Centre for Affordable Water and Sanitation Technology

Household Water Treatment and Safe Storage Fact Sheet: Ceramic Candle Filter

Treatment Type

Step 1 – Source Protection	Step 2 - Sedimentation	**Step 3 - Filtration**	Step 4 – Disinfection	**Step 5 – Safe Storage**

Effectiveness

Very Effective For:	Somewhat Effective For:	Not Effective For:
• Bacteria • Protozoa • Helminths • Turbidity • Taste, smell, colour	• Viruses	• Chemicals

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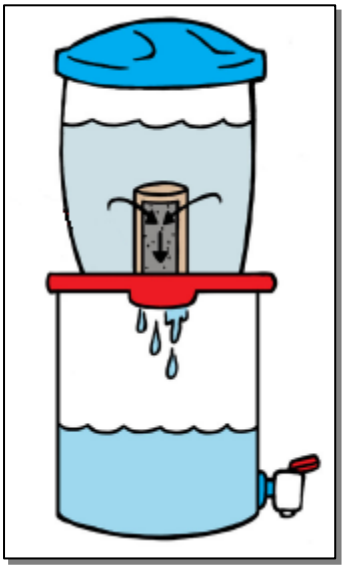
How Does it Work?

Ceramic candle filters are hollow cylinders that are usually made from clay mixed with a combustible material like sawdust, rice husks or coffee husks. Colloidal silver is sometimes used to help with pathogen removal. One or more candles are attached into the bottom of a container. Water is poured into the container and flows through the candle, and is collected in another container that has a tap at the bottom. This system also provides safe storage until it the water is used.

Effectiveness

- Quality: Can be very effective in removing turbidity and pathogens; quality varies depending on the manufacturer; provides safe storage to prevent recontamination
- Quantity: Can filter up to 10 litres of water
- Local water: Can be used with any water source, may need to sediment water before using the filter



Appropriateness

- Local availability: Can be manufactured and purchased locally
- Time: Flow rate is 0.1-1 litre/hour
- Operation and maintenance: Simple maintenance to clean the candle when the flow rate slows down
- Lifespan: Up to 3 years; usually 6 months to 1 year; candle needs to be replaced if there are visible cracks or leaks

Acceptability

- Taste, smell, colour: Filtered water has improved taste, smell and colour
- Ease of use: Easy

Cost

- Initial purchase cost: US$15-30
- Operating cost: None

Centre for Affordable Water and Sanitation Technology

Household Water Treatment and Safe Storage Fact Sheet: Chlorine

The Treatment Process

Step 1 – Source Protection	Step 2 - Sedimentation	Step 3 – Filtration	**Step 4 - Disinfection**	Step 5 – Safe Storage

Effectiveness

Very Effective For:	Somewhat Effective For:	Not Effective For:
• Bacteria	• Viruses • Most Protozoa • Helminths	• Cryptosporidium • Turbidity • Chemicals • Taste, smell, colour

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How Does it Work?

Chlorine is a popular chemical used to disinfect drinking water. Sodium hypochlorite and NaDCC, also known as sodium dichloroisocyanurate or sodium troclosene, are different types of chlorine that are available. There are several different brands of chlorine products that have been manufactured specifically for household water treatment. Each product should have instructions explaining how to use it properly.

Effectiveness

- Quality: Very effective in removing bacteria; not effective for certain types of protozoa; protects water against recontamination
- Quantity: Depends on the size of container being used
- Local water: Should only be used with clear water; may need to sediment and filter water before using chlorine

Appropriateness

- Local availability: Available for purchase in most places
- Time: Need to wait at least 30 minutes after adding chlorine
- Operation and maintenance: Follow manufacturer's instructions for specific products; store chlorine away from children
- Lifespan: Up to 5 years for tablets; liquid chlorine products should used within 3 months of being manufactured

Acceptability

- Taste, smell and colour: Some people do not like the taste or smell of chlorinated water; does not change the colour
- Ease of use: Follow manufacturer's instructions for specific products

Cost

- Initial purchase cost: None
- Operating cost: On-going cost to buy chlorine products; US$3/year

Centre for Affordable Water and Sanitation Technology

Household Water Treatment and Safe Storage Fact Sheet: Solar Disinfection (SODIS)

The Treatment Process

Step 1 – Source Protection	Step 2 - Sedimentation	Step 3 – Filtration	**Step 4 - Disinfection**	**Step 5 – Safe Storage**

Effectivess

Very Effective For:	Somewhat Effective For:	Not Effective For:
• Bacteria • Viruses • Protozoa • Helminths		• Turbidity • Chemicals • Taste, smell, colour

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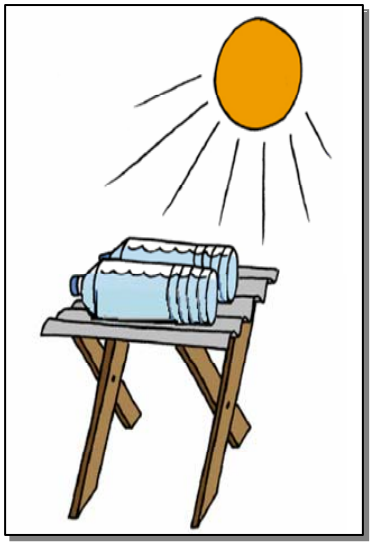
How Does it Work?
SODIS uses the rays from the sun to kill pathogens in the water. It can be used to disinfect small quantities of water with low turbidity. Households fill transparent, non-coloured plastic bottles made from polyethylene terephthalate (PET) and place them in direct sunlight. Water can be used directly from the bottle to avoid recontamination.

