6 Protecting Community Water

In this chapter: **page**

Protecting Community Water

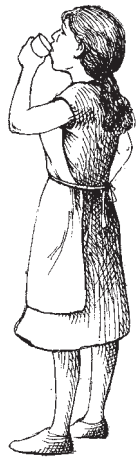
Water is essential for life. People, animals, and plants all need water to live and to grow. But in many places people do not have enough water to stay healthy. Many people have to travel long distances to collect water. And often, the water that is available is not safe to drink.

When a community has a water supply that is safe and easy to get to, everyone has a better chance of having good health. If women and girls are freed from the daily labor of carrying water and making sure it is clean, they have more time to go to school and be part of community life. This improves the well-being of everyone. With enough safe water, children grow healthier and have less diarrhea disease caused by contaminated water.

Water and Community Health

Water is nature's gift. And **water security** (regular access to enough safe water) is a necessary part of community health. When people make decisions together about how to collect, store, and use their common water resources, they can ensure community water security.

To have enough safe water, most people are willing to do the work required or to pay a reasonable price. But in many places, water people need for drinking is contaminated by germs, worms, or toxic chemicals, is taken instead by industry or industrial farming, or is sold at a price people cannot afford. People's needs for water for survival and health must have more importance than other uses when decisions are made about how much it costs and how it is protected, conserved, distributed, and used.



Everyone needs water

Industry takes a community's water

Plachimada is a small village in the south of India where farmers grow rice and coconuts. Farmers used to make a good living there because there was plenty of rain and good soil. But a few years ago this began to change after the Coca-Cola company built a bottling factory on the edge of the village.

The company drilled deep wells to get to the groundwater they needed to bottle the sugary drink. Every day the factory used 1½ million liters of water. 2 years after the factory opened, the villagers' crops were dying and their household wells were drying up. When they cooked rice, it turned brown and tasted bad. When they drank or bathed in the water, they suffered skin rashes, hair loss, pain in the joints, weak bones, and nerve problems. They learned that the company had polluted their groundwater with toxic chemicals. To protect their health, the villagers started collecting water far from their homes.

One year, the rains didn't come at all. But the Coca-Cola company continued to take water during the drought. Villagers watched as trucks left the factory day after day, carrying away the precious liquid that once gave life to them and their crops. Even sources away from the village dried up. As more and more people began to get sick, they gathered together to talk about how they could get the Coca-Cola company to stop taking their water.

After the meeting, more than 2,000 peaceful protestors marched to the Coca-Cola factory and demanded the company leave and pay the villagers for the loss of their water. The company responded by sending a truckload of water to the village every day. But this was not enough water to meet the villagers' needs. After 50 days of protests, police arrested 130 women and men. Months later, 1,000 people marched to the factory and again the police arrested many of them.

The struggle caused hardships for the people of Plachimada, but it also brought them together to demand respect of their right to safe water. After several years, the local government began to support the people and ordered the company to stop using groundwater in times of drought. But the state government said the company should be allowed to continue using groundwater. The conflict went to court where finally the people of Plachimada won the case and the Coca-Cola factory was closed.

When the people of Plachimada fought for their right to water, their campaign received attention throughout India and the world. Their struggle has inspired many others. In a world where people do not have enough safe drinking water, it makes no sense to use this limited resource to produce sweet luxury drinks, especially if a factory's use of the water makes people sick.

Raise Community Awareness

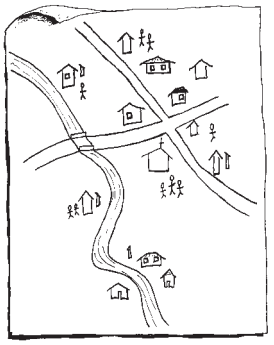
A woman who carries water long distances every day does not need to be told it is hard work. But she may not feel she has the power to change that.

When people see the need for a reliable and safe water supply as a problem shared by all, they can begin to work together to make changes. Often the first stage in making changes involves a group of people raising community awareness together.

Talk to the people in charge of the water

Is there a person, group, or business responsible for wells, pipes, or other water supply systems? Is there a person or group responsible for sanitation? Which people or groups most often collect, carry, treat, and store the water?

Together with the people responsible for the water, list all the water sources in the area. What do people say about drinking water quality and quantity? How much water is used every day? Are different sources used for drinking, cooking, bathing, watering livestock, farming, and other needs? Is there enough water for all these needs? Is there a water source or water storage for emergencies?



Visit the places where people collect water

Different kinds of water sources can have different problems and different solutions. Visit springs, wells, sources of surface water (rivers, streams, lakes, and ponds), and rainwater catchment sites. At each water source, start a discussion about how this water is used and whether anyone suspects it is contaminated (not safe).

Make a map of local water sources and sources of contamination

Your map can show where the water sources are in relation to people's homes and to sources of contamination. Use different colors to show safe water sources and contaminated sources.

Is your water safe?

It is difficult to know if water is safe or not. Some things that cause health problems are easily noticed by looking at, smelling, or tasting the water. Others can be found only by testing the water. Understanding what makes water unsafe and taking steps to protect water from contamination prevents many health problems (see Chapter 5.)

Clear water might not be clean water

This activity shows how there may be something harmful in the water even if it cannot be seen, smelled, or tasted.

Time: 15 to 30 minutes

Materials: 4 clear bottles, mud, salt, sugar, treated water

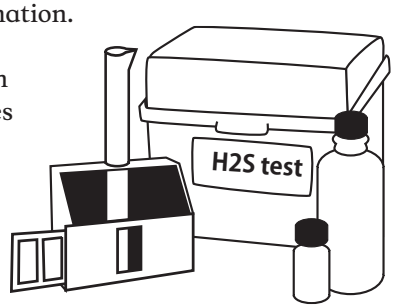
1. Before the activity, fill 4 clear bottles with water that has been boiled, treated with chlorine, or had some other treatment to make it safe. To one bottle, add a spoonful of mud. To another, add a spoonful of sugar. To a 3rd, add a spoonful of salt. Shake the bottles well. Add nothing to the last bottle. Bring these bottles to the group.
2. Ask people in the group to smell the water in all the bottles. Then invite them to drink water from any of the bottles. Most likely no one will drink the muddy water, but many will drink from the other bottles.
3. After several people have drunk the water, ask them why they did not drink from the muddy water bottle. Then ask what their water tasted like, and what did they think was in it. Did anyone drink the water with nothing added to it? Ask them how they knew it was just water, and did not contain something they could not see, smell, or taste.

4. Begin a discussion about things that may be in your water that make it unsafe to drink. This could include germs that cause diarrhea, blood flukes that cause schistosomiasis, and pesticides or other chemicals. Are there reasons to believe these things may be in your water? Are there other ways besides looking and smelling to know if water is safe or unsafe?

Testing for water safety

Water quality testing is often done by examining samples of water in a laboratory. These tests show the type and amount of contamination and are usually necessary to find chemical contamination. But they can be costly. While useful, water quality testing is usually less important than raising community awareness of water issues and careful protection of water sources (see page 75).

Some water testing kits can be used locally to test water for germs. For example, the "H2S test" is low cost (5 tests cost about 1 dollar) and gives quick results. But this test sometimes mistakes harmless living things for germs, and it does not show if chemicals or parasite eggs are in the water.



Water quality tests show only if the water was contaminated at the time and place the water sample was taken.

Improve Your Water Supply

Before trying to develop a new water supply, it will probably be easier to make your current water sources produce more and cleaner water. When making a plan to improve the water supply, start by making a list of local resources. Resources include water sources, building materials, and most important, people. Include the people with skills to build wells or tanks or install pipes, people who can facilitate group activities and organize work parties, and older people who remember how water was collected years ago.

Identify solutions

What your community does to improve the water supply may depend on which problems are most urgent or which problems are easiest to solve first. It is important to make a plan that addresses the root causes of the problems and satisfies the needs of everyone in the community.

Decide what each water source should be used for, especially if there is little water or it is difficult to get to. Building rainwater catchment tanks, storage tanks, or a piped water system may help bring water closer to the community (see pages 86 to 91). If this is not possible, the community can still try to make sure there is enough safe water for everyone:

- share the work of collecting water
- show everyone how to keep water safe from germs (see pages 92 to 99).

If there already is a water system, the community can:

- improve the ways water is collected
- fix broken pipes and pumps
- protect water sources upstream
- find new ways to protect and save water

If there is a possibility the water may be contaminated by toxic chemicals, use a different water source until a water quality test can be done. If a test shows the water is contaminated, keep using a different water source and work toward getting rid of what caused the contamination. Try to prevent the pollution of your water by demanding that industries dispose of their waste safely and use cleaner production methods, and by asking farmers to use fewer pesticides and chemical fertilizers.

Health workers and water safety promoters can help the community improve water security.

Women are important in planning

Women may have different needs for water than men. It is usually women who collect and treat water for family use. But it is often men who are in charge of building and maintaining water systems. Because of these differences in men's and women's work, it is helpful to use planning activities that involve women.

2 circles

This activity helps women think about their water needs and the barriers they face in meeting these needs.

Time: 45 minutes to 1 hour
Materials: Large drawing paper, drawing pens

1. Divide into groups of no more than 10 women each. Give each group drawing pens and paper.
2. Each group draws 2 circles on their paper, a large circle with a smaller circle inside.
3. Inside the larger circle each person draws or lists the water, sanitation, and health-related problems that affect the whole community. Inside the smaller circle they draw or list the problems that affect women in particular.
4. Bring the groups back together and discuss: How do the problems in the 2 circles differ? How are the problems similar? What solutions can be found for both? How can we make sure the women's problems receive enough attention?

