

15 Sustainable Farming

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Sustainable Farming



Sustainable farming means farming for the long-term health of people and the land. Farmers who use sustainable methods try to meet the needs of their families and communities for nutritious food while also conserving water, improving soil, and saving seeds for the future.

Most food comes from the land. But many people do not have enough land, or any land at all, to meet their needs for healthy food. Sustainable farming, cooperative food marketing (see page 313), and fair distribution of food can help to overcome these difficulties.

Farmers are caretakers of the land, and they are experts at what they do. Farmers develop methods of sustainable farming, and change and adapt these methods to serve the needs of their communities and the conditions of the land they work. Sustainable farming in cities and towns, or in areas that have been farmed for generations, helps solve problems of hunger, migration, loss of valuable soil, and contamination of water supplies.

Sustainable farming methods are not only for farmers. They are also valuable for home gardeners, health and development workers, and anyone who wants to begin a community garden or a city farm to improve nutrition, food security, and community health.

Juan, Pedro, and Hurricane Mitch

Juan's grandfather once grew plenty of food in the valley where he lived in Honduras, Central America. But when a fruit company bought his land, he moved up into the hills. There he taught his son, Juan's father Aurelio, how to clear the hillside of trees, and burn out the stumps. After each harvest, they burned the cornstalks and bean vines to make more ash to fertilize the soil.



Aurelio taught Juan to farm in the same way. But by the time Juan was a young man, the soil was tired and the harvests were poor. Juan could not clear new land because other farmers, fruit companies, and cattle ranchers owned all the nearby land.

Juan cut down all the trees on the hillside and planted as much corn, beans, and vegetables as he could. But the corn gave only one small ear and insects damaged the beans. Like many of his neighbors, Juan bought chemical fertilizer to help his crops grow, and sprayed pesticides to kill the insects. Finding the money for these was hard, especially when the land still produced barely enough to feed his family.

When a big storm brought 4 days of hard rain and strong winds, hillsides became rivers of mud and houses fell down all over the countryside. Juan's crops were ruined. His soil washed away, leaving behind nothing but rocks. His farm was destroyed, and he had to start all over.

Juan's neighbor Pedro survived the storm better. Pedro grows his corn, beans and vegetables between trees that produce fruit, shade, and fodder for his animals. Pedro does not burn his cornstalks and bean vines, but chops them up after the harvest and leaves them on top of the soil. Pedro also planted live barriers of agave cactus and other plants to keep soil from washing off his fields. After the storm, tree roots held most of the soil in place, and the barriers he made collected the rest.

"The different plants help each other and make the soil rich," Pedro says. "You would not even know we had a storm here. The water just soaked in better because my soil is like the soil in the forest."

With help from Pedro, Juan began to restore his field. He began by planting a bean crop as a green manure to restore soil fertility. He also planted live barriers and a variety of trees. Soon, other neighbors began trying these methods as well. Juan and the other farmers in the area have hope these sustainable methods of farming will help their families survive future storms.

As he watches his young plants and trees grow, Juan thinks of his children who will use this small piece of land to support their children for many years to come.

Farming for Health and a Better Life

Sustainable farming methods not only provide food, but they also build fertile soils, protect water, preserve valuable seeds, maintain **biodiversity**, and make sure the land will be able to sustain life for future generations. Using sustainable methods to grow food allows farmers and gardeners to grow more in less space, with few or no chemical pesticides and fertilizers. This can result in more and better food to eat and sell, less cost for producing food, and less pollution of the air, water, land, and our bodies. Sustainable farming improves people's health because it:

- reduces the threat of drought by conserving water.
- reduces dependence on chemicals, saves money, and builds self-reliance. Farming without chemicals prevents the health problems chemicals cause for farmers, farm workers, and everyone who eats the food that is produced or drinks the local water.
- decreases the amount of work needed to produce food when sustainable methods, such as green manures, are used. This is especially important when migration, HIV and AIDS, and other problems make it harder for people to work the land.

Sustainable farming makes the land more productive, so fewer people are forced to leave for the cities. Improving soil, conserving water, and saving seeds sustains farms and farming communities.

Principles of sustainable farming

Sustainable farming works best when farmers learn how to work with local conditions, and share what they learn with other farmers. Some general guidelines for sustainable farming are:

- **Healthy plants need healthy soil.** To use natural fertilizers to improve soil quality, see pages 282 to 288. To protect soil from erosion, see Chapter 11 and pages 289 to 293.
- **Save water and protect water sources.** Methods for conserving water are described on pages 294 to 295.

The green manure we planted last season really helped the soil.

The maize plants grew bigger, with larger ears than ever before!

And there was less weeding to do because the field was covered in crops all year.



- **Save seeds** from each season's crop to plant the next season. For information about saving seeds, see pages 303 and 246 to 247.
- **Control pests and plant diseases naturally.** To learn about natural pest and disease management, see pages 296 to 301.
- **Plant a variety of crops.** Plant mixed crops and change where they are planted each year. This keeps nutrients in the soil and improves people's health by providing a variety of foods to eat. It also controls pests and plant diseases (see page 300).
- **First make small changes.** Most crops have been improved over hundreds and even thousands of years by farmers trying new methods. But not all new methods succeed. Try new ideas in a small field or garden first. If they fail, you will still have food from the rest of your land.

Improving Soil

Farmers know that healthy soil is necessary for good crops. Many farmers enrich soil with natural fertilizers, such as animal manure, green manure, and compost. Natural fertilizers are healthier for soil, plants, water, air, and people than chemical fertilizers. They add all the nutrients plants need at little or no cost.



**Sustainable farmers not only grow crops
— they grow fertile soil that has all the
nutrients plants need.**

Know your soil

Soil is a mix of sand, silt, clay, and organic matter (for example, insects, bacteria, green leaves, rotting plants, and manure). The amounts of each of these things, and the way you work the land, affect the soil texture (how coarse or fine it is), fertility (how rich it is for growing crops), and soil structure (how the soil holds together). A soil that has good texture, structure, and fertility allows air, water, nutrients, and plant roots to move through it. This improves the soil's ability to grow crops and resist erosion.

In addition, some soils are alkaline (also called “basic” or “sweet”) while others are acidic (also called “sour”). You can learn the “pH” of your soil (how sour or sweet it is) by having it tested or simply by tasting it to see if it is sweet or sour. Most plants grow best in soils that are neither too sweet or too sour. Adding specific nutrients can make soils sweeter or more sour (see page 288). Adding organic matter tends to improve all soils.

Using heavy equipment to plow, till, turn over, or dig soil can make it become **compacted** (pressed down so tightly that no air or space remains). It is difficult for water or plant roots to get into compacted soil. It is also difficult for plants to get the nutrients they need from soil that is compacted.

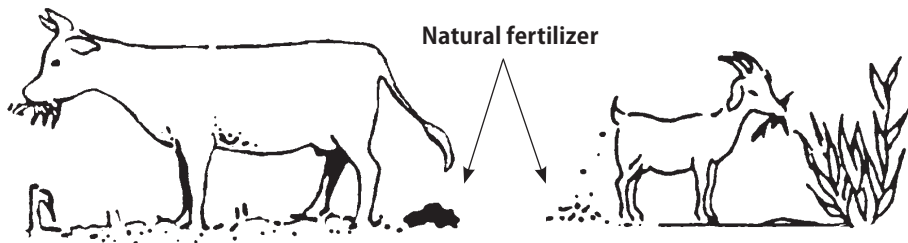
To prevent compacting soil, clear and turn over soil when it is not too wet or too dry, but moist like a wrung-out cloth. Many farmers turn their soil as little as possible, add animal manure and crop wastes, and use methods such as planting pits (see page 295) or green manures (see page 285) to make the soil loose for planting.

Chemical fertilizers may help now, but can harm later

Chemical fertilizers are costly to both the farmer and the farm because they damage soil, pollute water, and create the need for more chemicals. If you look at a bag of fertilizer from the store, it will have the letters N-P-K. These letters stand for the main nutrients that plants need (N is Nitrogen, P is Phosphorous, and K is Potash, or Potassium). Chemical fertilizers have these chemicals in **concentrated** (very strong) amounts. When these concentrated nutrients are washed from fields into groundwater and waterways, they can make the water unhealthy for drinking, washing, and bathing.



Chemical fertilizer



The biggest problem for growing crops with chemical fertilizers is that farmers who use them often stop adding organic matter, such as animal manure, to the soil. This very quickly causes soils to lose nutrients and become compacted, leading to pest problems, poor harvests, water loss, and more dependence on chemical fertilizer. If you use chemical fertilizers, it is important to add natural fertilizers along with them.

Learning about soil

Purpose: This activity helps show how different farming practices affect the soil

Time: 3 hours

Materials: digging tools, 3 boards or pieces of cardboard, water, paper, and a pencil or marker



- 1 Choose 3 parcels of farmland that have been used in different ways. For example, choose a field of maize or dry farmed rice, an orchard or home garden, and a plot that has been used for pasture for many years. The plots should be within easy walking distance from each other.
- 2 With a group of farmers, walk through each of the areas. Cross back and forth, looking at everything that may have affected the soil. What signs show how the land has been used? Are there signs of erosion (for example, gullies, bare or rocky spots of ground, richer soil at the bottom of hills than at the top)? Do the plants look healthy?
- 3 Talk to the person who farms each area to find out what practices they have used over the past 5 to 10 ten years. Do the group's observations match what you learn from talking to the farmers?
- 4 Dig a small pit about 50 cm deep in each parcel. Cut 1 wall of the pit so that it is straight down and flat. Using a flat shovel or a long machete cut a slice about 3 cm thick from the flat side of the pit. Lay this slice of soil gently on a board or flat surface. Label the soil sample to identify which parcel it came from.
- 5 When you have taken soil samples from all 3 areas, bring them to a meeting place where the group can examine them. What differences are there between the different soil samples? Look closely for differences in color, texture, structure, smell, and the presence or absence of worms and insects. Perhaps taste a small bit of each soil to compare the pH. Is it sweet or sour? Have different people take a little soil in their hands from different samples. Work in a small amount of water to each and say if it feels sticky, rough, smooth, or falls apart.
- 6 Discuss which of these differences may have been caused naturally by wind and weather, and which may have been caused by the way the land was used.

Using knowledge from the group, from this book, or from other sources, discuss ways to protect and improve the soil in the areas that will be used for farming. These ways may include adding natural fertilizers (see pages 285 to 289), protecting the soil from erosion (see pages 289 to 293), using sustainable grazing practices for livestock (see page 307 to 308), and trying other farming practices.

Green manures and cover crops

Green manures are plants that help fertilize the soil.

These same plants work as cover crops to choke out weeds. Since many plants do both these jobs, they are called by both names: green manures and cover crops.

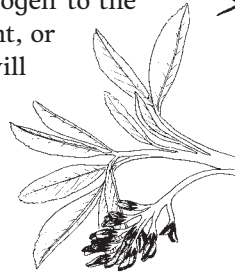


Fava bean
Vicia faba

Many green manures are from the “legume” family (plants with seed pods, such as peas, beans, and tamarind trees). Plants in the legume family add nitrogen to the soil. If you pull up a bean plant, or look at some tree roots, you will often see small balls formed on the roots. These little balls collect nitrogen from the air and put it into the soil. This makes the soil more fertile.



