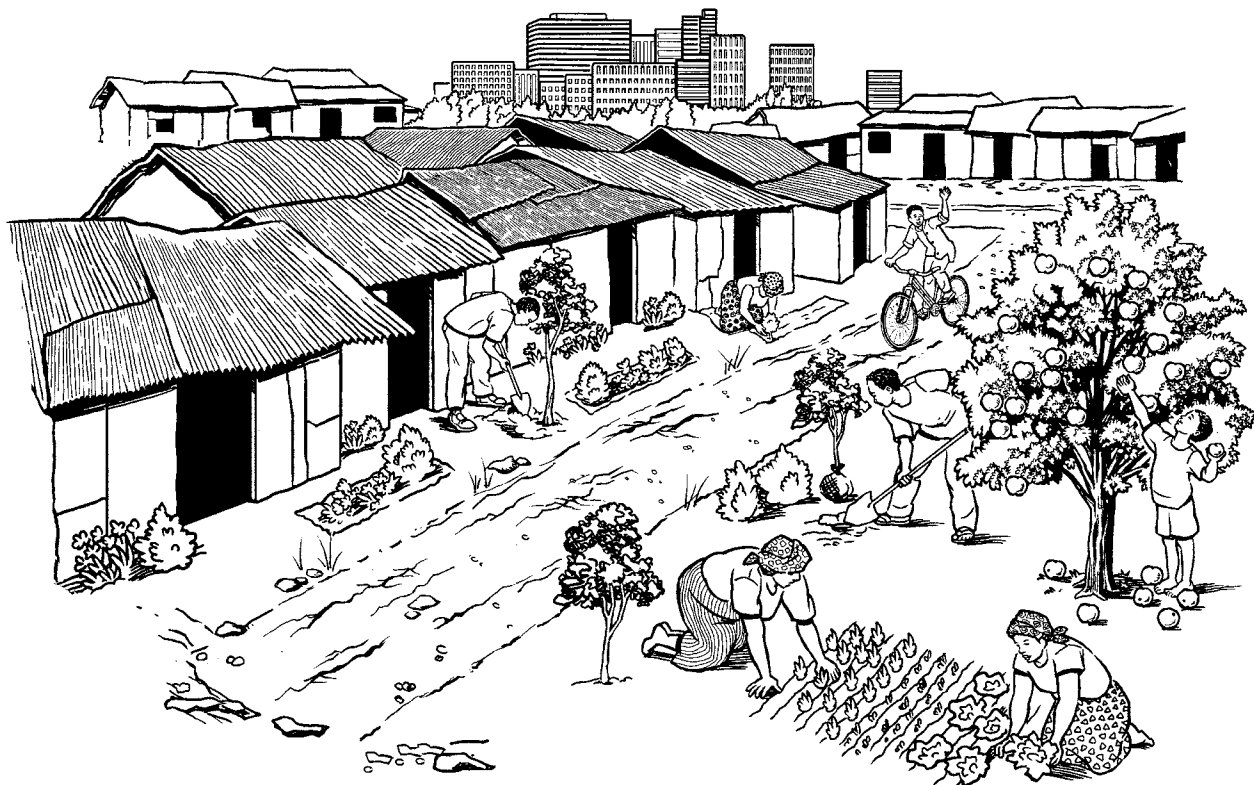


11

Restoring Land
and Planting Trees

In this chapter:	page
Preventing erosion	200
Story: NGO workers learn about erosion from farmers	201
Restoring damaged land	202
Natural succession	202
How to make seed balls	204
Story: Helping trees plant themselves	205
Planting trees	206
Growing trees in a nursery	209
Restoring waterways and wetlands	214