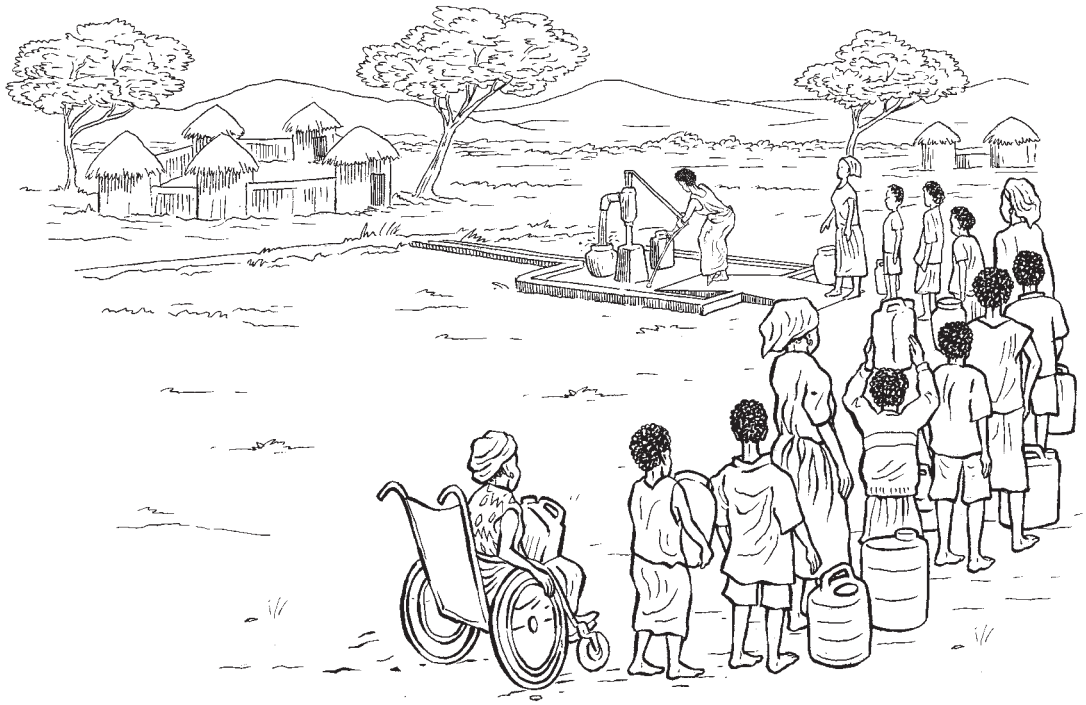
This activity can also be done with women and men together. If men participate, have one of the groups be only men, and have each group draw 2 small circles inside the large circle rather than only one. Let one of the smaller circles include problems that affect women and the other include problems that affect men.

When the groups come back together, ask the men to think about how they can help improve conditions that affect women. This may include building toilets closer to homes, having men collect and carry water, spend more time with children, and so on. It may be more comfortable to have the women discuss their issues in private before the men discuss theirs, especially in communities where men and women may have strong differences of opinion.

Barriers to improving your water supply

There may be many reasons why a community does not have safe water. Problems might include lack of money, not knowing how to build water systems, no government support, or lack of participation by people in the community. To have a constant and safe water supply, the barriers must be identified and removed, one by one. People are more likely to improve and maintain their water system when it results in:

- immediate improvements, such as more water, easier access, or less disease.
- low cost.
- only small changes in daily activities.
- improvements in the local environment, such as less mud, fewer mosquitoes, or more water for home gardens.



A sustainable water project should remove physical and social barriers, and help everyone in the community equally.

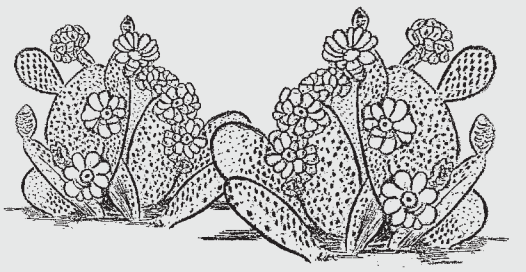
Look for solutions within the community

Throughout history, every community has developed ways to find, transport, and protect water. People have used sticks (called divining rods) to find water, invented devices for lifting and moving water, built many kinds of structures to capture the rain, and planted trees to protect water sources and watersheds. They have also made agreements to help neighboring communities share water. Protecting water and preventing conflicts over water can help to preserve water resources for future generations, even as we learn new ways to collect and treat water to make sure it is safe and abundant.

Villagers teach development workers

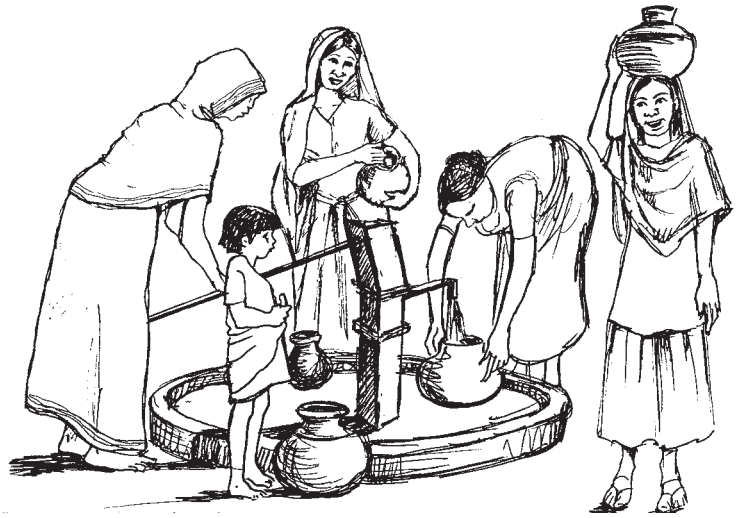
A group of development workers came to a mountain village in Colombia to help the villagers fight diarrhea by protecting their water sources. When they visited the village spring, they saw that cattle and soil erosion were damaging the spring. The development workers suggested 2 simple solutions: Put up a barbed wire fence to protect the spring, or graze the cattle elsewhere.

The villagers did not like these ideas. They predicted that the barbed wire would be stolen before long, and they did not have enough land and money to make proper cattle pastures. But seeing the problem, they came up with a solution that would work. They organized a work day when everyone from the village came out to plant prickly plants upstream from the spring. This forced the cattle to drink water at lower places along the river, and solved the problem for the village.



Protect Water Sources

Water is either surface water (from rivers, streams, lakes, and ponds) or groundwater (water that collects underground and comes up from springs or wells). Because surface water is often contaminated, it should not be used for drinking unless it is treated first (see pages 92 to 99). Groundwater is usually free of germs because it is filtered when it seeps through sand and soil. However, groundwater can be contaminated by natural minerals such as fluoride or arsenic (see page 61), by leaking sewer lines, septic tanks, or toilets, by waste dumps, or by toxic chemicals from industry and agriculture.



When land and waterways are not well cared for, the amount of groundwater can also become dangerously low. Where land has been cleared of trees and vegetation, rain that once soaked into the ground and was stored as groundwater can run off to rivers and the ocean.

The best ways to protect both groundwater and surface water are to:

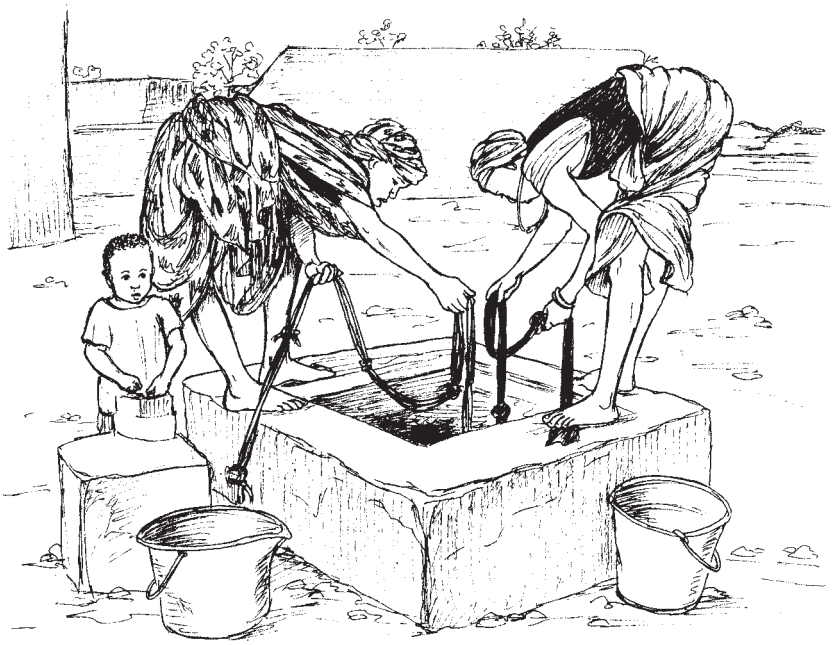
- practice sustainable farming (see Chapter 15).
- build and use safe toilets (see Chapter 7).
- protect the area where water collects, called the **watershed** or **catchment area** (see Chapter 9).

As more people settle around and use a water source, it becomes harder to protect. In places with industrial activity, water may be overused and polluted and the people who need it most may not be able to prevent the problem. These problems can be solved only when a community organizes for water security, puts pressure on governments, and enforces rules on industry.

Protected Wells

There are many kinds of wells for drawing up groundwater. The simplest is a hand-dug water hole, sometimes called a **scoophole.** The most costly kind of well, called a **tube well,** is a narrow pipe going deep into the ground with a pump at the top to draw water out.

A well is useful only if people can get water out of it. The best well for any community depends on the depth of the groundwater and the resources available for digging, drilling, and building a well. In many cases, simple shallow wells where people draw water in buckets may be better than costly deep wells that require pumps. Several shallow wells are often better than one deep well, because if one well goes dry, the others can still provide water.



When people stand on the lip of the well or use unclean buckets, the water in the well can be made unsafe.

Steps to safer wells and water holes

Before digging a well, make sure it is the best kind of well for everyone's needs. Well water becomes unsafe if wells are dug:

- too close to pit toilets, sewer pipes, garbage dumping pits, or livestock. Keep at least 30 meters away.
- near industrial activity such as mining or oil drilling, fields where chemical pesticides or fertilizers are used, or waste dumps.
- where waste water or surface runoff can flow into the well.