The small balls (nodules) on the roots of legume plants put nitrogen into the soil.



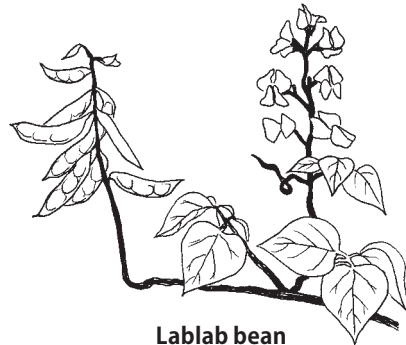
Alfalfa
Medicago sativa



Runner bean
Phaseolus coccineus



Sorghum
Sorghum



Lablab bean
Dolichos lablab



Velvet bean
Mucuna pruriens

Green manures have many benefits:

- They cover the soil, protecting it from erosion and helping it hold water.
- They add organic matter to the soil, making it more fertile.
- After using green manures for several years, the soil becomes easier to work.
- There are no costs for labor or transport because green manures grow right in the field where they are used.
- Planted with other crops, they control weeds and insect pests.

Green manures have other uses besides improving soil. Some provide food, such as oats, amaranth, rye, and beans. Others provide fodder for animals, such as alfalfa and clover. Plants such as Sudan grass and others in the mustard family prevent crop diseases. Trees used as green manures can provide firewood.

3 common ways to use green manures

- Grow them together with main crops such as maize, millet, and cassava.
- Plant them when the land is going to be left to rest (fallow). A 1-year fallow with green manure will improve soil and kill weeds just as well as a 5-year fallow with no green manure.
- Grow them during the dry season, after the main crop is harvested.

The best cover crop is a mix of plants. A grain that grows fast and tall will add organic matter to the soil, while a bean crop will add nitrogen and will cover the ground. Talk to other farmers in your region to learn what works best on your soils.



Grow the crop until harvest. Use the beans or grain for food or fodder, and then cut down the stalks.

Clear spaces in the cover crop and plant your next crop right into the ground.



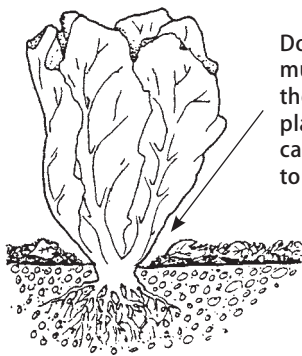
Mulch

It is best to keep soil covered, even during the growing season. **Mulch** is anything used to cover the soil. Mulch helps hold water, control weeds, and prevent erosion. Plant wastes, such as maize stalks, bean vines, or grasses make the best mulch, because they can be simply left to rot in the field, and they add organic matter to the soil. Weeds can be used in the same way, but they must be cut before they make seed to prevent them from growing back.

Mulch should not be more than 10 cm thick. A very thick mulch can hold too much moisture and cause plant diseases.



Straw and grass cuttings make good mulch because they break down slowly.



Do not let mulch touch the stems of plants. It can cause plants to rot.

Animal manure

Animal manures provide all the nutrients plants need, and over time improve soil texture, soil structure, and soil fertility. Chemical fertilizers, on the other hand, give crops only 2 or 3 nutrients and do not improve the soil.

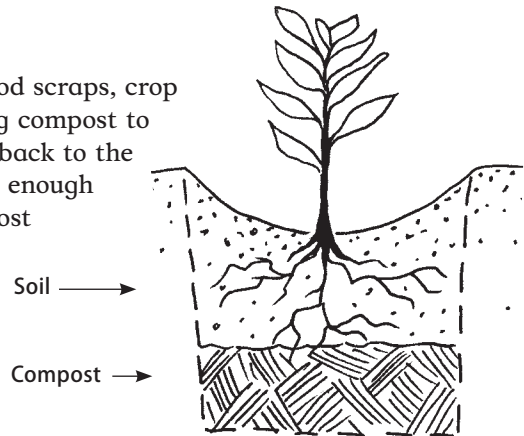
Some care must be taken with manure. Using too much manure will cause too many nutrients to build up in the soil and can pollute waterways. Fresh manure also carries germs that can cause illness. Do not put fresh manure near drainage ditches or waterways. Always wash your hands and your clothing well after handling manure.

Fertilizing with human waste

Human urine can be turned into fertilizer, and human feces when properly treated can add organic matter to the soil. But human waste carries harmful germs and causes illness if it is not properly handled. (To learn how to safely use human waste to improve crop yields, see Chapter 7.)

Compost

Compost is a natural fertilizer made of food scraps, crop waste, weeds, and animal manure. Adding compost to the soil is a way of adding crop nutrients back to the earth. It would take a lot of work to make enough compost for a large field, so compost is most often used on smaller plots. (To make compost, see pages 400 to 403.)



Compost can be used in many ways:

- Add a shovel full of compost in the bottom of planting holes before planting fruit trees.
- Mix a handful of compost with soil in planting holes when you plant seeds.
- Spread a layer of compost on top of your soil before turning it.
- While plants are growing, make a circle of compost around the plant stem. For a tree, make the circle where the edge of the tree's shade falls in the middle of the day. Cover it with a little soil. It will slowly feed the plant as water carries nutrients to the roots.

Compost tea

Compost can be used to make a liquid to fertilize plants and help control pests. Wrap some compost in a piece of cloth and tie it up. Put the cloth in a bucket of water for 7 to 14 days. When the water turns brown, take the cloth sack out. Spread the leftover compost in your field. Spray or sprinkle the compost tea on the leaves of your plants. Be sure to wash your hands after working with compost tea.



Other ways to add nutrients to soil

Other materials can be added to change soil pH (see page 282) and to add nutrients to the soil. Limestone, wood ash, and ground animal bones and seashells make soil less acid. The ground up animal bones also adds phosphorous and the wood ash adds potassium. Dried leaves and pine needles make soils more acid. Sugar cane that has rotted for at least a year and coffee pulp that is ground and dried add nutrients to soil, turning crop waste into fertilizer.

Ashes from wood fires can be dug into your garden soil to make it less acid.



Improving soil helps control weeds

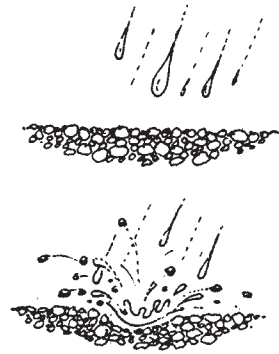
All of the methods of improving soil with organic matter, such as green manures, compost, and mulch, also help control weeds. When the soil is healthy, small amounts of weeds do not harm crop yields.



Weeds can also be controlled by planting crops close together so there is no room for weeds to grow, and by allowing animals to eat the weeds. Also, crops that are native to the area tend to be harmed less by local weeds. Over many years, locally bred crops adapt to weather, weeds, and pests, and do well where other crops or other varieties of the same crop may not.

Protecting Soil from Erosion

When soil is not protected, wind and water can erode or damage the thin layer of soil on top (**topsoil**) and also cause the soil to lose water. The soil that remains is often compacted, lacks nutrients, and is not good for growing crops. Preventing erosion and conserving soil and water are some of the farmer's most important jobs. (To learn more about preventing erosion, see Chapter 11.)



When rain hits bare soil, it washes it away.

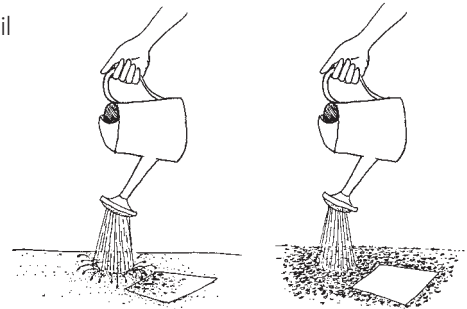
What rain does to bare soil

Purpose: To show the importance of keeping soil covered so it does not wash away

Time: 15 minutes

Materials: 2 pieces of clean paper or cloth, a watering can, or an old can with small holes in the bottom that makes water sprinkle like rain

- 1 Have the group meet on a piece of ground with no plants or weeds growing on it, just bare soil.
- 2 Place a piece of clean paper or cloth on the ground. Pour water from the sprinkler to make rain on the ground beside the paper or cloth.
- 3 See how many muddy spots were made on the paper or cloth when the water splashed on the ground. This is what happens when rain hits bare ground. The bare soil cannot hold the rain, and it washes away.
- 4 With a new piece of clean paper or cloth, repeat the activity in a place where the ground is covered by grass, weeds, or mulch. The second paper or cloth should have fewer muddy spots on it than the first one because the plants hold the water and help it sink into the ground.
- 5 Lead a group discussion of what happened and the importance of keeping the soil covered.

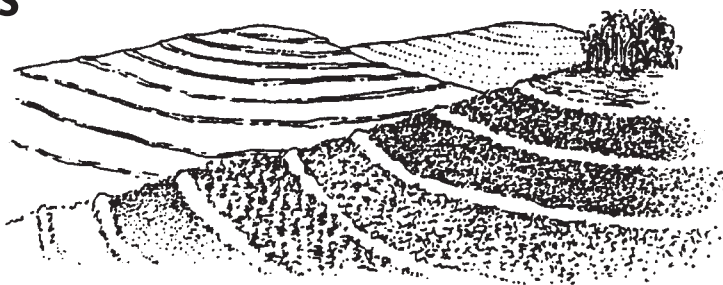


You may want to follow this activity with a farm experiment to show how mulch protects soil. Make a small demonstration plot and cover it with mulch after planting. Plant another plot with the same crop, but no mulch. At the end of the growing season, compare the results.

Contour Barriers

If you could make a path across a slope that would let you travel from one end to the other while always staying at the same level, you would be following the slope's **contour line**. Barriers built to follow **contours**,

such as walls, mounds, lines of grass or brush, or trenches, prevent soil from being carried away by wind and rain. They also help slow the downhill movement of water, spread it over the soil, and sink it into the ground. Plowing along contours, rather than up and down the slope, slows surface runoff and directs water toward your crops. A tool called an A-frame level can help you find your land's contour lines so you can build contour barriers.