Restoring Land and Planting Trees



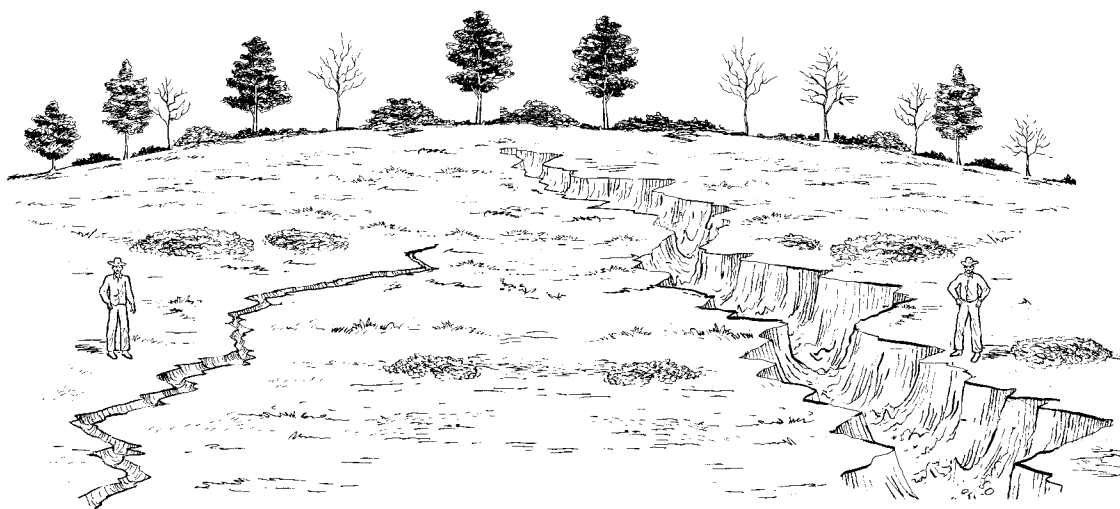
Healthy communities depend on a regular supply of clean water, fertile soils, and usually on trees and the resources they provide and protect. To maintain and improve the health of communities, it is important to learn how to restore damaged land and how to use the land in sustainable ways. When land has been damaged, trees cut down, and soil lost to erosion by wind and water, there are many ways to make the land healthy and productive again.

Preventing Erosion

Loss of soil, or erosion, is caused by wind and water wearing away the soil and carrying it off. Protecting soil from erosion, especially on steep hillsides, improves the land's ability to grow crops, protects water sources downhill, and prevents landslides. Farmers follow 3 principles to prevent erosion and surface water runoff:

1. **Slow the water** by creating natural barriers from the top of the watershed down.
2. **Spread the water** by creating channels to divide it and direct where it flows.
3. **Sink the water** by improving the soil so it allows the water to filter into the ground.

The signs of erosion are sometimes difficult to recognize. They include crops that do not produce as much as they used to, rivers that are muddier than they used to be (especially after storms), and soil that has grown thin.



This erosion gully is just forming...

... but before long, it will look like this.

Where erosion has not begun, it can be prevented by keeping as many plants and trees as possible, and by directing surface runoff water into ditches, ponds, and natural waterways. Where erosion is already severe, it is still possible to stop it and to restore healthy soils. Even placing a line of rocks or building a low stone wall across the slope of the land can prevent soils from washing downhill, and create fertile places for trees and plants. Sustainable farming methods such as green manures, crop rotation, mulching, and planting trees along with crops are also ways to protect soil and conserve water resources (see Chapter 15).

NGO workers learn about erosion from farmers

In the Gulbarga District of Karnataka, India, an NGO worked with farmers to prevent soil erosion in their fields. Farmers traditionally built high stone barriers that collected most of the soil but had openings below to let water through, even when the monsoons came.



The NGO workers noticed that the farmers' stone barriers allowed some soil to be lost to the fields below. And when high stone barriers were built at the lower edges of the field, some of the stones toppled over and had to be collected from below and replaced. They proposed building solid stone barriers that would stop all the soil loss and would not need constant repairs.

The farmers said they did not mind replacing a few stones. But the NGO workers could not understand this. The farmers' stone barriers took more work to build and they let soil through, failing to control erosion completely. They proposed an experiment. In some fields they would build solid, low stone walls. In others the farmers would build the traditional barriers.

At the end of the season, the farmers and the NGO workers met and compared the effects. Many farmers with fields below the new, solid walls were unhappy. Cattle wandered across the low walls onto their fields, and after the monsoons, these farmers had less new soil and less water for rice paddies than before.

These problems led to arguments between the owners of the lower fields and the fields above. The experiment showed the farmers that their own traditional barriers worked better than the "improved" walls. The farmers told the NGO workers that the solid stone walls caused too many problems. Through this experience the NGO workers learned that the farmers' traditional barriers not only prevented soil erosion, they also prevented cattle from straying. Allowing some soil and water through prevented good neighbor relations from eroding, which was more important to the farmers than a little extra work!