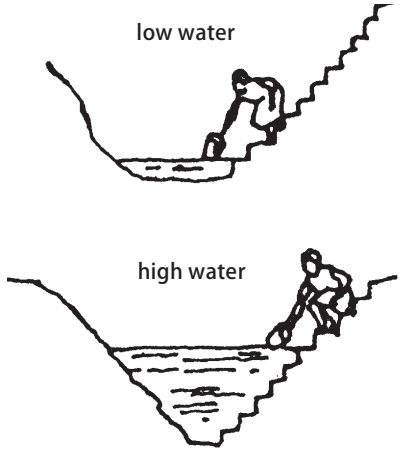
Shallow hand-dug wells can provide good, safe water. But the water can dry up or be easily contaminated. During rainy seasons, surface runoff may drain into a water hole, carrying germs and other contamination. People or animals who use the water may carry germs on their feet to the water hole. Buckets and ropes around the rim of the well may also collect germs, and can easily contaminate the water when they are lowered into the well.

Simple improvements can prevent contamination. For example, make sure only clean buckets and ropes are lowered into the water. Build up earth around the hole or line the top with bricks or a concrete ring to keep water safer. Lining the hole also makes it less likely to dry up or collapse, and allows for a deeper well that can store more water. (For some ways to improve wells, see the drawings on the next page.)

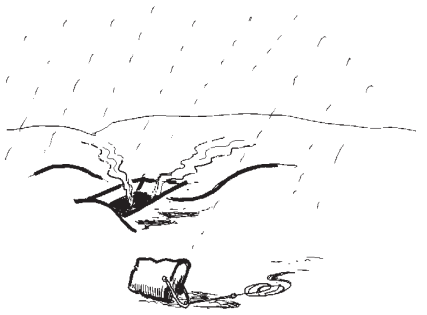
Before drilling new wells or making costly improvements to water systems, consider making small improvements like these to make your water sources safer.

Improvements to open water holes

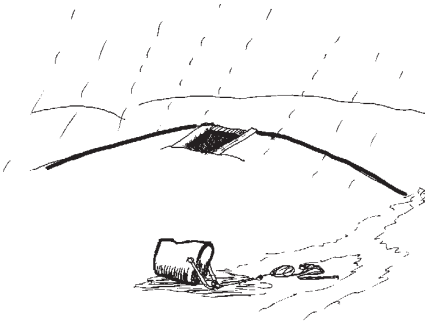
Build stone steps into the water hole so a person can draw water up from a step, without getting wet. Always use the last dry step. Never walk into the water.



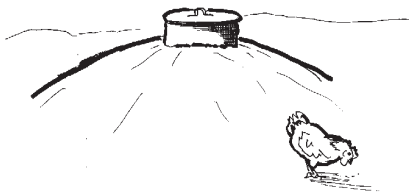
Improvements to basic wells and scoopholes



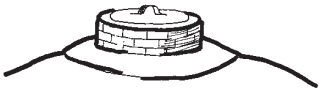
1. Unimproved scoophole



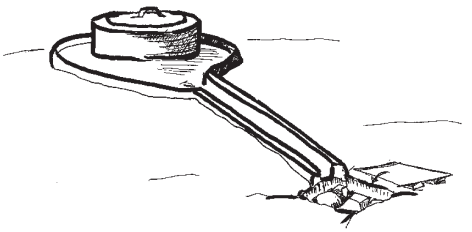
2. Mouth of hole built up to keep out runoff



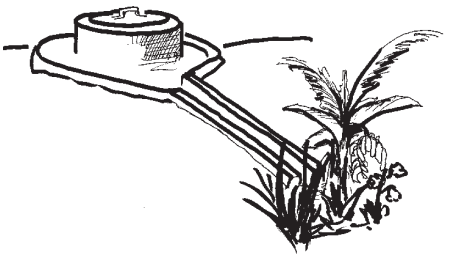
3. Mouth closed off with barrel and lid



4. Top strengthened with bricks and small drainage platform



5. Protected water hole with drainage platform and runoff channel



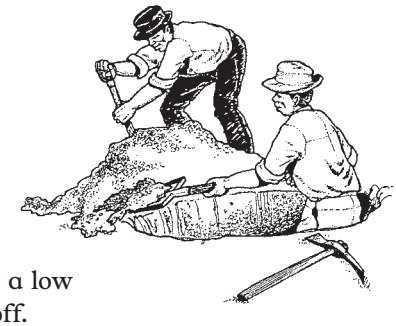
6. Protected water hole with drainage platform, runoff channel, and garden

IMPORTANT: Never drink directly from a water hole. Filtering the water through a cloth and letting it settle before drinking will remove some germs. Water treatment methods are described on pages 92 to 99.

Protect the family well

Many communities have tube wells or boreholes with pumps built by governments, or local or international agencies. These deep, closed wells protect water from contamination by people and animals. But years after they are drilled, many of these wells can no longer be used because the pumps have broken, or spare parts are no longer available, or the people who knew how to fix them are gone. This results in no regular supply of clean water. People must walk long distances or collect contaminated surface water to fill their needs. In some parts of Africa, protected family wells are replacing tube wells.

A protected well is a hole dug by hand with a lining, a concrete cover, a windlass to raise water, and a drainage platform. Each of these things adds protection to the well. With all of them in place, and with careful handling of the water, a family well can be very safe.

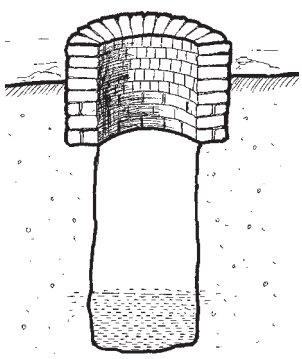


Where to dig a well

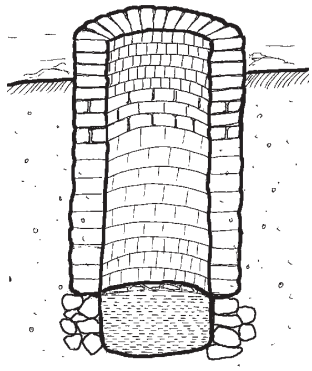
When digging a well, the best sign there will be water is when you see other wells nearby. But if the other wells are deep boreholes, the groundwater may be too deep to get to by hand digging. Another good sign is the year-round presence of plants that need a lot of water to survive. Low areas are more likely to have water than higher ground. But if a well is dug in a low area, it will need to be protected from rainwater runoff.

The well lining

In very firm soils, lining the well may seem unnecessary. But it is wise to line at least the top 1 to 2 meters below ground to prevent the side walls from collapsing. If the entire well is lined it will make the water source more dependable, but it will be more difficult to dig the well deeper at a later time. A well can be lined with stones or rocks, with fired bricks, or with concrete.



Top 1 to 2 meters lined

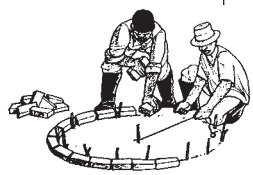


Fully lined well

How to make a cover slab for a well

Once a well has been lined, the next step is fitting a concrete cover slab. The cover helps prevent polluted wastewater or objects from falling into the well. It also makes the well safer for children and provides a clean place to put buckets as people collect water.

Tools you need: shovel, metal saw, blocks of wood, bucket, rope



Make a mold for the slab.

1. The cover should fit neatly over the upper well lining. Clear a flat place to pour a concrete slab and mark out a circle the size of the cover slab to fit the well. Place a ring of bricks around the marked circle. This ring is the slab mold.

2. Leave a hole in the slab to pass a bucket through or to fit a pump. The size of the hole depends on the kind of bucket or pump used, but generally the hole should be large enough for a 10 liter bucket. A tin drum big enough for a bucket to pass through can be used to form the hole.

Place reinforcing wire and a mold for the hole.

3. Place reinforcing wire (3 mm) within the slab mold to form a grid, with spaces 10 cm apart.

4. Remove the reinforcing wire grid and make a concrete mix of 3 parts gravel, 2 parts washed river sand, and 1 part cement. If gravel is not available, use 4 parts washed river sand and 1 part cement. Pour concrete in the mold, halfway to the top. Place the wire grid on top of the wet concrete. Add the remaining concrete and level it with a piece of wood.

Pour the concrete slab and form the protective collar.

5. Let the slab cure for 1 hour. Remove the tin drum mold, and fill the central hole with wet sand. Replace the mold on top of the sand and place a ring of bricks around it, leaving 75 mm of space between the bricks and the mold. Fill the space between the bricks and the mold with concrete and let it cure for an hour. After an hour, remove the bricks and the tin mold and shape the protective collar. For the collar to give the best protection, a tin cover should fit snugly over it.

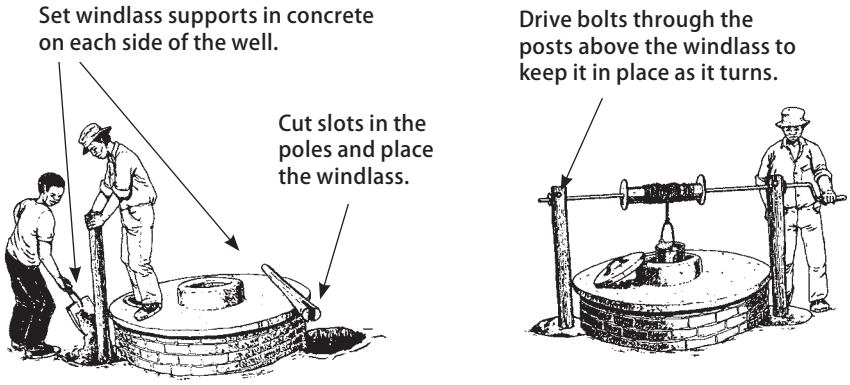
Shape the protective collar.

6. Let the slab harden overnight and cure for at least 5 days, keeping it wet the entire time. Before putting the slab on a well, test its strength. After it has cured for 7 days or so, place 4 blocks of wood 1 or 2 inches high under the 4 sides of the slab to raise it off the ground. Then dance on it! A well-made slab will not break even with several people dancing on it. Place a bed of cement mortar on the top of the well lining and carefully set the well cover in place.

Set the well cover in place.