Effectiveness
- Quality: Very effective in removing pathogens; provides safe storage to prevent recontamination
- Quantity: 1-2 litres/bottle
- Local water: Should only be used with clear water; may need to sediment and filter water before using SODIS



Appropriateness
- Local availability: Plastic bottles are available in most places
- Time: 6 hours on a sunny; up to 2 days when cloudy; cannot use when raining
- Operation and maintenance: Simple
- Lifespan: Bottles need to be replaced if they have a lot of scratches

Acceptability
- Taste, smell, colour: People do not like to drink warm water; does not change smell or colour
- Ease of use: Easy

Cost
- Initial purchase cost: Free or low cost since households can use recycled plastic bottles
- Operating cost: None

Centre for Affordable Water and Sanitation Technology

Household Water Treatment and Safe Storage Fact Sheet: Boiling

The Treatment Process

Step 1 – Source Protection	Step 2 - Sedimentation	Step 3 – Filtration	**Step 4 - Disinfection**	Step 5 – Safe Storage

Effectiveness

Very Effective For:	Somewhat Effective For:	Not Effective For:
• Bacteria • Viruses • Protozoa • Helminths		• Turbidity • Chemicals • Taste, smell, colour

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How Does it Work?

Boiling is considered the world's oldest, most common, and one of the most effective methods for disinfecting water. Pathogens are killed when the temperature reaches 100 degrees Celsius. CAWST recommends boiling water for 1 minute and adding 1 minute per 1000 metres of elevation.

Effectiveness

- Quality: Very effective in killing all pathogens
- Quantity: Depends on the size of pot being used
- Local water: Can be used with any water source

Appropriateness

- Local availability: Different fuel sources may be locally available (e.g. wood, charcoal, biomass, biogas, kerosene, propane, solar panels, electricity)
- Time: Need to heat water until it boils for 1 minute
- Operation and maintenance: Water is heated over a fire or stove until it boils; potential for burn injuries; cause of respiratory infections associated with poor indoor air quality
- Lifespan: Pots and stove may need to be replaced

Acceptability

- Taste, smell, colour: Some people believe that boiled water tastes flat; does not change smell or colour
- Ease of use: It may take a lot of time to collect enough fuel

Cost

- Initial purchase cost: Free or low cost since households can use existing pots
- Operating cost: On-going cost for fuel; cost varies depending on the type of fuel

Appendix 2: Decision Making Tools

Tool: Matrix Scoring

What is it?
This tool uses a grid to compare and list things in order of importance. For example, if a community is deciding to implement household water treatment, this tool can help show the different technology options and the criteria for choosing one technology over another.

Why use it?
Matrix scoring provides a way to score and compare different things against the same criteria.

How to use it
1. Agree on what subject and options to discuss. For example, 'What household water treatment technology are we going to promote in our community?' Draw or write each option on a separate card. This is called an options card.
2. Draw a matrix – a big rectangle with rows and columns. The number of columns is the same as the number of options cards.
3. Put one option card at the top of each column, except the top of the left-hand column.
4. Agree on criteria for prioritising the options. This will depend on what is important to the participants. For example, criteria for prioritising ways of selecting a HWTS technology may be: ‘Less expensive’, ‘Easier to use’, ‘Highest level of contaminant removal, ‘Easily accessible’ and ‘Less maintenance’.
5. Draw or write the criteria in the boxes in the left-hand column of the matrix. Do not write in the top box of the left-hand column.
6. Agree a scoring method. For example, numbers 1–10, where 1 is very low and 10 is very high.
7. Give each option a score for each of the criteria. Show each score on the matrix. Participants can use beans or stones to do this. It is OK to give the same score to different options.
8. Add up the scores for each option.
9. When the matrix is finished, encourage the participants to discuss what the matrix shows. Talk about whether the matrix makes sense or whether there should be further discussion.
10. Discuss how to use the information on the matrix.

Facilitator Notes
- The selection of criteria for scoring is a very important part of this process. Help the participants take enough time to discuss and agree the criteria.
- The criteria for scoring must be either all positive or all negative, because they will be scored and added up. For example, if the participants are talking about different HWTS options, ‘less expensive’ is a positive reason and ‘more expensive’ is a negative reason.
- Using beans or stones to score allows participants to make changes easily during discussion and provides a quick visual indication of what the scores are.
- Different HWTS options can be combined to provide the most effective treatment through a multi-barrier approach. The matrix can include a combination of technologies. For example, the biosand filter followed by SODIS, or sedimentation and a ceramic filter.