Restoring Damaged Land

Sometimes land is so damaged that it seems impossible to restore it to a healthy state. In places where healthy land has turned to desert, or where toxic chemicals in the soil have made it impossible for plants to grow, the land could take hundreds of years to restore. But in many places, with careful work and understanding of the ways the earth restores itself, we can help the land recover.

Nobody can force land to be productive. Even chemical fertilizers work for only a little while before the land no longer produces. But if we pay attention to natural cycles, we can help create the conditions the land needs to restore itself to a healthy, fertile state.

Natural succession

Sometimes, the best way to restore land is to leave it alone or help it recover in small ways. Building fences or posting signs asking people to stay out, or reducing the number of livestock that graze the land, can go a long way toward letting land recover. When land is protected from use, and the conditions are right for life to return, plants come back in a natural order, called natural succession. This process can take many years, even several generations.

Natural succession will NOT restore land when:

- There are no sources of seeds or native plants nearby.
- Rapidly spreading plants have taken over and crowd out desirable plants.
- The land is so degraded or contaminated that nothing will grow. (For a story about restoring land after an oil spill, see page 520.)

Native and non-native plants and trees

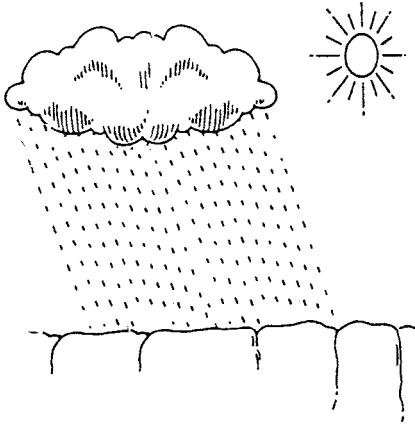
Native plants (plants from the local area) grow easily in local conditions. They also preserve biodiversity by attracting and providing homes for native insects, birds, and animals.

Sometimes, plants and trees that are not native to the local area become popular because they grow fast, produce good lumber, or help improve the soil. Some trees, such as eucalyptus, pine, teak, neem, and *Leucaena* have been planted all over the world.

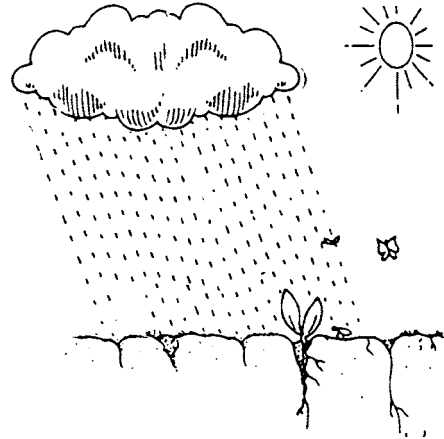
But planting trees and plants that are not native to your area can lead to problems. They may use too much groundwater, compete with crops and native trees for water and soil nutrients, spread beyond where you want them to grow, or cause native animals and insects to seek other places to live. When non-native plants take over, it is difficult to restore land through natural succession.



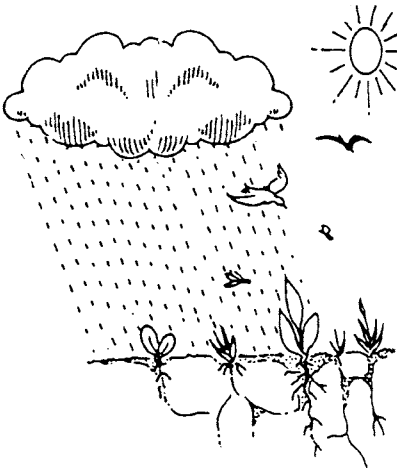
Natural Succession



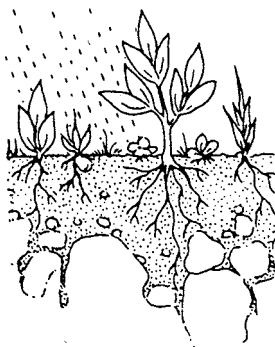
1. Degraded land with poor soil and no plant life.