The windlass, bucket, and chain

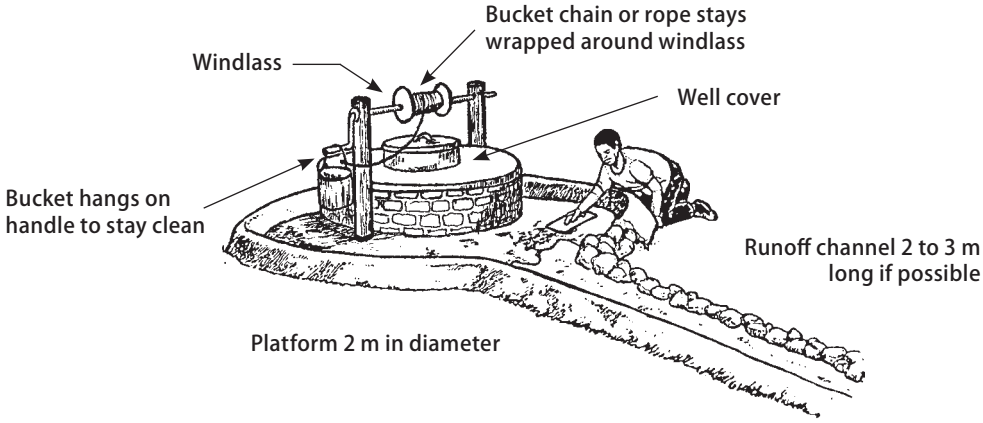
A windlass is a shaft fitted with a handle that makes raising the bucket easier and provides a place to wrap the bucket chain or rope. If a pump is fitted to the well later, the windlass can easily be removed. Attach a bucket to the end of the chain or rope. Chain is best because fewer germs will grow on it, but it is costly. Rope is less costly and can be replaced easily if it breaks.



This design shows wooden windlass supports set in the ground. Windlass supports may also be made of bricks.

The drainage platform

The drainage platform carries runoff away from the well to a drainage area. This prevents the area around the well from getting muddy, and breeding germs and insects. Germs can grow in cracks, so it is important that the platform is well made.



Pour concrete to a depth of 75 mm, with a raised outer rim 150 mm high. The entire platform and rim should be reinforced with 3 mm wire to prevent it from cracking.

Maintain your well

Well water is easily contaminated when dirty buckets and dirty ropes or chains are lowered into it. To keep well water clean, keep one bucket attached to the well and use it to fill other containers. Washing hands before collecting water and building a fence to keep animals out will also prevent contamination.

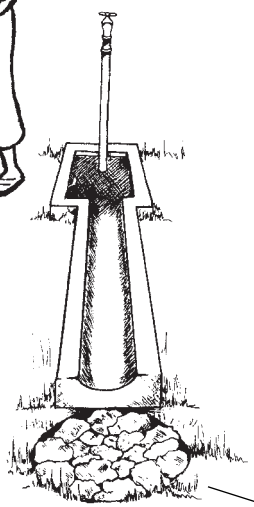
You can also protect your well water when you:

- keep the well cover in place.
- keep the platform and runoff channel clean.
- grease the handle bearing often to make it easier to use.
- do not let children play with the well or pump.
- fence the area to keep livestock out.
- have a person be caretaker of the well.

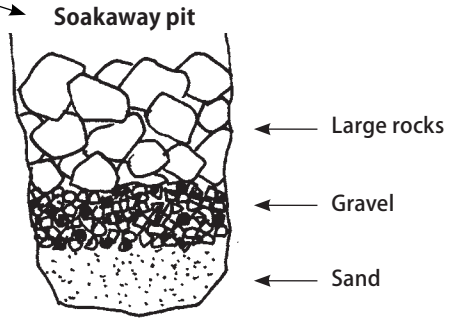
Drain runoff from wells and taps

Wherever people collect water, water spills. When water collects in puddles, it becomes a breeding ground for mosquitoes that carry malaria and other illnesses. Wells, taps, outlets from storage tanks, and other water collection areas need good drainage to allow spilled water to flow away or to drain into the ground.

To take advantage of water that runs off, plant a tree or a vegetable garden where the water drains. If you cannot plant a tree or garden, make a hollow in the ground filled with rocks, gravel, and sand for the water to seep into. This is called a "soakaway pit." It will help prevent mosquitoes from breeding.



Community water tap with drainage



Pumping water from wells

To move water up from a well, a pump is needed. Pumps use various kinds of energy, including electricity, gas, solar energy, or human power. If a pump is difficult to use or if it is often out of service, people will start to collect water from unsafe sources.

How to choose a pump

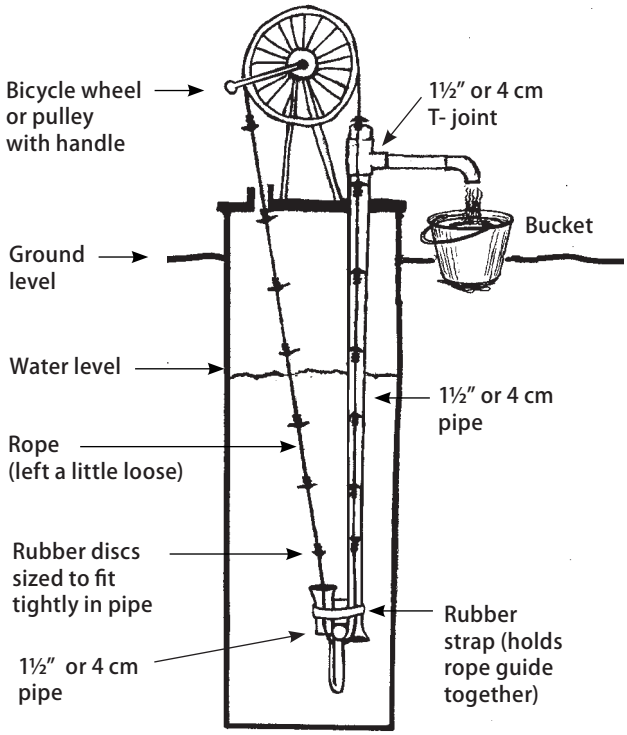
All pumps have one thing in common: if they break, there is no water. For most people, the best pump is one they can build, operate, and repair by themselves, or that can be repaired by trusted local mechanics. Consider the following when choosing a pump:

- Will it be usable by and meet the needs of both men and women? Were women involved in selecting the community pump?
- What kind of energy source is available? If a pump uses costly fuel, or electricity that is not available, it will not be useful.
- Is the pump easy to repair with available spare parts? Would it be better to have a pump that breaks easily but is very easy to repair locally, or a pump that will break after many years but cannot be easily repaired by local people?

The rope pump: a low cost, easy way to lift water

The rope pump is based on an ancient design from China. It is used to pump water from wells up to 15 m deep with little effort. As a person turns the wheel, water is lifted and pours out of a spout at the top of the well.

This pump costs little to make and is easy to fix. The rope is the part most likely to break, but even if it is fixed rather than replaced, the pump still works. People in many countries have adapted rope pumps to fit their needs and the materials they have. (See Resources.)



The rope pump is made from low cost, durable parts.

Protect your Spring

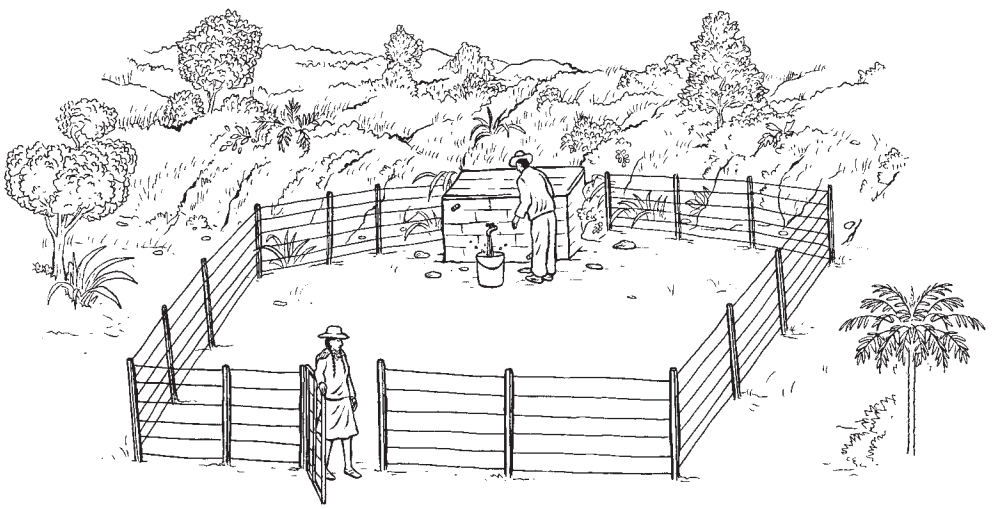
Springs are where groundwater naturally comes to the surface. Because spring water is filtered through rock and soil and moves quickly, it can be considered safe unless it is contaminated at the surface. To know if a spring is safe, find its source (where it comes out of the ground) and ask these questions:

- Is it the true source, or is there a stream or other surface water that goes underground above the spring? If so, what appears to be a spring may in fact be surface water that flows a short distance underground. In this case it will likely be contaminated, or may flow only during the rainy season.
- Are there large openings in the rock above the spring? If so, check the water in the spring after a heavy rain. If it appears very cloudy or muddy, contamination from surface runoff is likely.
- Is there a possibility of contamination near or just above the source of the spring? This could include pastures for livestock, pit toilets, septic tanks, use of pesticides and fertilizers, or other human activity.
- Is the soil very loose or sandy within 15 m of the spring? This could allow contaminated surface runoff to enter the groundwater.

Protect the area around the spring

Protecting a spring is cheaper than digging a well or borehole. Once a spring is protected it is relatively easy to run pipes from the spring closer to the community. To protect the area around a spring, fence the area all around it and dig a drainage ditch to carry away surface runoff and waste. This will also keep animals out.