How to make an A-frame level

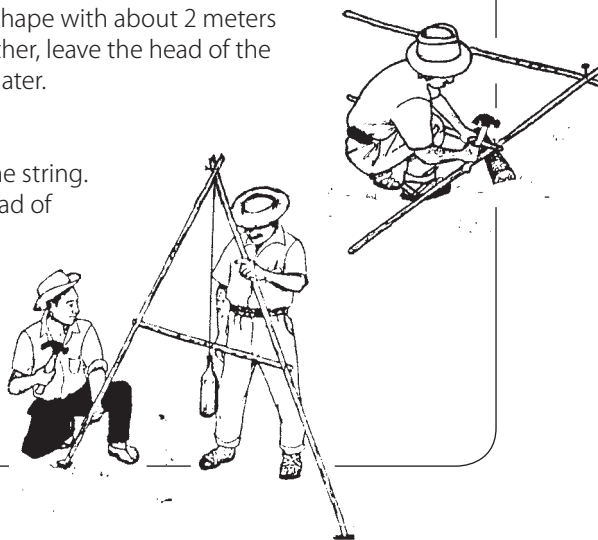
An A-frame level is a tool that can help you find contours. Use these materials:

- 2 sturdy sticks about 2 meters long and 2 cm thick to form the legs, and 1 stick about 1 meter long for the crossbar.
- 3 nails long enough to go through 2 sticks with a little sticking out.
- A bottle with a twist cap or cork, or a stone to use as a weight (about ½ kilo, or 1 pound).
- A string 2 meters long with a knot tied at one end.
- A pencil or pen, a hammer or stone, a machete or saw, and a tape measure.

1 Fasten the 2 legs together in a triangle shape with about 2 meters between the feet. If you nail them together, leave the head of the nail sticking out because you will use it later.

2 Fasten the crossbar to the legs.

3 Attach the weight (bottle or stone) to the string. Tie the other end of the string to the head of the nail so the weight hangs about 2 cm below the crossbar. If the bottle is plastic, fill it with water, sand, or soil and put on the cap or cork. The string with a weight on the end is called a plumb line.

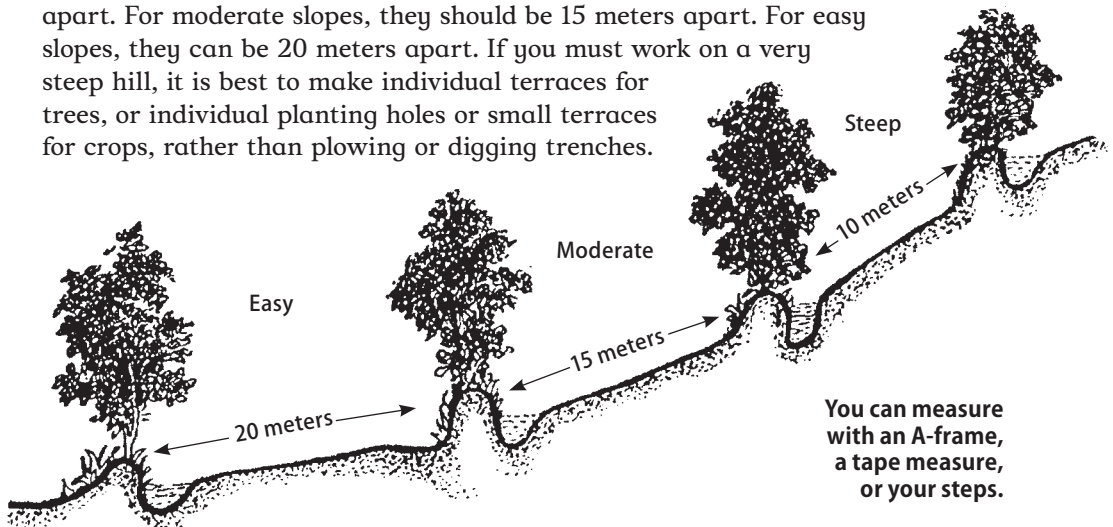


How to ready an A-frame by marking its center

- 1 Set the A-frame on a nearly flat piece of land. Mark where each leg stands. Make sure the plumb line can move freely, and then hold it still. Once the string stops moving, make a mark where the string touches the crossbar.
- 2 Turn the A-frame so the first leg is where the second leg was and the second leg is where the first leg was. Mark where the string crosses the crossbar. You will now have 2 marks on the crossbar.
- 3 Stretch a string between the 2 marks and fold the string in half to find the middle. Make a third mark there.
- 4 Set the A-frame on a flat place where the plumb line hangs right over the center mark on the crossbar. When the plumb line hangs at the center mark, the 2 feet of the A-frame are level (at the same height). Turn the A-frame and put each leg where the other was. It should still hang over the center mark. If the string does not hang over the center mark, repeat this process until it does.

Decide where to place each barrier

Once the A-frame is built, decide roughly how close together to place your barriers going down the slope. Your first barrier should be near the top of your field, to stop water from the fields above. Where you place the other barriers depends on the slope. For steep slopes, barriers should be about 10 meters apart. For moderate slopes, they should be 15 meters apart. For easy slopes, they can be 20 meters apart. If you must work on a very steep hill, it is best to make individual terraces for trees, or individual planting holes or small terraces for crops, rather than plowing or digging trenches.

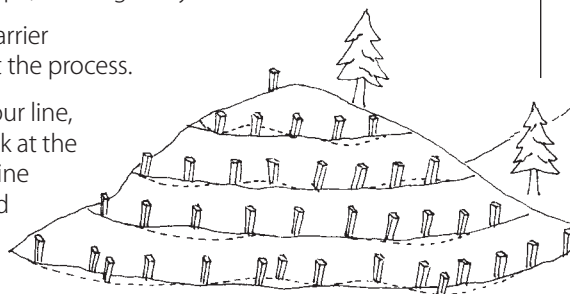
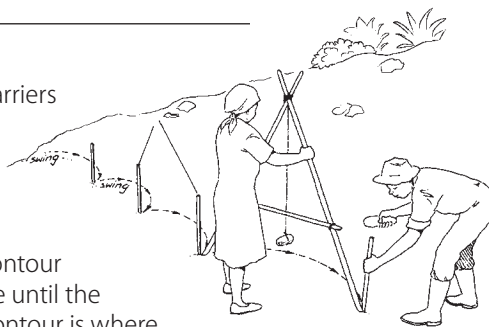


Also, consider the soil. Clay soil will not absorb water easily, so barriers should be a little closer together. If the soil is sandy or has a lot of organic matter, it will absorb water easily and barriers can be farther apart. When you have an idea of the distance you want between barriers, put stakes in the ground to mark them.

How to mark contour lines

The next step in preparing to build contour barriers is finding the contour lines.

- 1 At the top of the slope where you want the first barrier, place your A-frame so it goes across the hill, not uphill or downhill. Put one leg of the A-frame where you want the contour line to start. Move the other leg of the A-frame until the plumb line hangs over the center mark. The contour is where the feet of the A-frame are when the plumb line is on the center mark.
- 2 Put a stake next to the second leg of the A-frame.
- 3 Turn the A-frame to find the next level place across the hill, and repeat the first step. Continue to the end of the field or slope, marking every 2 meters with a stake.
- 4 Move to the next place you want a barrier (10 to 20 meters downhill) and repeat the process.
- 5 When you finish marking every contour line, stand at one end of each line and look at the line of stakes. Notice if each contour line is an even curve or not. You may need to move some of the stakes a little to make an even curve.



Contour lines marked with stakes

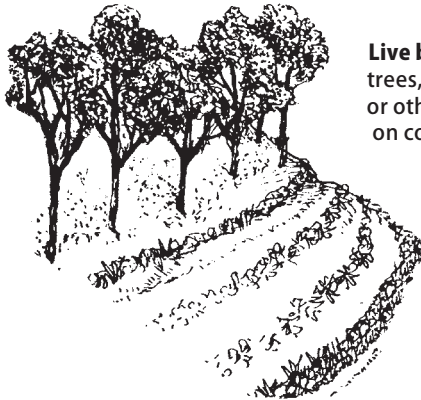
Guidelines for building contour barriers

Once contour lines are measured and marked, and as you decide what kind of barriers are best for your land, keep these general guidelines in mind:

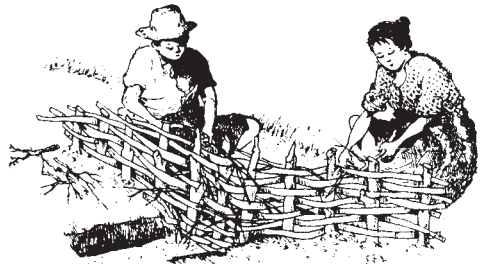
- **Preserve or plant trees and plants.** If the slope is very steep, the trees already growing there or trees you plant will protect it from collapsing. Grasses and plants with strong roots will help to hold soil and water.
- **Slow down water, but keep it moving.** It is important to keep water moving, whether down the slope or into the soil. Poorly planned barriers can lead to standing water, which lets mosquitoes breed and spread malaria and other illnesses.
- **Fix problems as soon as they happen.** Heavy storms may cause a contour trench to collapse or a wall to break. Fix it right away to prevent further erosion.
- **Start from the top.** Water runs downhill. By starting at the top, you protect everything below, and can use many small barriers.

Different types of contour barriers

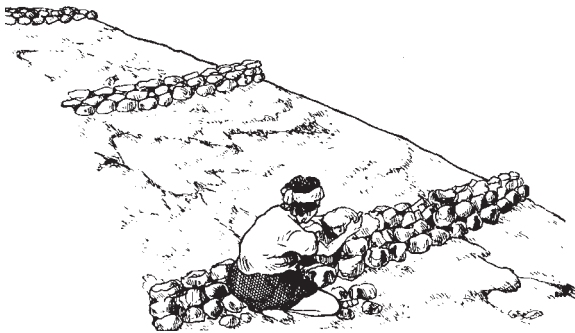
Use the contour barrier that is easiest to build and works best for your land.



Live barriers made of trees, shrubs, grasses, or other plants grown on contour lines hold water and soil.

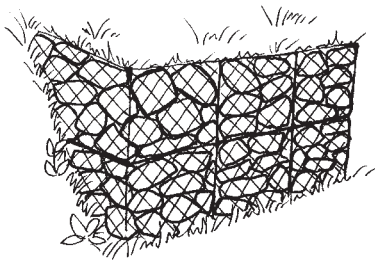
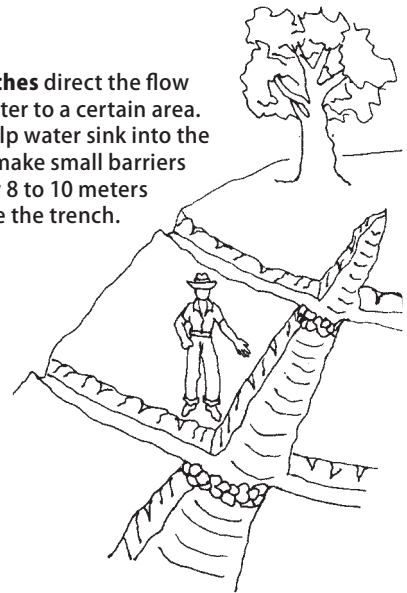


Check dams of brush, rock, or straw bales placed across gullies and eroded areas where water flows let the water through, but slow it down.



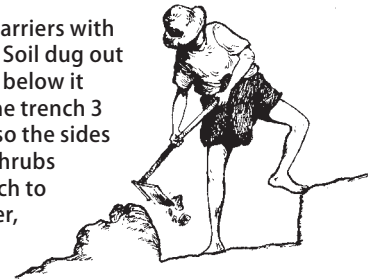
Walls 30 cm wide and at least 25 cm high, made of stone, earth, straw bales, or other materials will slow the water and help it sink into the ground.