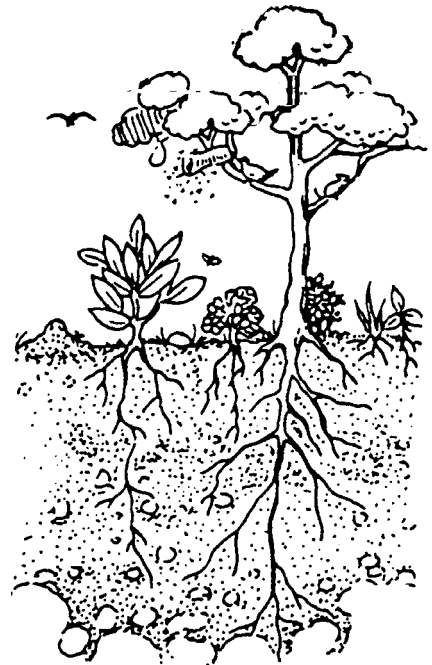
2. Small, hardy plants called pioneer plants grow back first in places where soil can collect. Pioneer plants hold water and attract insects and birds.



3. Water settles into small catchments created by pioneer plants, bringing seeds and nutrients. Birds bring more seeds.



4. Larger plants and small trees grow. Plant roots break up compacted soil. Soil builds up and holds more water.



5. Bigger plants and shrubs grow back, and the land is restored.

How to make seed balls

A simple method to restore plant life to an eroded area is by using seed balls. Each year, collect wild seeds. Children are especially good at gathering seeds, and it is a fun learning activity.

Gather as many different kinds of seeds as possible from plants native to the area. With these seeds and some soil, make little balls.

Mix:



**1 part
mixed
seeds**



**2 parts
sifted compost or
planting soil**



**3 parts
clay soil sifted to
remove stones**



**a small
amount
of water**

Mix seeds with compost or planting soil, then add clay. Add just enough water to make the mixture damp. If you add too much water, the seeds will sprout too soon. Make small balls out of this mixture. Let them dry for a few days in the sun.

Just before or during the rainy season, go to the area where you want to restore plant life and toss the balls out. Building contour trenches and other barriers there first (see page 293) will direct surface runoff water and help the seeds sprout and grow.



The seeds will sprout when it rains. The compost provides nutrients, and the clay prevents the seeds from drying out, being eaten by mice or birds, or blowing away. After a year the new plants will make their own seeds, and before long many new plants will grow. Soil will build up around the plants, preventing erosion. Soon, other kinds of plants will appear. If it is not disturbed, after many years the whole area will be restored.

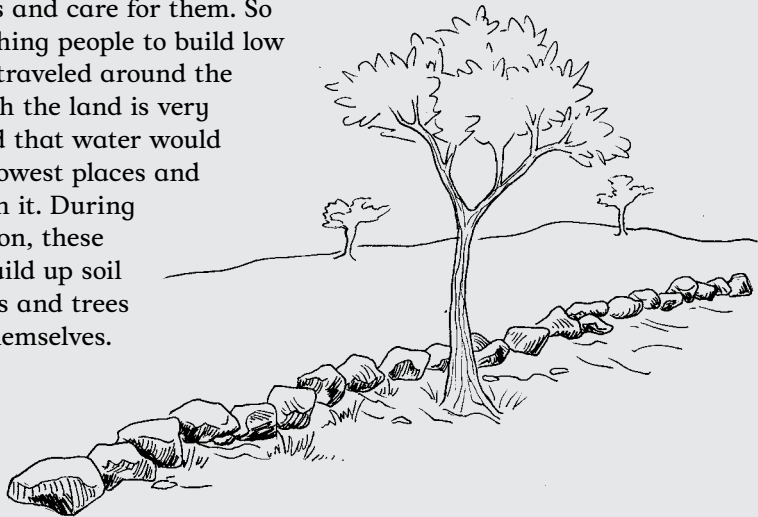


Helping trees plant themselves

In Somalia, East Africa, there are few trees due to the dry, desert climate. But the number of trees has gotten even smaller because the few trees that do grow are often cut down to make charcoal. Some of this charcoal was used by the Somali people, but much of it was sold to other countries. When a woman named Fatima Jibrell saw this problem, she started a campaign to prevent the sale of charcoal to other countries. “When we have barely enough for ourselves,” she said, “we cannot afford to let others exploit our resources.”