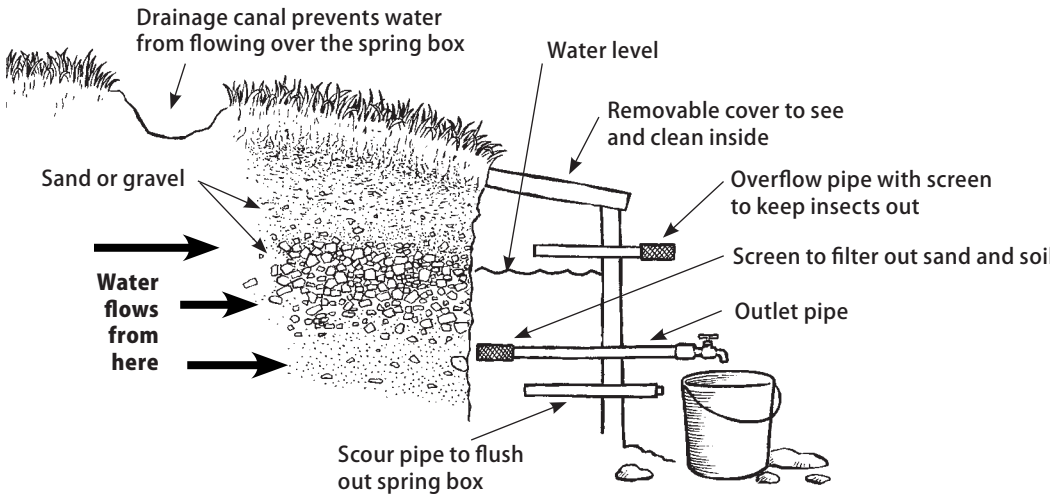
Plant native trees near the spring to protect it even more. Trees will prevent erosion, and make it a more pleasant place to collect water.



Build a spring box to capture the water

A spring box is a covered container made of masonry, brick, or concrete that helps protect spring water from contamination. A spring box also makes it easier to collect water at the spring or direct water into pipes to community taps or storage tanks. The kind of spring box that is best depends on the lay of the land and the materials that are available.

Parts of a spring box



This shows one kind of spring box with the hillside cut away to show what is inside.

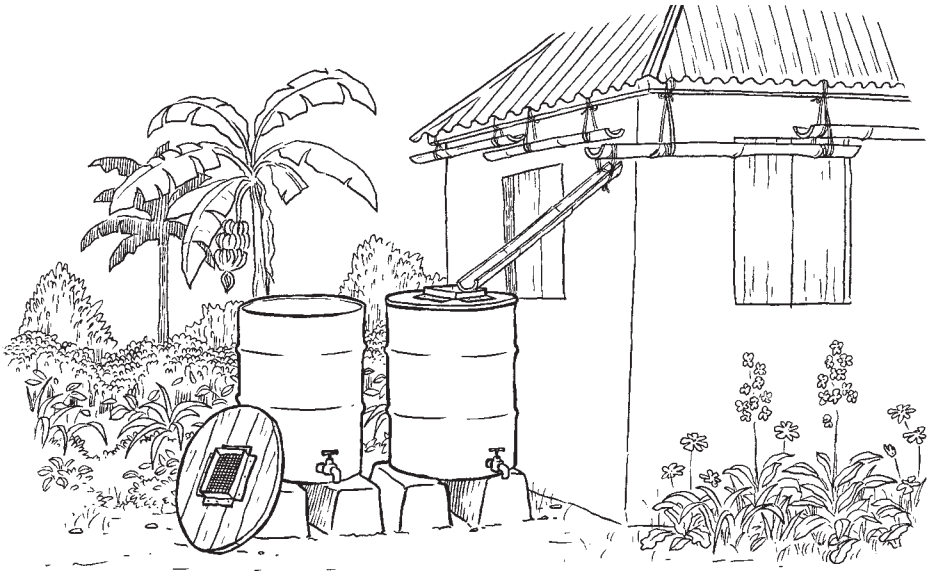
Pipes and spring boxes need cleaning often

Spring boxes need to be checked to make sure the spring continues to provide safe water. Silt, leaves, dead animals, and other things can collect in the pipes and spring box and block the pipes or contaminate the water. Put a wire screen on the pipe leading into the spring box to prevent unsafe things from entering pipes. Cleaning the screen every now and again will make sure there is a steady flow of water.

Collect Rainwater

Collecting rainwater is one of the easiest and most effective ways to have a safe supply of water. Rainwater is safe to drink except in areas with a lot of air pollution. Rainwater collection is a good solution to both water scarcity and water safety.

Above ground tanks can be placed next to the house. The roof will catch rainwater and divert it into the tank. Roofs made of tin or corrugated metal are best. Roofs made of thatch may collect too much dirt to be safe. Roofs made of lead, asbestos, or tar have toxic chemicals in them that will make the water unsafe to drink. Make sure your rain barrel is clean and was never used to store toxic chemicals, such as oil or pesticides.



Using a tin roof to collect rainwater

Ground **catchments** can collect surface runoff and rainwater. To make a simple catchment, dig a depression into the ground and press down the earth or line it with clay, tile, concrete, or plastic sheeting. These reservoirs can be used to give water to animals or to collect water for bathing. If a ground catchment is used for drinking water, it should be fenced to keep animals out. Water from ground catchments should be cleaned (see pages 92 to 99) before drinking.

Water collected on roofs or in ground level catchments can also be diverted into underground tanks for storage. This is a good way to keep water cool and covered. It may also be less costly than building or buying above ground tanks.

Make rainwater safe to drink

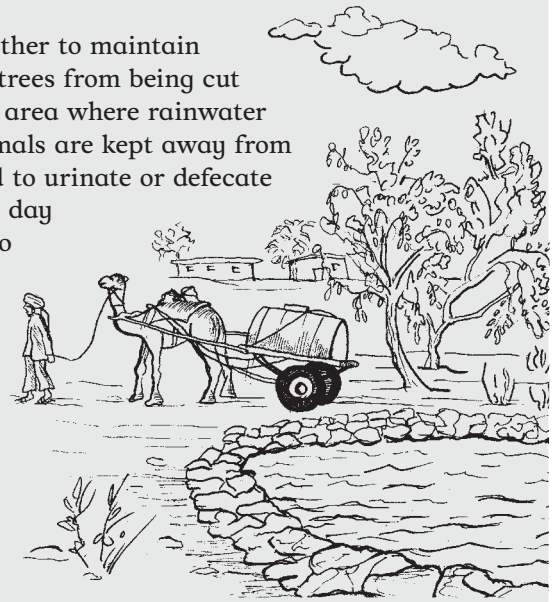
Rainwater must be kept free of contamination to be safe to drink. To make sure the water you collect will be safe:

- Clean the tank, entrance pipe, roof, and roof gutters before the rainy season.
- Never collect water in containers that have been used for oil, pesticides, or other toxic chemicals.
- Allow the first rains of each year to run through the tank to clean it.
- Cover the tank and place a filter or screen over the inlets to keep out insects, leaves, and dirt. This will also help prevent mosquitoes from breeding.
- Take out water through taps, if possible. If water is removed with buckets or other containers, make sure they are clean.
- For added safety, add chlorine to the tank (see page 99) or connect a water filter to the tank (see page 96).
- Do not stir or move the water. That way, any dirt or germs in the tank will settle and stay at the bottom.
- Sweeping the roof from time to time will also help keep collected rainwater clean.

Collecting rainwater in the desert

One way rainwater is collected in the Thar Desert of Rajasthan, India, is in village ponds, called naadi. Everyone in the village, and even people passing by, may use naadi water.

Everyone in the village works together to maintain the naadi. Ancient laws prohibit any trees from being cut near the edges of the naadi, or in the area where rainwater collects and runs into the naadi. Animals are kept away from the naadi, and people are not allowed to urinate or defecate near the naadi. Once a month, on the day of no moon, the entire village works to dig out any sand and silt that has collected in the naadi. Digging out the naadi makes it deeper and also removes germs that may have settled on the bottom. After digging it out, the villagers allow the water to settle so it becomes clear again. In these ways the community comes together to protect their water.



Safe Water Transport

Care must be taken to keep water safe and clean while it is being moved from its source to where people need it. Carrying water is some of the hardest daily work done in any community, and it is often done by women and girls. Carrying heavy loads of water on the head, on the back, or with a head strap can lead to frequent headaches, backache, harm to the spine, and can cause a pregnant woman to lose her baby due to strain.

Water improvement projects can reduce this burden. Sometimes simple changes can make it easier to carry water. Water systems can be built so there will be no need to carry water long distances. And homes can be built closer to the water source. Community health will improve if men understand the importance of this work in family life and share the tasks of collecting and carrying water.

Piped water

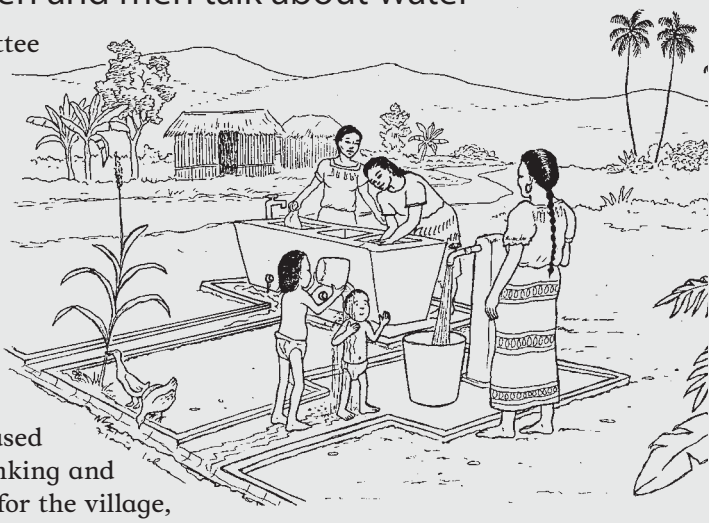
There are many advantages to a piped water system. Piped water reduces the risk of contamination and there are fewer places for snails and mosquitoes to live. However, a piped water system that is poorly built and used unsafely may make water contamination worse than no system at all. A piped water system must be planned carefully, with an understanding of how much water is needed and available now, and how much water may be needed in the future as your community grows.

Water can be piped from almost any water source, but springs and reservoirs are the most common. The least costly source is one that is uphill from the community, so that gravity will carry the water downhill. Most piped water systems bring the water to a large storage tank. The tank may be treated with chlorine or have a filter attached to treat the water. Water is then piped from the storage tank to taps in people's homes or to public water taps around the community.