Trenches direct the flow of water to a certain area. To help water sink into the soil, make small barriers every 8 to 10 meters inside the trench.



Gabions are wire cages fixed to the sides of a gully and filled with stones that catch and hold soil.

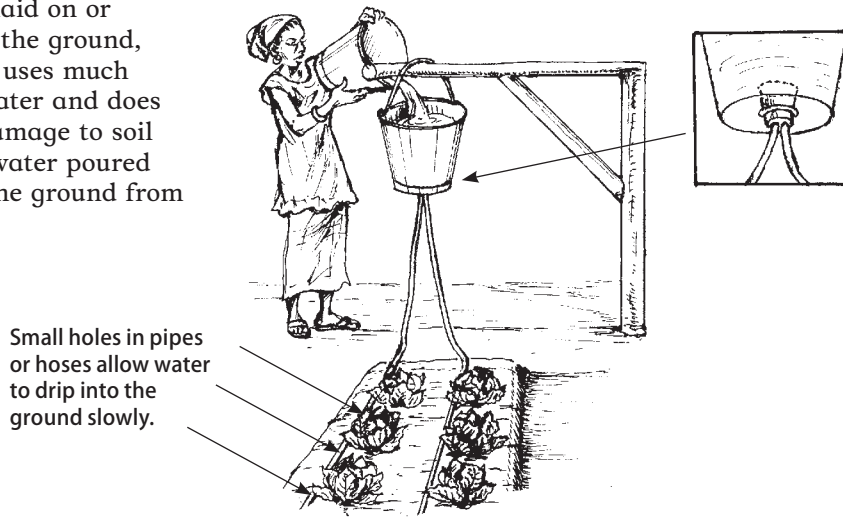
Swales are small earthen barriers with a trench on the uphill side. Soil dug out to make the trench is piled below it to make the swale. Make the trench 3 times as wide as it is deep so the sides will not collapse. Trees or shrubs may be planted in the trench to take advantage of the water, and on the swale to hold it in place.



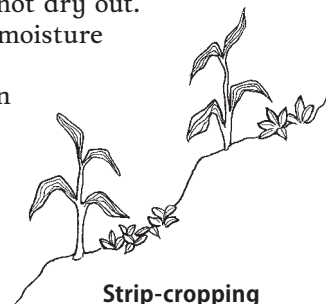
Use Water Wisely

Every farmer needs water. If you live in a dry place, the best way to conserve water is to grow plants native to your area or plants that need water only during the rainy season. Green manure and mulch help hold water in the soil, and contour barriers save water by keeping it from running off. Other methods to save water on the farm are:

- **drip irrigation** from pipes laid on or under the ground, which uses much less water and does less damage to soil than water poured onto the ground from above.



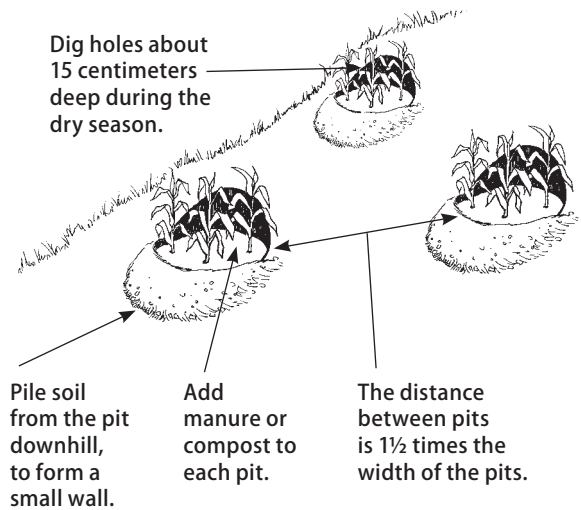
- **planting shade trees** to protect plants and soil from drying out in the sun. Some trees bring water up from deep in the ground for shallow-rooted plants to use.
- **planting crops close together** to shade soil so it does not dry out. The air between plants close together holds a little moisture so plants do not wilt. This can be done with green manure or by planting a variety of crops together in the same field.
- **strip-cropping** (growing different crops together along contour lines) to help crops share moisture. A ground-cover crop is planted uphill from the contour line, and a crop that gives only a little ground cover is planted below it. Water collects on the ground cover and flows to the downhill crops.
- **reusing wash water** to water gardens near the house (see page 100).
- **protecting water catchment areas** to provide more water for people and crops (see Chapter 9).



Make planting pits

Planting pits collect rainwater to help plants grow even in very dry conditions. Planting several crops in the same pit makes the best use of water. The crops that need the most water grow best at the downhill end. Crops that can live with less water grow well on the higher side of the slope.

In the second year, plant in the same pits, or dig new pits between the old ones. If you dig new pits, over the years the whole area will be fertilized.



Stone walls prevent erosion and save water

The central plateau of Burkina Faso is a mix of flat ground and gentle slopes. Rainfall has always been low, but there has been even less in recent years, and the land and people have suffered. To conserve water and prevent erosion, farmers build low stone walls across fields. The walls slow down the flow of water, allowing time for it to soak into the ground. The walls also prevent soil from blowing or washing away and catch soil that erodes from higher slopes.

Farmers also dig large planting holes. They fill the holes with compost or manure to fertilize the crops and hold water.

Where gullies have formed, people fill them with stones. If a gully is too big to fill, they build a stone wall across it. Just as on the field, the stone wall slows water down and keeps the gully from getting worse. Over time, soil may fill the gully.

By using these methods, farmers in Burkina Faso are able to make the land richer and improve crop yields even with less rainfall. And with more food, people's health has improved.



Managing Pests and Plant Diseases

Pests, plant diseases, and weeds can be serious threats to crops. Chemical companies say the only solution is to spray pesticides regularly. But chemicals may cause more problems than they solve (see Chapter 14). Sustainable farming works with nature to keep crops, pests, diseases, weeds, and soil life in balance. This is called **natural pest management** or **integrated pest management (IPM)**.

Natural pest management prevents problems with pests and plant diseases, and keeps harmful chemicals out of our bodies and environment. It also avoids problems of chemical dependence and pesticide resistance (see page 273). (For some immediate methods to resolve pest problems, see pages 298 and 299.)

Even if you are willing to use pesticides, it is still important to know if pests are harming your crops, how much damage is being done, and whether creatures in the fields are already controlling the pest. Then you can decide if and when to use chemicals, and what kinds to use.

The best way to control both pests and diseases is to keep plants healthy.

- **Build healthy soil.** Healthy soil provides a home to friendly insects and helps prevent many plant diseases.
- **Plant resistant varieties.** Ask farmers or extension agents about seeds to make sure the ones you choose are resistant to common pests and diseases.
- **Space plants correctly.** Planting crops too close together limits the sunshine and air that reaches the leaves, and allows diseases to thrive. But planting crops farther apart leaves room for weeds, dries the soil, and may reduce the harvest. Experiment to see what spacing works best for each crop.
- **Plant at the right times.** Pests and diseases often respond to the weather, such as the first rains or the first warm day. Watching how each crop grows and talking with other farmers about these patterns can help you decide the best time to plant. Planting earlier than usual can make sure crops are big enough to resist pests or diseases that come at a certain time. Planting later can cause most of the pests or diseases to die out for lack of food.
- **Plant a variety of crops and change crop patterns.** Large areas with only 1 kind of plant attract pests who like that plant (see page 300).
- **Water from below.** Watering from above can cause diseases that live in soil to splash onto plants. And wet leaves and stems are good places for diseases to grow. Using drip irrigation (see page 294) or flood irrigation can keep plant leaves and stems healthy.



Look for pests

Plant-eating insects are a normal part of farming. They cause little harm to crops as long as they remain in balance with other types of insects, especially those that eat pests.

Examine your crops regularly. This will help you understand when to allow friendly insects to do their work, and when you might need to spray with natural pesticides or use other pest control methods. When you look for pests and diseases, ask questions such as:

- Are pieces of the plant being eaten by an insect?
- Is damage increasing? Will it affect the crop yield?
- Are friendly insects keeping pests under control?



Watch what insects do to see if they are damaging or helping your crops.

Is it a pest, a friend, or harmless?

Sometimes the insects easiest to see are protecting plants by eating the pests. Or, the plant may be at a stage of growth where it can withstand some pest damage and remain healthy.

Worms are important for healthy soil. Bees, spiders, and most insects that live in water (such as in rice paddies) are friends, and help control pests. Also, small wasps or flies with long, thin tubes at their backside are probably friends. It is best to leave insect friends alone so they can help your crops.

Watch the insects in your fields to know if they are pests, friends, or harmless. If you are unsure about some insects, collect them in a container together with some plant parts, and watch them for several days. If you find insect eggs, watch what they hatch. If tiny worms or grubs (larva) are released, they may be pests. If they release flying insects, they are often friendly.

The main ways pests damage crops are by sucking the liquid from them and by eating them.

- **Sap-suckers** include aphids, scale insects and mealy bugs, leaf and plant hoppers, white flies, thrips, mites, and nematodes.
- **Plant-eating insects** include caterpillars, slugs, snails, plant and pod borers.

If it is a pest, how can you get rid of it?

Once you know how the pest damages crops, you can use natural pesticides (see next page) made for that kind of pest.

Once you know when the pest appears and how it relates to its environment, you can use physical methods of pest control (see page 299). Answers to these questions can help know how to control a pest: Where does it come from? When does it damage crops? Does it appear in one form and then change to another form (for instance, caterpillars turn into moths and butterflies)? Is it food for birds, other insects, or field creatures?

Spray with natural pesticides

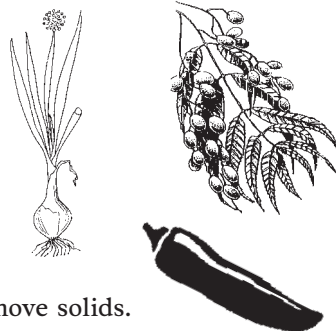
Natural pesticides prevent crop damage with much less harm to people and the environment than chemical sprays. They are easy to make and cost less than chemicals.

But even natural pesticides must be used with care. Never use more than you need. Always wash your hands after handling them. Always wash food before eating or selling it. A natural pesticide may work well in some conditions but not in others. If one kind does not work, try other kinds.

Natural pesticides for plant-eating insects

Plant-eating insects are best controlled by pesticides made from strong-smelling plants such as garlic, onion, chili pepper, marigold, and citronella leaves.

1. Collect the plant you want to use, let it dry, and grind the dried plant to a powder.
2. Soak the powder in water overnight (1 handful of powder to 1 liter of water).
3. Pour the mixture through a screen or cloth to remove solids.
4. Add a little bit of mild soap to help the pesticide stick to plants.
5. Spray or sprinkle the mixture on plants. Test your mixture on 1 or 2 plants first. If it seems to hurt the plants, it may be too strong. Add more water and test it until it seems good.
6. Repeat as needed, and after it rains.