(Adapted from International HIV/AIDS Alliance, 2006)

Tool: Weighted Matrix Scoring

What is it?
This tool is a version of the matrix scoring tool. Weighted matrix ranking uses a grid to compare and list things in order of importance. Each thing on the list is scored according to agreed criteria. Weighted matrix ranking is different from matrix scoring because it shows how important each criterion is. This helps prioritise things according to the criteria that participants think are most important.

Why use it?
Using weighted matrix ranking helps to:

- put things in order of importance and show which reasons for choosing are most important
- review priorities that were decided by using a previous matrix scoring activity
- look at the different criteria people have for their choices
- explore which of these criteria are the most important and which are the least important
- select strategies that respond to identified needs. For example, if community members have identified three important issues about a sexual health problem, weighted matrix ranking can help to decide which issues to address first.

How to use it
1. Agree on what subject and options to discuss. For example, 'What household water treatment technology are we going to promote in our community' Examples of options might include, settling, coagulants, biosand filter, ceramic filter, SODIS, chlorination, boiling.
2. Draw or write each option on a separate card. This is called an options card.
3. Draw a matrix – a big rectangle with rows and columns. The number of columns is the same as the number of options cards.
4. Put one option card at the top of each column, except the top of the left-hand column.
5. Agree on criteria for prioritizing the options. This will depend on what is important to the participants. For example, criteria for prioritising ways of selecting a HWTS technology may be: ‘Less expensive’, ‘Easier to use’, ‘Highest level of contaminant removal, ‘Easily accessible’ and ‘Less maintenance’.
6. Draw or write the criteria in the boxes in the left-hand column of the matrix. Do not write in the top box of the left-hand column.
7. Discuss which criteria are important and which are less important.
8. Give participants 50 stones (or beans or other local materials).
9. Ask participants to divide these stones among the criteria according to which criteria are most important. For example, the most important criteria will have the most stones and the least important will have the fewest stones.
10. The number given to each criterion is its ‘weight’ or importance.
11. Agree on a scoring method for scoring the option cards – for example, numbers 1 to 10, where 1 is very low and 10 is very high.
12. Give each option a score for each of the criteria. Show each score on the matrix. Participants can use beans or stones to do this. It is OK to give the same score to different options.
13. Multiply the score for each option by the 'weight' of the criteria. For example, if 10 stones represent the numbered ‘weight’ of the criteria, multiply the option score by 10.
14. Add up the scores to find the weighted totals.

15. When the activity is complete, discuss what it shows. Which options have scored highest? What options have scored lowest? How can we use this information?

Facilitator Notes

- Weighted matrix ranking is most useful if there are many criteria and some are much more important than others. If there are only three or four criteria of roughly equal importance, then the matrix scoring tool will be more useful.
- The selection of criteria for scoring is a very important part of this process. Help the participants take enough time to discuss and agree on the criteria.
- The criteria for scoring must be either all positive or all negative, because they will be scored and added up. For example, if the participants are talking about different HWTS options, 'less expensive' is a positive reason and 'more expensive' is a negative reason.
- Using beans or stones to score allows participants to make changes easily during discussion and provides a quick visual indication of what the scores are.
- Different HWTS options can be combined to provide the most effective treatment through a multi-barrier approach. The matrix can include a combination of technologies. For example, the biosand filter followed by SODIS, or sedimentation and a ceramic filter.

(Adapted from International HIV/AIDS Alliance, 2006)

Tool: Ranking Line

What is it?
This tool involves drawing a line and placing things on it in order of their importance.

Why use it?
Using a ranking line helps to:

- put things in order of importance and show the reasons for the order
- explore the concerns and priorities of different people
- explore which problems are most serious or most common, and why
- organize information gained during an assessment
- select technologies according to agreed criteria – for example, the technology that is most appropriate for a community

How to use it
1. Agree what HWTS technologies to rank – for example, settling, coagulants, biosand filter, ceramic filter, SODIS, chlorination, boiling.
2. Draw or write each of the items to be ranked on separate papers or cards. These are called ranking cards.
3. Agree the first reason for ranking these items. For example, the first reason for ranking the technology options could be how effective participants think each option is.
4. Draw a long line. Use drawing or writing to show what the line represents – for example, effectiveness of different technologies. One end of the line should represent 'very effective' and the other end 'ineffective'.
5. Discuss each ranking card and decide where to place it on the line. For example, if participants are ranking the effectiveness of different technologies, the most effective treatment option will be placed at one end of the line. The least effective treatment option will be placed at the other end of the line. Cards of equal ranking can be put beside each other.
6. Repeat the process for other criteria. Draw a new ranking line for each criterion.
7. When the activity is complete, discuss what the ranking lines show. For example, compare where items have been placed on different lines. Are there items that always appear high or low on the ranking lines? How can the information shown by the ranking lines be used?

(Adapted from International HIV/AIDS Alliance, 2006)