A piped water system needs regular maintenance. Keeping records of where pipes are laid can prevent accidents and make it easier to find and repair broken pipes. Leaking pipes can waste a lot of water, draw in sewage and other contamination from the soil, and make breeding grounds for mosquitoes and snails. If pipes have been fixed with jute, hemp, cotton, or leather, germs may grow on these things and contaminate the water inside the pipes.

An important part of any piped water system is making sure that someone is responsible for fixing damage to the pipes.

Women and men talk about water



When the water committee in a small Mexican village planned to pipe water to the village from a large spring, they decided they had enough money to install a shared tap for every 2 houses. At the village assembly the men from the water committee announced that the taps would be used to provide water for drinking and cooking. This was good for the village, they said, because now the women would not spend all day carrying water from the river and boiling it to make it safe to drink.

A woman at the assembly stood up and asked, "What about washing clothes?" One of the men from the water committee said, "You can continue to wash clothes in the river as you always have done." A second woman stood up and asked, "What about bathing our children?" The man said, "You can continue to bathe the children in the river as you always have done." A third woman stood up and asked, "What about our home gardens? We need water to grow vegetables."

The women felt their voices had not been heard. They said there was not a single woman on the water committee and so women's needs would not be met. The women demanded that they be allowed to join the water committee and help make a new plan. The rest of the assembly agreed.

The new water committee made a different plan. Rather than a tap for every 2 houses, they would install a tap and a wash basin for every 6 houses. Though the women would still walk to collect water, they would also be able to wash clothes, bathe children, and clean maize right in the village. The tap would be used for drinking water and the washbasin for everything else. This would help make sure that the drinking water stayed clean. And they would use the wastewater from the washbasin to water their home gardens.

The plan was popular among the men as well because it would give them a place to wash their tools when they returned from the cornfields each day. In this way, the villagers met many of their needs at once.

Store Water Safely

If water is not handled carefully while it is being collected, carried, and stored in containers, it can be easily contaminated. Water stored in tanks with cracked walls, or containers with loose, poorly made, or missing covers can be contaminated by animal waste and germs.

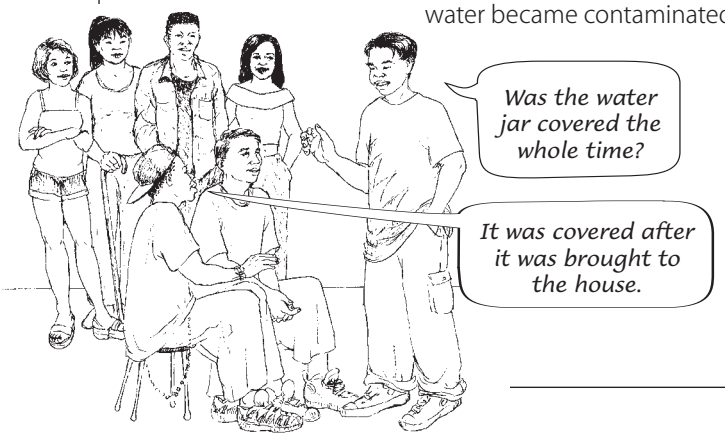
Detective story: **How did the drinking water get contaminated?**

This activity helps explore how water drawn from a well, spring, or tap can become contaminated before it is consumed. It can be done with 4 people or more.

Time: ½ hour

1. The facilitator explains to the group they are health detectives, then gives the detectives their briefing. Here's an example: 10 families collect clean drinking water from a well. During the next few days, children from one family become sick from drinking contaminated water at home. The other families are fine. The task for the detectives is to find out how the water became contaminated after it was drawn from the well.
2. The facilitator asks for 1 to 3 volunteers. Away from where the rest of the group can hear, the facilitator explains that their role is to give "clues" as the group asks questions to try to discover how the water became contaminated. Then the facilitator can either tell the volunteers, or ask them to quickly decide, how the water got contaminated before they rejoin the rest of the group.
3. The group then takes turns asking the volunteers questions, who respond with "clues" until someone is able to guess correctly how the water became contaminated.
4. If the group is large, it can be divided into several teams. Limit the number of questions, for example, allow each team or person up to 4 questions. The first person or team to guess the right answer wins.

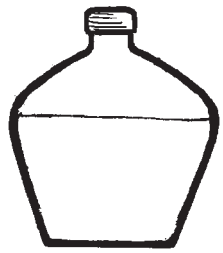
Repeat the activity several times with different ways the water became contaminated. Afterwards, the facilitator can lead a discussion to explore the different ways that drinking water becomes contaminated. Talk about what can be done to keep drinking water clean and how to do that at home and throughout the community.



Keeping water containers clean

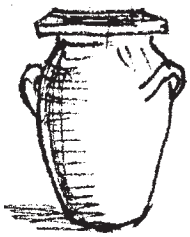
Stored water can become unsafe when it is touched by people with dirty hands, when it is poured into a dirty container, when dirt or dust gets in the water, and when dirty cups are put into it. To prevent water from becoming unsafe at home:

- Wash hands before collecting and carrying water.
- Clean and cover the container that is used to carry water.
- Regularly clean the container where water is stored in the house.
- Keep water containers off the floor and away from animals.
- Pour water out without touching the mouth of the container, or use a clean, long-handled dipper to take water out of the container.
- Clean all cups that are used for drinking.
- Never store water in containers that have been used for pesticides or toxic chemicals.
- If possible, do not treat more water than you need for short-term use. For drinking and cooking, that is usually less than 5 liters for each person each day.



Narrow mouthed containers are safest for storing water.

Cover tanks and cisterns

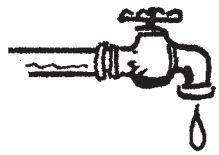


Covered tanks and cisterns are safer for storing water than open ponds because mosquitoes and snails cannot live in closed tanks. Covering storage tanks also reduces water loss from evaporation. If water is stored in ponds or ditches, digging them deeper will expose less water to the air and so will reduce the amount lost to evaporation.

Cisterns should be placed as close as possible to where the water will be used.

Fix leaks

A lot of water can be lost through leaks, evaporation, and seepage. To save water, make sure taps are closed when they are not in use. Fix or replace broken or leaky pipes and cracked tanks as soon as leaks are found. Leaks are also a sign of possible contamination, because germs and dirt enter the cracks in tanks and pipes.



Make Water Safe to Drink

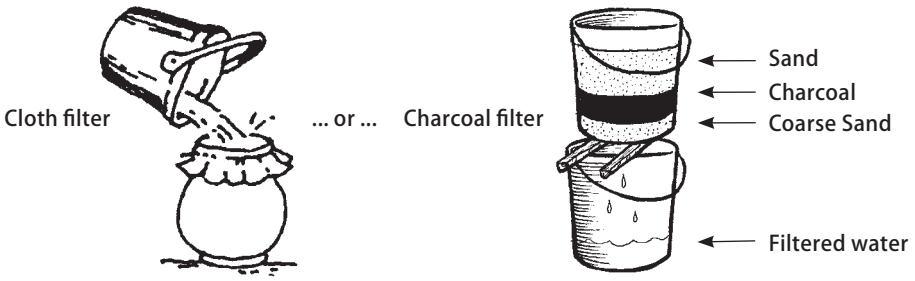
It is better to protect and use a source of safe water, such as a spring or protected well, than to treat and use water from a contaminated source, such as a river or waterhole. But water from any source will need to be treated if it has been contaminated, if people refuse to drink it due to color or taste, or if it is carried and stored in the home. (Water from pipes, tanks, and wells will also need treatment before drinking if it has been contaminated.)

The methods you choose to treat water will depend on how much water you need, what it is contaminated with, how you will store it, and what resources are available. No matter how it is treated, it is best to either let the water settle and pour it into another container, or to filter the water before disinfecting it (see page 94). This removes the sediment (particles of dirt). Removing sediment makes disinfection easier and more effective.

The methods shown here do not make water safe from toxic chemicals. Water that contains toxic chemicals is never safe for drinking, bathing, or washing clothes. It may lead to cancer, skin rashes, miscarriages, or other health problems.

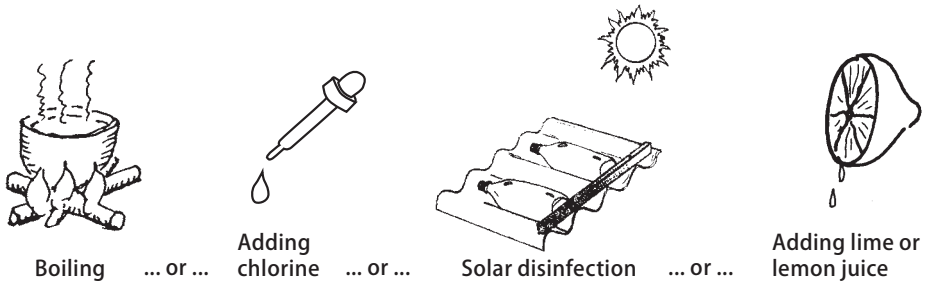
To make water safe from germs, follow these 2 steps, filter and disinfect:

1. First, let the water settle for a few hours and pour it into a clean container, or filter it:



See pages 93 to 97 for other ways to settle and filter water.

2. Then, disinfect the water using 1 of these methods:



IMPORTANT: Only after the second step is the water safe to drink.

Settling water

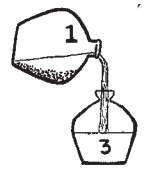
Settling water allows dirt, solids, germs, and worms that cause some illnesses to fall to the bottom of the container. Storing water for 5 to 6 days will reduce the number of germs in the water. But some germs, such as **giardia,** will not be killed by any length of storage. For this reason, use another method after letting water settle to make it safe, such as filtering, chlorinating, or solar disinfection.

3-pot method

The 3-pot method settles water so germs and solid matter fall to the bottom. This method is safer than settling water in 1 pot, but it does not make the water completely free of germs. The 3-pot method should always be followed by disinfection (see page 97).

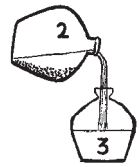
Morning, Day 1: Fill pot 1 with water. Cover the top and let it settle for 2 days.