Natural pesticides for sap-sucker insects

Sap-sucker insects are killed by coating them with mild soap or oil that blocks their breathing holes. Spraying plants with mild soapy water or water mixed with vegetable oil will kill these pests. Do not use detergents or strong soaps because they damage plants, soil, and insects.

Other natural pesticides

Urine diluted in water and sprayed on plants kills pests. Mix 1 cup of urine with 10 cups of water. Let it sit in a closed container for 10 days. After 10 days, spray the mixture onto your crops.

Tobacco kills many pests. Boil 1 cup of tobacco leaves or cigarette butts in 5 liters of water. Strain out the leaves or butts, add a little soap, and spray it on plants. Do not use tobacco on tomatoes, potatoes, peppers, and eggplant. It will damage these plants and will not kill most pests that attack them.

IMPORTANT: Tobacco juice is poison! Avoid getting tobacco juice on skin or clothes. Avoid breathing the steam while boiling tobacco leaves.

Physical methods of pest control

There are many ways to control pests, or to encourage predators and parasites, based on their habits and life cycles. Talk to other farmers to learn about methods they use.

Animals and insects

Many birds, bats, snakes, and insects eat pests and pollinate crops. You can tell what a bird eats by the type of beak it has and by watching how it acts in your fields. To scare off birds that are eating crops, some farmers hang shiny things such as shiny paper, tape from old cassette tapes, and scraps of metal near crops.

Most bats eat mosquitoes. But some bats eat fruit and a few others bite animals. By watching them eat, or by looking at the remains of their food under the place where they sleep at night, you can tell if they are eating the fruit off your trees or are eating the insects that bite you or eat your crops.

Some physical methods of pest control

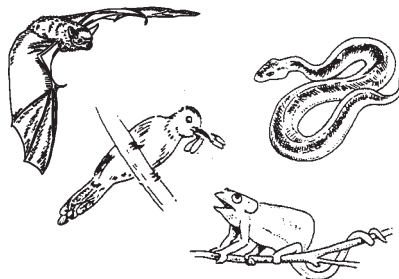
To control fruit flies, put some rotting fruit in a plastic bottle with fruit-fly-sized holes in it. Hang it from the fruit tree you want to protect about 6 weeks before the fruit will be ripe (when the flies start laying their eggs on the fruit). The flies will fly in but will not be able to get out.

Many small wasps feed on pollen and attack pests. Growing flowering plants that make lots of pollen will attract these wasps, and the wasps will protect crops from pests.

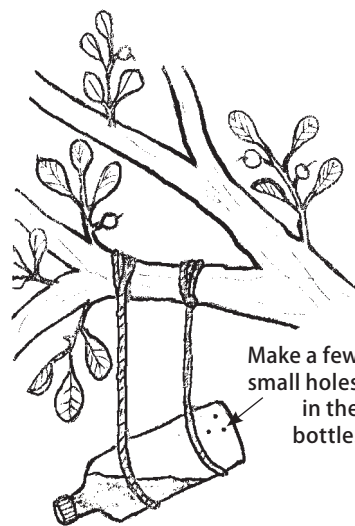
Tall trees planted around your field can stop locusts or make them pass over your field. Trees also provide shelter for useful insects.

Ants are fierce predators. If your crops are attacked by grubs, sprinkle sugar water on the stems or harvested tubers. Ants will come for the sugar water and stay to eat the grubs!

Many flying insects lay their eggs on crops. The eggs then hatch into grub and caterpillar pests. Hanging a torch or a lamp above a bucket or lined hole full of water will attract flying insects, which then fall into the water and drown. This solves the problem before any eggs can be laid or hatched.



Watch the animals in your fields to know if they control pests.



Fruit fly trap

Change crop patterns

Crops in the same plant family can get the same pests and diseases. For example, if you always plant potatoes in the same field, potato beetles may come to live and breed in that field. But if every 3 years you plant something they cannot eat, the beetles will leave or die. The third year crop must not be a relative of potato, like tomato or pepper. It should be something completely different, like maize. This is called **crop rotation**. 2 ways to prevent disease and pests are to rotate crops and to plant a variety of crops together.

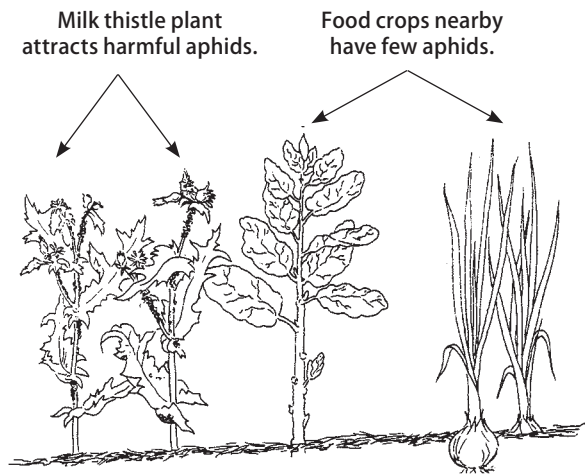
Rotate crops

Rotating crops (changing the crops you grow in a particular field) controls diseases and pests by depriving them of food. It will also improve the soil by adding different nutrients. For example, rotating grains in one season with beans in the next will make the soil richer. Grains grow tall and provide organic matter, while beans add nitrogen to the soil.

Plant a variety of crops together

Planting different types of crops provides places for useful insects to live and makes it harder for pests to find the crop they like to eat. Growing many types of crops also improves food security, because if one crop fails, there are others to use. Planting different crops next to each other protects against pests in these ways:

- Some strong smelling herbs and vegetables keep away pests.
- Some flowers attract predators that eat pests.
- Some plants “trap” pests. This is the opposite idea from keeping pests away. If you plant something that pests like better than your crop, they will stay on the “trap plant” and leave your crop alone.

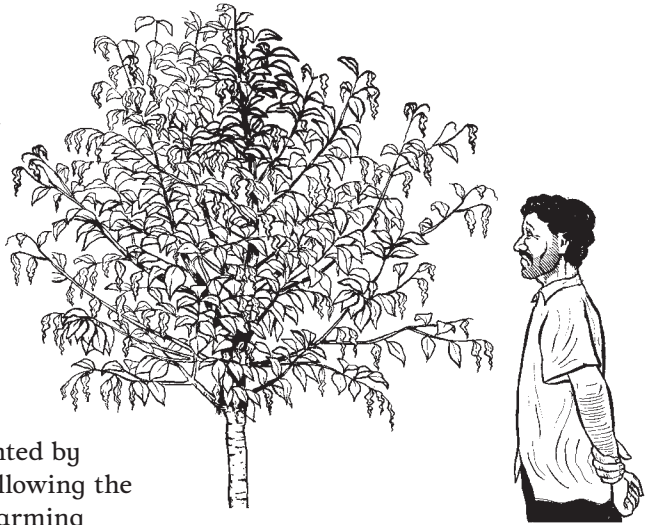


Trap plants attract pests away from your crops.

Farmers also combine trees with animals and crops to increase the benefits of each of them (see page 302).

Plant Diseases

Plant diseases can be recognized by their effects on plants, such as making leaves change in color, causing leaves to wilt, or making parts of the plant grow in unusual ways. Plant diseases may be caused by a fungus, a bacteria, or a virus. All of them can be controlled with natural methods.



Plant diseases are best prevented by maintaining healthy soils and following the other principles for sustainable farming (see page 281). When you are certain a disease is affecting your crop, you can prevent the disease from spreading to other plants.

- **Destroy diseased plants.** Infected plants can pass diseases or pests to future crops. For diseases that kill the entire plant or severely reduce production, the entire plant should be removed and burned at the first sign of disease. Do not compost it, because some plant diseases survive composting.
- **Clean tools used on diseased plants.** Plant diseases can be spread when your body, tools, and clothing touches infected plants and then touches healthy plants. Wash everything with warm soapy water before touching healthy plants.
- **Control sap suckers.** Many plant diseases are carried between plants by sap sucking insects. See page 298 for natural pesticides to use against sap suckers.
- **Milk kills fungus diseases, caterpillar eggs, and spider mites.** Mix 1 liter of milk with 15 liters of water and spray on your crops. For fungal diseases, repeat after 10 days. For caterpillar eggs, repeat after 3 weeks.
- **Ashes kill fungus diseases.** Planting ashes together with seeds will prevent some fungus. For late blight of tomato and potato crops, spray crops with a strained mix of ashes and water.

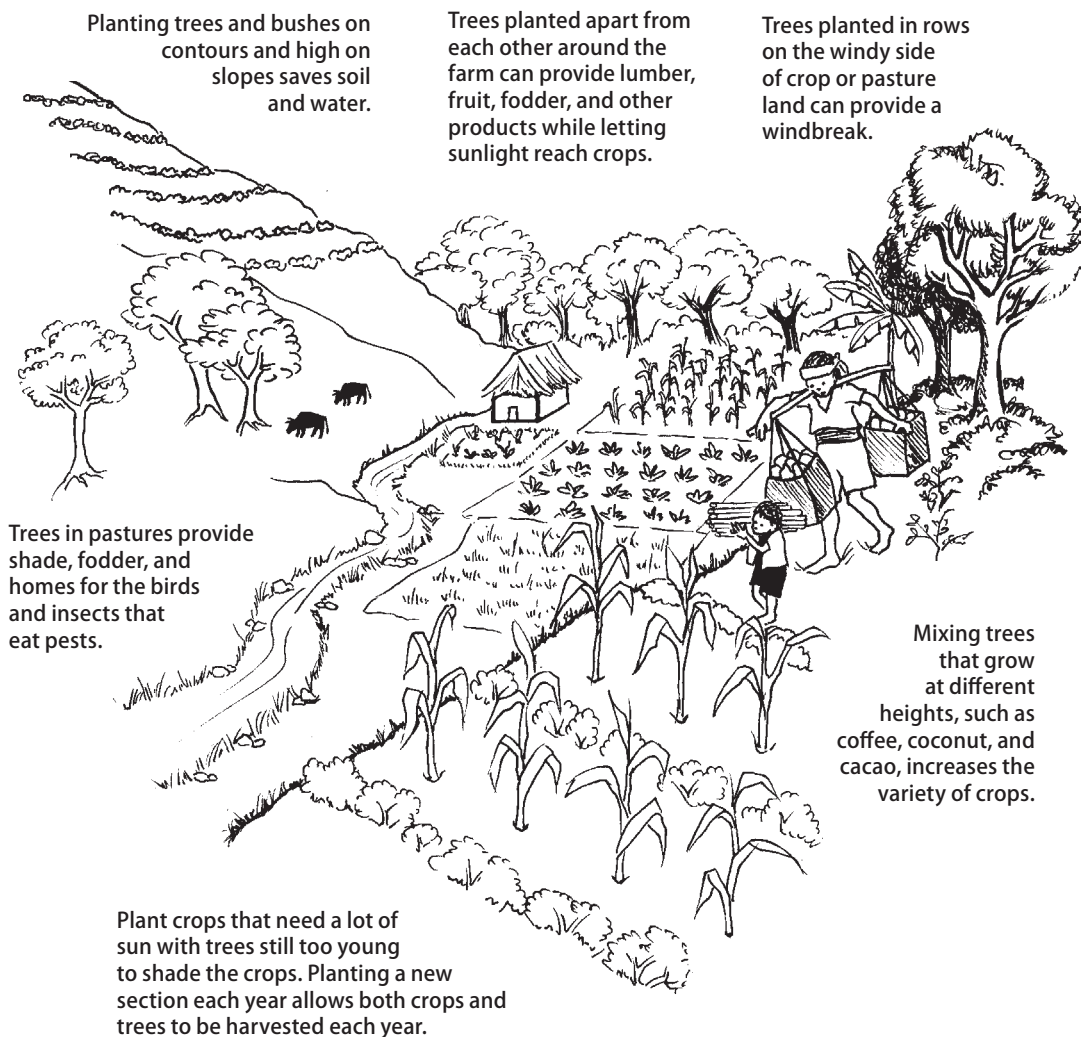


Planting Trees and Crops Together

When land is scarce, some farmers cut down trees in order to plant crops. But planting trees and crops together (agroforestry) can make farmland more productive and provide more and different crops.

Agroforestry requires care in choosing trees and in planting them where they will be of most use. Some farmers use these guidelines:

- Trees should not compete with crops for water, sunlight, or space.
- Each tree should provide for more than one need, such as food, fodder, medicine, shade, firewood, thatch, or lumber.



Planting trees and bushes on contours and high on slopes saves soil and water.

Trees planted apart from each other around the farm can provide lumber, fruit, fodder, and other products while letting sunlight reach crops.

Trees planted in rows on the windy side of crop or pasture land can provide a windbreak.

Trees in pastures provide shade, fodder, and homes for the birds and insects that eat pests.

Mixing trees that grow at different heights, such as coffee, coconut, and cacao, increases the variety of crops.

Plant crops that need a lot of sun with trees still too young to shade the crops. Planting a new section each year allows both crops and trees to be harvested each year.

Saving Seeds

Many farmers produce their own seed by allowing some plants to mature and then collecting the seeds. Saving seeds allows farmers to grow plants with the qualities they want. Local plant breeding and seed saving are important to preserve biodiversity and promote food security. (For more about plant breeding, see Chapter 12.)

Selecting seeds

To make sure you have good seeds, collect them from:

- strong plants, free of pests and disease.
- plants adapted to the area. For example, if you live in a cool area where a certain type of plant grows, but you collect seeds from the same type of plant that grows in a warmer area, the plants may not survive the cool weather.
- plants with the qualities you want, such as size, taste, resistance to drought, and so on.
- plants that grew some distance away from other varieties of the same type of plant, to make sure the different varieties of plant did not breed together.

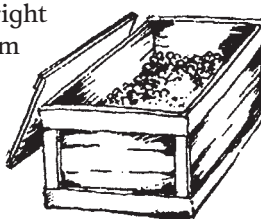
Do not collect seeds that have fallen to the ground by themselves. Sweep under plants to remove fallen seeds, and then shake the plant or tree to remove fresh seeds. Then clean the seeds as soon as possible after collecting them, and sort them to remove any seeds that are rotted or damaged.

Storing seeds

To judge how long each kind of seed can be stored, think about the conditions they need to grow. For example, seeds from areas with a cold or dry season usually can be stored for months or years, because they need the right conditions to sprout. Seeds from areas that are hot and rainy most of the year will not store well, because they can sprout any time. Seeds with hard shells usually can be stored more easily and for longer times than seeds with soft shells.



Put hard coated seeds in a container of water. The seeds that float will not sprout. The seeds that sink can be planted.

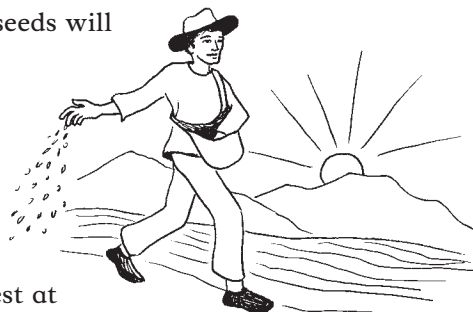


Most seeds should be stored in a cool, dry, dark place, with some air flowing through them, or they will rot.

Sprouting seeds

Some seeds need special treatment in order to sprout (see page 207). But all seeds need:

- **water.** Soak seeds in water overnight before planting. If you use very hot (but not boiling) water, it will kill many plant diseases and pests carried by seeds. This will also help sprout seeds that usually do so only after passing through the stomachs of animals. Experiment first with a few seeds and then plant them to be sure they will sprout.
- **air.** If the soil is compacted or waterlogged, seeds will not sprout because there is not enough air.
- **daylight.** Some seeds, especially those from northern areas where there is very different weather at different times of year, will only sprout when there is just the right amount of light.
- **correct temperature.** Because each crop has its own season, different seeds sprout best at different temperatures and at different times of year.



Planting seeds

The 2 common ways to plant are by starting seeds in a nursery or by planting right into the ground. Which method you use depends on what crops you want, the weather conditions when you are ready to plant, and whether or not you have room for a nursery (to make a nursery, see page 209).

Direct planting

Larger seeds are best planted directly in the field because their roots grow quickly and are easily damaged if they are transplanted. Make planting holes 2 or 3 times as deep as the size of the seed. Drop 1, 2, or 3 seeds in each hole and cover the seeds.

Very tiny seeds should be tossed out over the soil to spread widely over the planting area. Mixing seeds with sand when you toss them out will prevent the seeds from sticking together. Then cover the planting area with a thin layer of mulch or soil. Also, using a roller to lightly press the seeds into the soil will help them sprout.



Most vegetables can be transplanted once they have their first set of true leaves.

Starting seeds in a nursery

Starting seeds in a nursery helps seeds sprout by controlling temperature, water, and pests. Transplanting seedlings from the nursery into freshly weeded fields helps young plants make better use of the soil and water.

Safe Food Storage

One of the tragedies in communities that produce food is that much of the food goes bad because of weather, pests, or other causes. Safe food storage is as important as the ability to grow food in the first place.

Protect stored grains from pests

After harvest, much grain is lost to rodents, insect pests, or rot. To protect grains in storage:

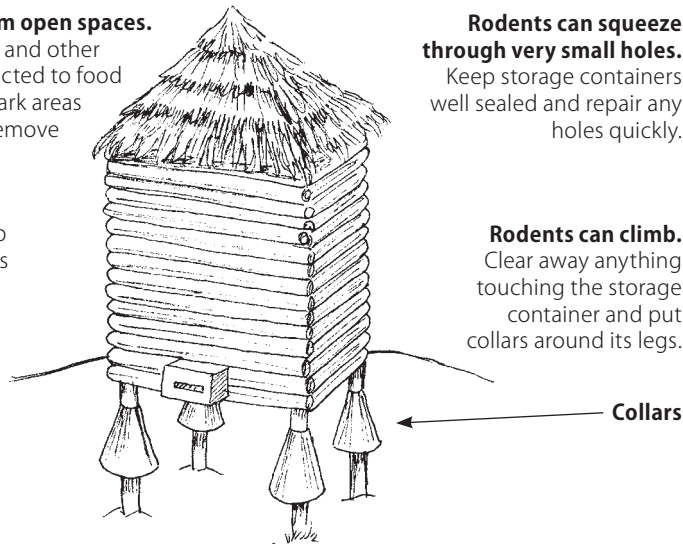
- Dry and store the grains as soon after harvest as possible to avoid loss in the fields. Well-dried grains should be soft enough to break with your teeth and dry enough that they make a good cracking noise.
- Store dried grains in well-sealed, clean containers in a place protected from moisture and pests.
- Smoke the grain before it is stored to kill pests.
- Repel insects, but not rodents, with wood ash and plants such as hot chilies, eucalyptus, and other strong smelling plants. (If grain is already infected with pests, the protection will not work.) Dry the eucalyptus leaf, chili seeds, or other plant and grind it to a powder. Mix 1 handful of the powder with each kilo of grain or beans to keep insects out. Be careful not to breathe in the powder. More time and effort are needed to wash the grains before eating, but there will be more grain to eat.

Rodents stay away from open spaces.

Clear the area of weeds and other cover. Rodents are attracted to food waste and protected, dark areas where they can nest. Remove these from the area.

Rodents can leap. Keep grain storage containers high off the ground.

Rodents are scared of dogs and cats, so keep these animals in the area.



Rodents can squeeze through very small holes.

Keep storage containers well sealed and repair any holes quickly.

Rodents can climb.

Clear away anything touching the storage container and put collars around its legs.

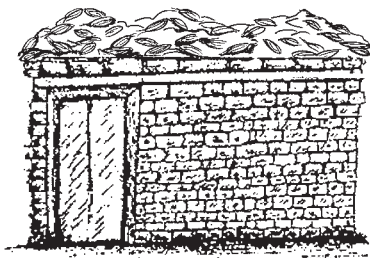
Collars

Grain storage containers keep out rodents such as rats, mice, and squirrels.

Storing fruits, vegetables, meat, and milk

Fruits, vegetables, meat, and milk are full of moisture. Moisture is needed by the bacteria and fungus that cause rot. Keeping foods cold or frozen will slow down the rotting process. When there is no way to store foods cold, they can still be preserved by:

- **drying.** Foods can be dried in the sun, in an oven on very low heat, or by putting them in salt. If kept away from pests and moisture, dried foods can be stored for a very long time.
- **smoking.** Foods put over a smoky fire will be preserved both by the drying that happens and by the smoke. Meats are commonly preserved by smoking.
- **fermenting.** Fermenting, like rotting, is the process of letting bacteria and fungus change food. But unlike rotting, fermenting allows only certain kinds of bacteria and fungus to grow. Cheese and some kinds of sour breads are fermented foods. Fermented foods can be more nutritious and easier to digest than the food they are made from.
- **pickling and jarring.** Fruits, vegetables, and meats are soaked in vinegar and kept in covered or sealed containers. The sourness of the vinegar keeps bacteria and fungus from growing. Fruits can be cooked in sugar syrup and sealed in boiled jars to preserve them.



Sun, and heat from cooking, will dry maize placed on a roof.

Storing root crops

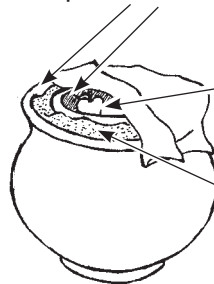
Root crops can last a long time if they are stored in places that are dark, fairly dry, cold, and safe from pests. Layering root crops in straw or sawdust so they do not touch each other keeps them fresh.

How to make a natural refrigerator

A Nigerian teacher named Mohammed Bah Abba developed a method called the "Pot-in-Pot" to store food where there is no electricity.

Leave the Pot-in-Pot in a dry, open place. As dry air surrounds it, water in the sand passes through the outer surface of the larger pot, making it stay cool. When the water passes from the sand, the inner container is cooled, destroying harmful germs and preserving the food inside. The only maintenance is washing and replacing the sand every so often.