Morning, Day 2: Fill pot 2 with water. Cover it and leave for 2 days. The dirt in pot 1 is beginning to settle.



Morning, Day 3: Pour the clear water from pot 1 into empty pot 3, making sure not to pour out the sediment at the bottom of pot 1. The water in pot 3 is now ready for disinfecting. The dirty water and sediment left in the bottom of pot 1 can be poured out. Wash pot 1 and refill it with water. Cover it and let it settle for 2 days. (It will be poured out and ready for disinfecting on Day 5.)

Morning, Day 4: Pour the clear water from pot 2 into pot 3 for disinfecting. Wash pot 2 and refill it with water.

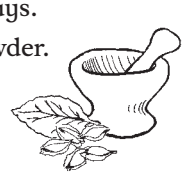


Every few days, wash the clear water pot (pot 3) with boiling water. If you use a clean hose to siphon water from one pot to the next, the sediment will be less disturbed than if you pour the water.

Using plants

In many places, people use plants to make water safer to drink. Moringa seeds are used in East Africa. Moringa is called malunggay in the Philippines, horseradish tree or drumstick tree in India, and benzolive tree in Haiti and the Dominican Republic. To use moringa seeds:

1. Dry the seeds for 3 days.
2. Grind the seeds to powder. It takes 15 ground moringa seeds to clear 20 liters of water.



3. Mix the powder with a little water to make a paste, and add it to the water.
4. To dissolve the paste, stir for 5 to 10 minutes. The faster it is stirred the less time is needed.
5. Cover the container and set it aside to let it settle. After 1 to 2 hours, pour the water into a clean container. Be careful to leave the solids in the first container.

Filtering water

There are many ways to filter water to make it safer from germs. Some filters, like the ceramic filter below, require special equipment. Others need no special equipment and can easily filter small or large amounts of water before disinfecting.

Cloth filters

In Bangladesh and India, a filter made of finely woven cloth is used to remove cholera germs from drinking water. Because the cholera germ often attaches to a tiny animal that lives in water, filtering out these animals also filters out most cholera germs. This method also filters out guinea worms.

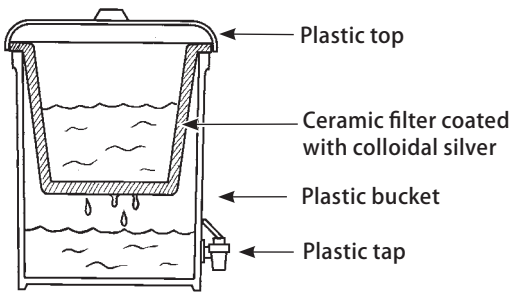
You can make a cloth filter out of handkerchiefs, linen, or other fabric such as the cloth used to make saris. Old cloth works better than new cloth because worn fibers make the spaces in the weave smaller and better for filtering.

3. Let water settle in a container so that solids sink to the bottom.
4. Fold the cloth 4 times and stretch or tie it over the mouth of another container or water jar.
5. Pour water slowly from the first container through the cloth into the second container or jar.

Always use the same side of the cloth, or germs may get into the water. After using the cloth, wash it and leave it in the sun to dry. This kills any germs that may be left in the cloth. In the rainy season, disinfect the cloth with bleach. Be sure to clean the container you use to store the filtered water in, at least every 2 to 3 weeks.

Ceramic filters

A small water filter can be made from fired clay coated with colloidal silver (a substance that kills germs). With basic training, any potter can easily make these filters. (For more information, see Resources.)



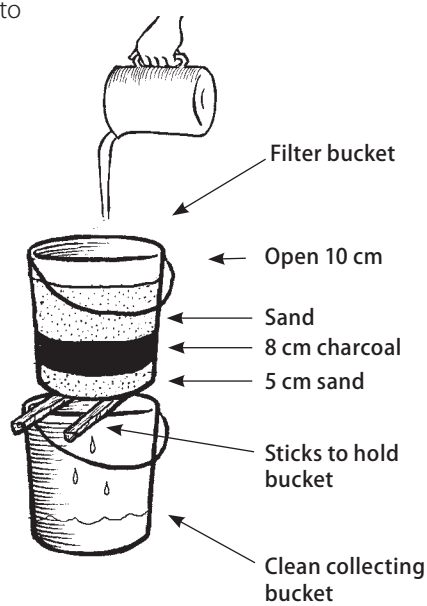
Ceramic filter used inside a plastic bucket

How to make a charcoal filter

This filter is easy to make and removes most germs from small amounts of water.

Materials: 2 metal or plastic buckets, a hammer and 1 or 2 large nails, a bucket of coarse sand (not sea sand), a quarter bucket of wood charcoal

1. Make holes in the bottom of 1 of the buckets. Wash the bucket. This is now the filter bucket.
2. Clean the sand by rinsing it in water and draining until the water that drains off is clear.
3. Crush charcoal into small pieces. Activated charcoal works best, but ordinary wood charcoal will also work. Never use charcoal briquettes! They are poison!
4. Put a layer of washed sand 5 cm deep into the filter bucket and pour water over it. Water should run out through the holes. If no water runs out, make the holes bigger. If sand runs out, the holes are too large. If this happens, remove the sand, place a thin cloth over the holes, and replace the sand.



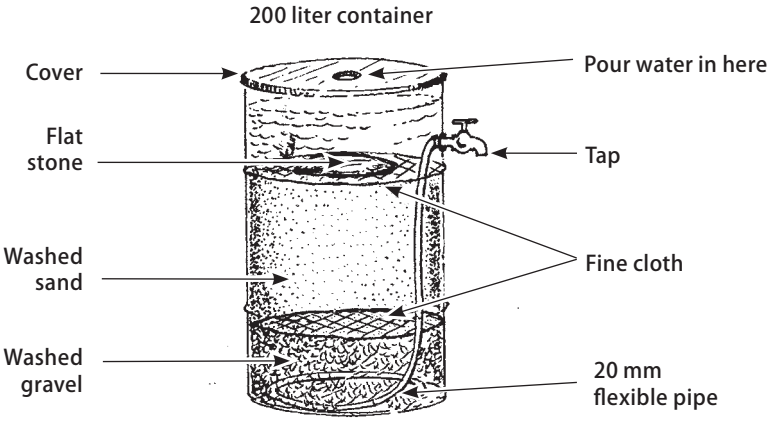
5. Place a layer of crushed charcoal about 8 cm deep on top of the sand. Now fill the bucket with more sand, until the sand is 10 cm below the top of the bucket.
6. Place 2 sticks on top of the second bucket and set the filter bucket on these sticks. Pour clean water through the filter bucket several times until the water comes out clear into the collecting bucket. Now the filter is ready for use.
7. To use the filter, allow the water you collect to settle before pouring it through the filter. Drinking water collects in the clean, bottom bucket. To be safest, after filtering, disinfect the water (see pages 97 to 99.)

Because the germs that are filtered out will grow on the charcoal, it is important to remove and clean the charcoal every few weeks if the filter is used daily, or any time the filter has been unused for a few days.

How to make a household slow sand filter

This is one of the safest, most effective, and cheapest ways to filter water for a household. This filter can treat enough water for a small family (at least 50 liters per day).

1. Clean a watertight 200 liter container and disinfect it with bleaching powder. Make sure the container did not contain toxic materials.
2. Drill a hole ¼ to ⅓ of the way down from the top of the container for the valve or tap. The hole should be sized for the fitting on the tap. (For example, if the tap has a 12 mm fitting, the hole should be 12 mm wide.)
3. Fit the tap to the hole and fix it in place with hard-setting putty. If a brick container is used, the valve can be cemented within the wall.
4. Prepare the flexible water collecting pipe. Drill or punch many small holes in the first 35 cm of the hosepipe, seal the end, and form it into a ring on the bottom of the container with the holes facing downward.
5. Connect the top of the hosepipe (the end with no holes) to the tap. Seal the pipe fittings with hose clamps or wire.
6. Place a layer of clean gravel 7 cm deep on the bottom of the barrel to cover the water-collecting pipe. Cover the gravel with fine cloth and fill the barrel with clean river sand to about 10 cm below the tap. Then cover the sand with a second fine cloth.
7. Make a cover for the container, with a hole in it to pour water through. Place a flat rock or dish under the hole to prevent disturbing the sand when water is poured in.
8. Flush the filter with water. Once the filter is cleaned, it is ready to use.



To use and maintain a slow sand filter

After a few days of use, a layer of green scum (bacteria and algae) will grow on top of the sand. This helps to treat the water, so do not remove it. For this scum to work, the sand must always be covered with about 5 cm of water. (This is why the tap is placed above the sand layer.) Fill the filter daily and remove water only in small amounts. If the filter is drained completely it will not work well, and will need to be cleaned and refilled.

Allow solids to settle out of the water before pouring it into the filter. This will reduce the need to clean the filter because the water will be cleaner when it enters. Letting water flow like a waterfall as you pour it will add air into the water and make it taste better.

When the water flow from the tap slows down, clean the filter. Drain all the water and remove the green layer and about 1 cm of sand from the top. After many cleanings, when more than half of the sand has been removed, replace all the sand and gravel with new cleaned sand and gravel and start over. This may be necessary 1 or 2 times a year.

Arsenic filter

To filter out arsenic from water, add a container filled with iron nails to the top of a slow sand filter. Use 5 kg of the smallest sized iron nails. Do not use "galvanized" nails because the nails must be able to rust for the filter to work. Arsenic binds to the rust on the iron nails and is removed from the drinking water. If possible, test the water after it has been filtered to be sure that the filter works in your area. (For more information, see Resources.)

Disinfecting water

Disinfecting water kills germs and worms, making water safe to drink. The best methods are boiling, solar disinfection, or using chlorine.

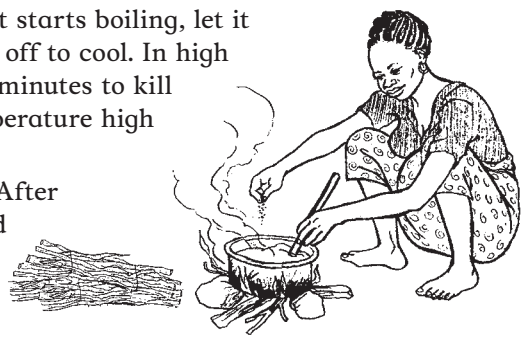
IMPORTANT: These methods will NOT make water safe from toxic chemicals.