Two clay pots of different sizes, one placed inside the other.



Food or drink is placed inside the smaller pot and covered with a damp cloth.

The space between the pots is filled with wet sand that is kept always moist.

This natural refrigerator works best in a dry, hot climate.

Raising Animals

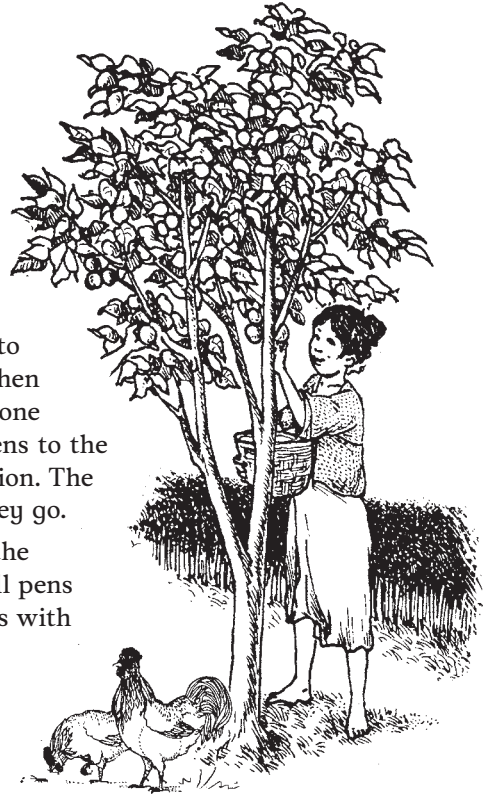
Animals bring many benefits to the farm besides the food they produce. Just like plants, a variety of animals is better for the farm and the farmer.

Bees make honey to eat, and they also pollinate flowers.

Chickens, geese, and ducks eat weeds, weed seeds, and pests, and leave manure to fertilize the soil. They also turn the soil when they scratch for food. Let chickens run in one section for a month. Then move the chickens to the next section. Rake and plant the first section. The chickens will weed and turn the soil as they go.

Pigs turn the soil when they dig, and eat the deep roots of spreading weeds. Make small pens to move them through your garden, just as with the chickens.

Goats clear land by eating brush. Because goats eat everything, you may need to tie the goats next to the brush you want them to eat.



Grazing animals

Grazing animals such as cows, sheep, and goats, can either help or hurt the land, depending on how they are managed. When animals graze in overgrown pastures, they reduce weeds and add manure. But if grazing animals eat all the grass, the soil dries out and forms a hard crust. When rain comes, water runs off and takes the soil with it. When soil is eroded from overgrazing, nothing grows.

Keep animals enclosed near the house to make it easier to protect them and to use their manure. But if their space is too small, they get sick easily when flies, parasites, and diseases grow in their manure. Clean pens regularly, especially in the wet season, to prevent animals and people from getting sick. The manure can be composted and used as fertilizer.

Whether your animals are fenced in or graze freely, keep only as many animals as the land can support.

Move animals from pasture to pasture

If you let your animals graze wherever they want, they will eat the grasses down to the roots. Next year, those plants will not grow back well. Move grazing animals between pastures when half the leaves of grazing plants are eaten.

If you can make fences, divide your grazing land into small pastures according to the type of plants that grow there. Move the animals between the different areas. If you graze cattle, even low stone walls will keep them from moving between pastures. If you herd your animals, you do not need fences.

Take care that livestock do not graze in and around water sources used by people. If manure gets into water people drink, or where they bathe, swim, or fish, disease can spread. Make a ditch from the stream to a watering hole for your animals.

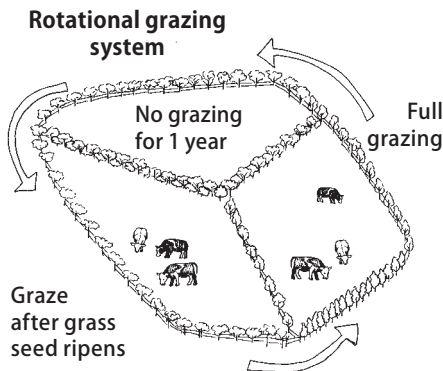


Make a watering hole instead of letting animals graze next to streams or ponds.

How often to move animals

How much time animals stay in one pasture before they are moved depends on the number of animals, and the size and quality of the pasture. Each year, let one part of the grazing land rest completely, with no grazing at all. This will prevent soil from being compacted and allow grasses to grow back.

For example, if you divide the land into 3 or more pastures, move the animals through all but one of the pastures. Leave that one to rest. The following year, let a different pasture rest. Or, after each harvest, let your herd eat the crop stalks, weeds, and grains that fall on the ground. They will clean up the field and spread their manure.



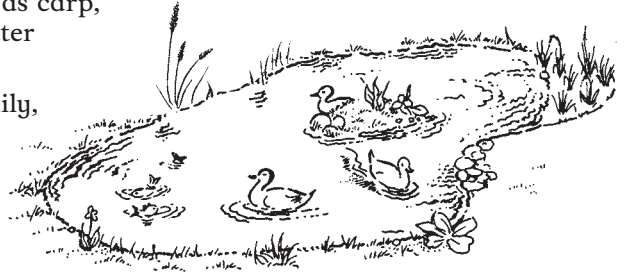
How many animals can your land support?

Animals provide security when times are hard because people can sell or eat them. They also bring respect. But when people try to earn more respect and security by having more animals than the land can support, both the animals and the land become unhealthy. The amount of land needed for animals depends on how green and wet the area is. In dry lands, much more land is needed for grazing than in very green areas.

Fish Farming

A small fish pond can produce a lot of food in a little space, and can store irrigation water. In a pond or rice paddy, you can grow:

- fish or shellfish for food, such as carp, tilapia, crawfish, and freshwater shrimp.
- plants for food, such as pond lily, lotus root, taro, rice, and water chestnut.
- plants for making things, such as reeds and bamboo.
- **algae** (pond scum) for food, animal feed, and fertilizer.
- rich soil for your garden.



Ponds with fish and birds will prevent mosquitoes from breeding while providing food and water for you and your land.

How to build a fish pond

- 1 Before you start, be sure your land has the right conditions to support a fish farm. You need enough water to make sure that some will always move through the pond. If water does not move, mosquitoes will breed.

You also need soil that will not let the pond water drain away. Clay soil is best. If you do not have clay soil, a pond liner to keep the pond from leaking can be made of clay brought from elsewhere, from concrete, or from plastic. Pond liners can also be woven grass or bamboo, sealed with pitch or other plant gums.

The best place for a pond is at the bottom of a hill (so runoff water goes into the pond) and at least 10 meters away from drinking water sources. If the pond will have water flowing in from a stream, build a temporary dam to stop the water while you prepare the pond.

- 2 Dig a hole at least 1 meter deep and as big around as you can. Even a very small pond, 1 or 2 meters across, can grow algae and small fish to enrich your diet. If you have enough space, make several ponds, each less than 3 meters across. This will make digging the ponds and harvesting the fish easier.

- 3 Press down the clay bottom of the hole by walking on it. If it is a big pond, ask neighbors to help. Even cows or other large animals can be used to compact the clay. Their manure will help seal the bottom.

Once the pond is filled with water, algae and other plants will grow. If there are streams or other ponds nearby, collect plants and animals to breed in your pond. To grow fish, you may need to buy some live fish so they will breed in your pond.

Sustainable Farming in the City

More and more, people are creating farms and gardens in cities to feed themselves, to create jobs, and to keep alive their knowledge and traditions of working the land. Creating green spaces with crops and trees also improves the air in cities, and reduces illnesses caused by air pollution, such as asthma. Turning the empty spaces that often become trash dumps into farms and gardens makes a city healthier and more beautiful.

Adapt farming methods to smaller spaces

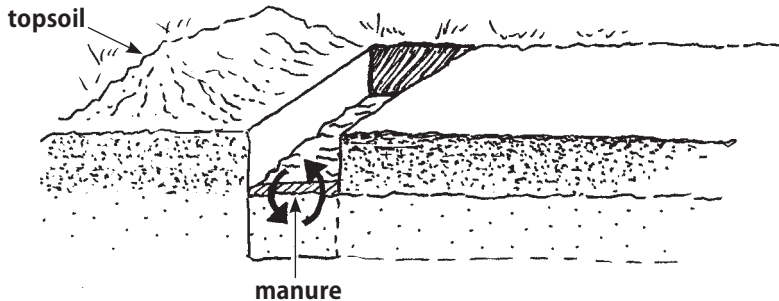
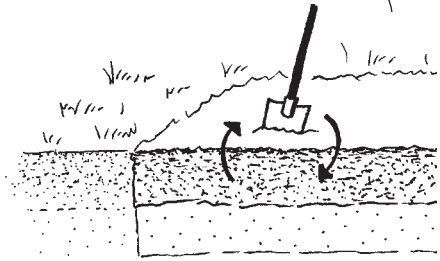
- Grow plants upward on stakes, walls, or other supports. The sides of buildings can be good places for climbing plants.
- Grow food crops on rooftops and balconies, in buckets, bags, tires, tin cans, and old baskets. You can use any container that has a hole for water to drain out. Leaf crops such as spinach and lettuce, and vegetables like tomatoes, peppers, and eggplant, grow well in containers. Bananas, figs, pygmy date palm, pineapple, dwarf citrus, and dwarf mango also grow well in containers.
- Garden beds as shallow as 20 cm deep can be filled with organic matter such as corn husks, rice or cocoa hulls, leaves, or even shredded newspaper. Plant seedlings with a small amount of soil into holes in the organic matter and their roots will spread. Over time, the organic matter will turn to soil.
- Make raised planting beds by double digging (see next page) or by piling soil 1 meter deep on top of concrete surfaces and enclosing it in large containers.
- Sow seeds or seedlings closer together than usual. Plants grown this way will adapt to the close spacing over time.
- Grow more than one crop together in a small space.
- Replant a new crop immediately after harvesting the previous one.



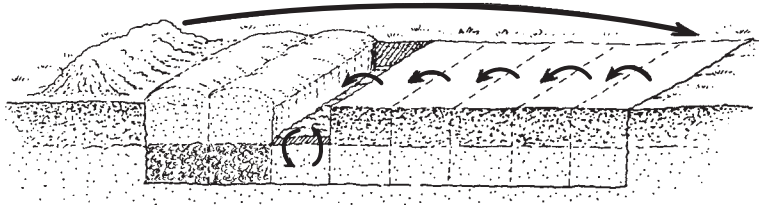
How to double dig a garden bed

To grow as much as possible in a small area, or to plant on hard soils or soils with little organic matter, double digging is a good method.

- 1 The edges of the planting bed should be just wide enough across so that 2 people can kneel at the edges of the bed and touch hands in the middle. The bed can be as long as you need.
- 2 Loosen the top of the soil and spread finished compost or manure on top of the whole bed.
- 3 Starting at one end, dig a ditch across the bed 30 cm deep and 30 cm wide.



- 4 Use a digging fork or shovel to loosen the soil at the bottom of the ditch and add some compost or manure to it.
- 5 Dig a second ditch across the bed. Put the soil from the second ditch into the first ditch. Loosen the soil at the bottom, and spread compost or manure.



- 6 Continue until you have dug the entire bed. The loose soil will rise above the surrounding soil. Make the bed smooth and flat, with the edges angled so that water and soil do not run off. Add a layer of sifted, finished compost to the top of the bed. Now it is ready for planting.

After you have prepared the beds, you should not walk on them because this compacts the soil. If you double dig a plot once and add natural fertilizer every season before you plant again, your soil will stay healthy and loose for many years.

Contaminated soils

Soil in cities may be contaminated with toxic chemicals, such as lead from paint, gasoline, and old batteries. These can all cause serious health problems (see Chapter 16). To know if your soil is contaminated:

- Find out how the site was used in the past. If it was a factory, gas station, parking lot, or waste dump, the soil is probably contaminated.
- If the soil smells like chemicals, it is probably contaminated.
- Areas underneath painted walls are most likely contaminated with lead.

Soil samples can be tested at a university, extension agency, or private laboratory. Lead tests are not expensive, but testing for other contaminants is often difficult and expensive.

Planting safely in contaminated soil

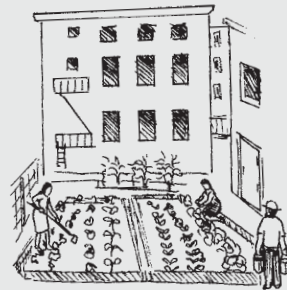
You can still grow food safely on contaminated soil. One way is to cover the soil with a layer of hard packed clay or concrete. This seals the contaminants in. Grow crops in containers or shallow beds on top. It is safer to grow fruit crops (such as tomatoes) on contaminated soils because they absorb fewer toxins than leaf crops (such as spinach) and root crops (such as carrots and potatoes).

Urban farming blossoms

Cuba is an island nation that once produced large sugar and tobacco crops for export. It had an industrial system of farming, relying on petroleum fuels and petroleum-based agricultural chemicals. When the Soviet Union collapsed, Cuba lost both its largest petroleum supplier and its largest buyer of sugar and tobacco. Because of political disagreements, most countries would not sell chemicals to Cuba or buy Cuban products. Cuba was forced to find a new way to grow food.

Cuba made sustainable farming their new national policy. It promoted sustainable methods through land grants, education, and by setting up local markets. As the new methods developed and spread, there was more healthy food for everyone.

As in other countries, many Cubans moved from the countryside to the cities. Now the government encourages people to grow food in the cities using sustainable methods. Urban farming promotes good nutrition, and provides jobs and education. Most of the fresh produce (vegetables, poultry, flowers, and medicinal plants) used in Cuba's capital city of Havana is now grown in or close to the city. Plant medicines grown in Havana are sold at low cost in shops called 'green pharmacies.' Although brought on by a crisis, sustainable farming has changed Cuban people's lives for the better.



Marketing Farm Products

To sell their products, farmers need reliable roads, transportation to markets, and fair prices. Changing government policies to support small farmers may take a long time. But there are many ways farmers can organize for fair prices, while working to gain more government support.

Local markets and international markets

Small farmers often sell to a middle buyer and get very little money for their product. Governments may offer support to stop growing traditional crops like maize and rice, and instead grow cash crops like sugar, coffee, or cacao for international markets. But the earnings from cash crops are uncertain. If the international price drops, you may have no money and nothing to eat.

For many farmers, producing food crops for local and regional markets can offer a steady source of income.

Cooperative marketing

One way to make sure there are good prices and food security is to form a cooperative or a marketing association with other farmers. When farmers sell their products together, they can better control the prices they get for their crops, and reduce the costs of transportation and marketing. Most countries have rules about how to form a cooperative or association.



Marketing associations share the labor and expense of getting produce to consumers, and lower costs for all members.

It is important to work with people you trust to make sure everyone carries out her or his responsibilities. It is also important to agree on rules that give everyone a voice in making decisions and a fair share of the earnings.

Value-added products

Companies that process foods and farm products make a lot of money that could be made by farmers instead. When farmers process crops into products for sale, such as dried fruit, dried and packaged plant medicines, jams and jellies, honey, cheese, baskets, furniture, and so on, this is called **value-added production** because you are adding value to the crops you have grown.

Buying the equipment needed to process foods and finding a market for value-added products can be difficult. A cooperative can make this easier.

Specialty products and certification

Large farm corporations are able to keep prices low and still earn a profit because they produce so much and often get support from the government. But farmers who grow on smaller plots of land can also benefit from programs that promote products grown using certain methods.

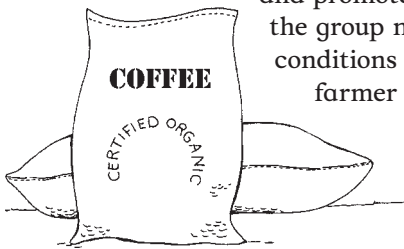
Several **certification programs** help farmers earn better prices for their products. A certification program lets the buyer know crops were grown without chemicals, or that the farmer gets a fair price. Two programs for the international market are **organic certification** and **fair trade certification**. Before making the decision to seek certification, consider the changes you will need to make in how your farm is organized. Think about how much time and money it will take to make the changes, if there is a market for the certified products you will produce, and what you will gain from having your crops certified.

Organic certification

Organic products are grown using sustainable methods, without chemicals or GE seeds (see Chapter 13). Organic certification also requires that after harvest, the products are kept separately from foods grown with chemicals. Every country has different rules for certification. Most require farmers to keep records of how they grew their crops.

Fair trade certification

Fair trade certification is given to farm cooperatives or to farm workers who belong to unions. To be fair trade certified, farmer groups show that they use fair labor practices (no forced labor, no child labor, and fair wages for workers) and promote good environmental practices. To stay certified, the group needs to show that labor and environmental conditions improve over time. There are scholarships for farmer groups who cannot afford the cost of certification.



Organic and fair trade certifications help farmers earn more money.

Fair trade certification is currently provided for small producers of coffee, tea, cacao, bananas and other fresh fruit, and may include other crops by the time you read this book. (To learn about organic and fair trade certification programs, see Resources.)

Farmers market products cooperatively

Farmers in the Talamanca region of Costa Rica grow cacao beneath the shade of banana and other fruit trees. In the past, they sold their bananas and fruit at local markets. When they realized they could earn more money by selling cacao on the international market, many farmers decided to work together to do that.



They formed a cooperative, the Association of Small Producers of Talamanca (APPTA). At first they had trouble finding buyers for their cacao. A few buyers paid prices that covered the costs of production, but did not cover the costs of processing and transporting the cacao. APPTA needed money to build a cacao processing plant.

After several visits to the city to talk to cacao buyers, the farmers learned about fair trade and organic certification programs that would bring higher prices for their crops. Because they were a cooperative of smallholder farmers, they were already eligible for fair trade certification. If they also had organic certification, they could raise their prices enough to generate funds to build a processing plant. But even though they did not use chemicals, none of them could afford to have their land certified.

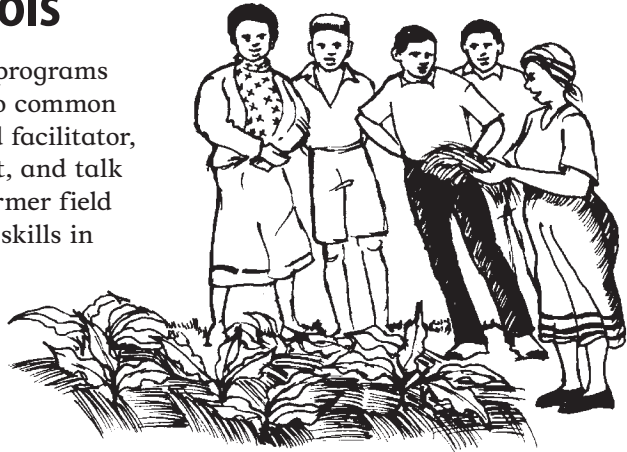
APPTA negotiated with the organic certification organizations of Europe and the United States to suggest they certify the whole cooperative. The cooperative made sure that no chemicals were used and that each farm followed the same standards for quality and health. Several cooperative members were trained to visit each cacao farm and report on their standards. The cooperative paid only 1 fee for certification, checked the farmers' records themselves, and then filled out just 1 report for each of the certification organizations.

Once the cooperative was certified organic and fair trade, they received better prices. They got a loan to build a cacao processing plant. Soon they were selling organic bananas and other fruit for very good prices, both locally and internationally, and making organic chocolate to sell in the city.

By forming a cooperative, the farmers and their families not only gained better prices for their products, they also gained more control over their work and more possibilities for their futures.

Farmer Field Schools

Farmer field schools are teaching programs that help farmers find solutions to common problems. Together with a trained facilitator, farmers ask questions, experiment, and talk about what they are learning. Farmer field schools also help farmers develop skills in solving problems, organization, and leadership. When they are encouraged to value their own knowledge and skills, farmers are better able to build on traditional farming methods to make farming more sustainable.



Farmers find solutions to their problems in their own experience and in their fields.

Farmer field schools build skills and confidence

Hoa and Khanh live in Dong Phi Village, Vietnam. Their husbands help prepare the land for sowing, and they harvest crops at the end of the season. The rest of the year, Hoa and Khanh manage their family lands alone because their husbands work outside the village. When Hoa noticed she was harvesting less rice each year for several years in a row, her husband suggested buying more fertilizer. But Hoa knew there was no money for fertilizer. When a government agricultural agent told the villagers about farmer field schools, Hoa and her neighbor Khanh decided to join.

As soon as they began attending sessions, they saw this school was different from any school they had known. Together with other farmers, Hoa and Khanh talked about crops, insects, weather, and soil. They experimented with different farming methods and decided which ones they liked and which ones they did not like. Hoa invited all the farmers to her land to help her understand why her rice harvest had gone down.

Khanh was shy and had never spoken in front of a group before. But after the first season at the farmer field school, she felt more confident and she tried leading some experiments. When Khanh tried new things in her field, she had the other farmers visit. She explained what she was doing and why. The other farmers listened, asked questions, and shared their opinions and experiences.

As Hoa and Khanh began changing the way they farmed, they realized they had to teach their husbands as well. “I had to make sure my husband would not be afraid because I stopped using chemical pesticides,” Hoa said. “When he came home from work, I took him to the field to show him the different insects and talk to him about natural pest controls.” When Hoa’s husband saw there was more rice, he did not question his wife’s wisdom. And when she used money saved from fertilizers and pesticides to buy a motorcycle for the family, he was convinced that farmer field schools helped.

Now Hoa and Khanh have started training women farmers all over their region. “I think we women work better as a group apart from the men. Our discussions are more open and we make sure everybody gets to say what she sees in the field and what she thinks about it. Knowing about pests, fertilizers, and how to care for our crops helps us take control of our lives. This makes me sleep easier,” said Khanh. “If it helps me, I’m sure it can help everyone.”