Boiling water

Bring water to a rapid, rolling boil. Once it starts boiling, let it boil for 1 full minute before taking the pot off to cool. In high mountain areas, water needs to boil for 3 minutes to kill germs because water boils at a lower temperature high in the mountains.

Boiling changes the taste of the water. After boiled water cools, pour it into a bottle and shake it strongly. The shaking will add air to the water and improve the taste.

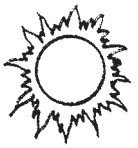
Where firewood is scarce, boiling water can be difficult. Planning to boil water after food is prepared but before the fire dies is one way to reduce your use of wood.



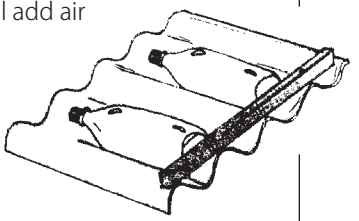
Boiling water for 1 minute makes it safe from germs.

How to disinfect water with sunlight

Solar disinfection is an effective way to disinfect water with only sunlight and a bottle. Filtering or settling the water first will make it clearer so it will disinfect more quickly. Solar disinfection works best in countries close to the equator, because the sun is strongest there. The farther north or south you are, the more time is needed for disinfection to work. (For more information about solar disinfection, see Resources.)



1. Clean a clear plastic or glass bottle, or a plastic bag. Bottles made of PET plastic work best.
2. Fill the bottle half full, then shake it for 20 seconds. This will add air bubbles to the water. Then fill the bottle or bag to the top. The air bubbles will help to disinfect the water faster.



3. Place the bottle where there is no shade and where people and animals will not disturb it, such as the roof of a house. Leave the bottle for at least 6 hours in full sun, or for 2 days if the weather is cloudy.
4. Drink directly from the bottle. This will prevent contamination from hands or other vessels.

Solar disinfection can be done faster and more completely by putting the bottle in a solar cooker (see page 364).

Use 1 lime or lemon for every liter of water.

Lime or lemon juice

Add the juice of a lime or lemon to 1 liter of drinking water and let it sit for 30 minutes. This will kill most cholera and some other germs as well. This does not make water completely safe, but is better than no treatment in areas where cholera is a threat. Adding lime or lemon juice to water before using solar disinfection or the 3-pot method will make the water safer.

Chlorine

Chlorine is cheap and easy to use to kill most germs in drinking water. But if too little chlorine is used, it will not kill germs. If too much is used, the water will taste bad. Chlorine is best used in community water systems, because it can be difficult for a single household to do it well all the time. To use chlorine to disinfect household water, follow the instructions on the next page.

Large amounts of chlorine are harmful to people and the environment, but the amounts used to disinfect home and community water are generally safe. It is safer to disinfect water with chlorine than to risk the health problems caused by germs.

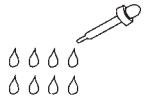
How much chlorine to use?

The amount of chlorine needed to disinfect water depends on how contaminated the water is (how many and what kinds of germs it contains). The more germs there are in the water, the more chlorine you need to get rid of them. It is important to add enough chlorine so that some is left in the water after the germs are killed. The chlorine that is left is called free chlorine. This will kill any new germs that get into the water. If the water has free chlorine in it, it will smell and taste just slightly of chlorine. This tells you it is safe to drink. If it has too much, the smell and taste will be strong and unpleasant.

To use the right amount of chlorine, you need to know how strong your chlorine solution is. Chlorine comes in different forms — gas, bleaching powder, high-test hypochlorite (HTH), and household liquid bleach. But household bleach is the form of chlorine that is easiest to find.

Household bleach may have different amounts of chlorine. Most common are 3.5% and 5%. This book shows how to disinfect water with 5% chlorine household bleach. Read the label to see what percent of chlorine is in your bleach. If it is less than 5%, you will need to add more bleach to the water.

If there is a lot of solid matter in the water, the chlorine will not work as well, so filter the water or let the water settle. Pour the clear water off into a clean container and then add chlorine. If you cannot filter the water or the water is cloudy, use twice as much bleach as what is shown in the chart below.

Water	5% Chlorine Bleach
For 1 liter or 1 quart 	 2 drops
For 1 gallon or 4 liters 	 8 drops
For 5 gallons or 20 liters 	 ½ teaspoon
For a 200 liter barrel 	 5 teaspoons

Add these amounts of bleach to filtered or settled water and wait at least 30 minutes before drinking. If the water smells and tastes just slightly of chlorine, it is safe to drink. If you do not have a dropper, you can dip the spoon in the bleach and let the drops fall one by one off the side of the spoon.

Wastewater: A Problem or a Resource?

Because the amount of water in the world stays the same, all water is used over and over again. But runoff water and water that has been used for washing, farming, sanitation, or industry often contains germs and chemicals that make it unsafe for drinking, bathing, or washing.

Water that is not contaminated with toxic chemicals or human waste can be reused after simple treatment. The method best suited for your household or community depends on the amount of wastewater to treat, what it is contaminated with, what it is to be used for, and how much time, space, and labor you have to treat the water.

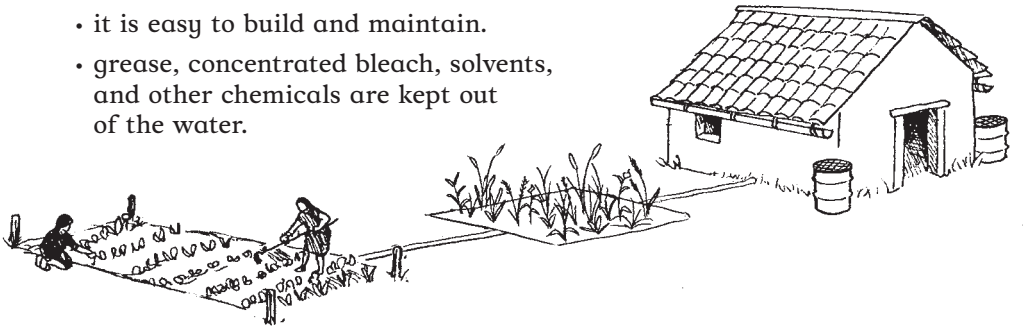
Greywater solutions

Greywater is wastewater that has been used for washing and other household chores, but does not contain human wastes. As long as you do not use toxic soaps or cleaners (see page 373 for how to make safer cleaning products), greywater needs only simple treatment before being reused in the garden, or no treatment at all before being disposed of into the ground.

IMPORTANT: Greywater is never safe for drinking.

There are many different types of greywater systems (see Resources). Any greywater system works best when:

- it is easy to build and maintain.
- grease, concentrated bleach, solvents, and other chemicals are kept out of the water.



Constructed wetlands (reed beds) filter greywater

One way to treat greywater is to copy nature's way of cleaning water by making a wetland. Constructed wetlands (also called reed beds) treat greywater by filtering water through layers of plants, soil, and rocks. Nutrients in the wastewater feed the plants, and the plants add oxygen to the water, which helps clean it. Reed beds also:

- provide irrigation water for food crops.
- grow plants you can harvest for other uses, such as bamboo or reeds.
- replace stagnant water with beautiful gardens.

IMPORTANT: Constructed wetlands cannot treat solid human wastes (feces).

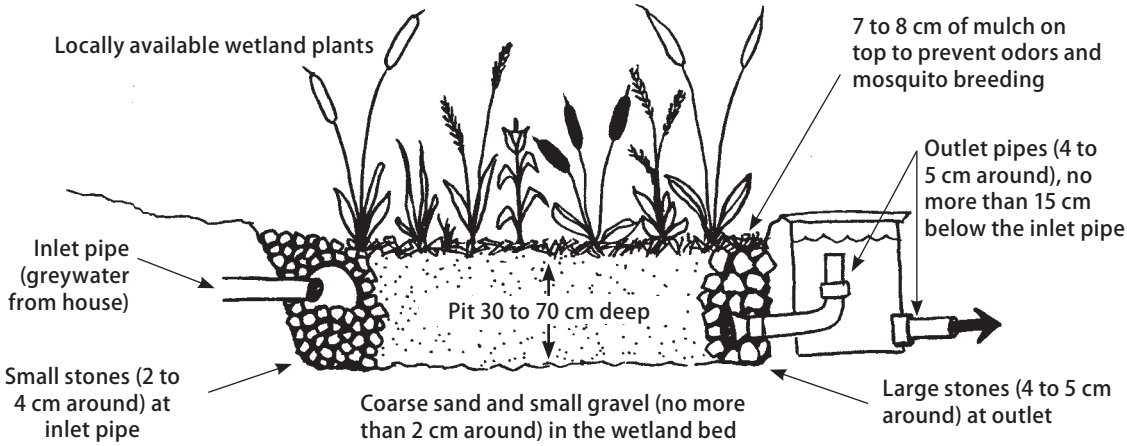
To make a constructed wetland

In planning a constructed wetland, consider these issues:

- How much area do you need and how deep does it need to be? The more water that flows through the system, the bigger and deeper it needs to be to safely filter greywater. If water flows too quickly, the reed bed cannot clean it well.
- Is the water source higher than the wetland? Water must flow through the wetland, so it needs to come from a source above, or be pumped.
- Where will cleaned water flow to? Can it be collected in a storage tank or directed to a garden?

Wetlands can be built anywhere there is enough space. If there is little space, they can be built above ground in basins, such as a 200 liter drum. In areas with well-drained soil or high groundwater, dig a pit and line it with thick plastic or cement. In areas with clay soil, no lining is needed.

To maintain a constructed wetland



A constructed wetland dug into the ground can treat large amounts of greywater.

Every constructed wetland has different needs depending on the amount of water, the type of soil and plants, and other conditions. Experiment to find the best way to make your constructed wetland work.

- **If plants dry out or die,** not enough water is running through. More water sources can be added to the system, the pit can be made smaller or less deep, or new plants can be added.
- **If water does not flow through,** try bigger stones and less sand, or lower the outlet pipe.