Fatima’s campaign was successful. But by then, there were very few trees left. So she started a campaign to promote new tree growth in Somalia. She believed that the best way to reduce the severe poverty of her people was to bring trees back to Somalia.

The land in Somalia is very hot and dry, making tree planting difficult. And because most people in Somalia move from place to place with the seasons, it was not practical to expect people to plant trees and care for them. So Fatima started teaching people to build low rock fences as they traveled around the country. Even though the land is very flat, Fatima believed that water would find its way to the lowest places and would bring life with it. During the short rainy season, these low fences helped build up soil nutrients, and plants and trees began to grow by themselves. Now there are more trees growing in Somalia than there have been in many years.



Planting Trees

Under the right conditions, planting trees helps restore damaged lands and provide firewood, timber, food for people and for animals, and medicine. Planting trees can make land that is poor and barren become rich and fertile again. But trees planted in harsh conditions need care to grow well. Tree planting has many benefits, but it is not right for all areas or all communities (see page 191 for an activity that can help decide whether to plant trees).

There are several ways to grow trees:

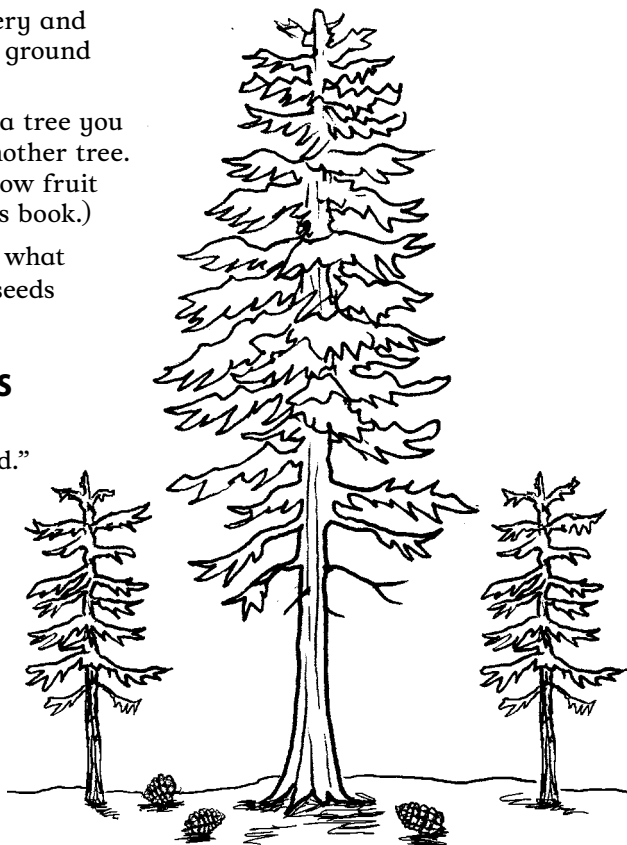
- Plant seeds or cuttings (pieces of a branch) directly into the ground (see page 207).
- Collect and transplant wild seedlings (see page 208).
- Grow tree seedlings in a nursery and then transplant them into the ground (see page 209).
- Graft (attach) a cutting from a tree you want onto the root stock of another tree. (Grafting is usually used to grow fruit trees and is not covered in this book.)

The method you choose depends on what trees you want to plant, and what seeds or cuttings are available.

Selecting seeds or cuttings

Many people have sayings such as, “Like the parent, so will be the child.”

Just as a child whose parents are tall will also likely grow tall, a tree seedling whose “parent” has a straight trunk that is good for lumber, or produces useful medicine, is likely to share those same qualities. It is best to collect seeds or cuttings from parent trees that are healthy and have the qualities you want. If you cannot collect seeds in your area, you may be able to get seeds from an extension agent, or from a nursery or garden in a nearby town.

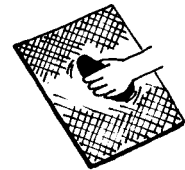
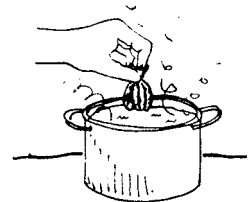
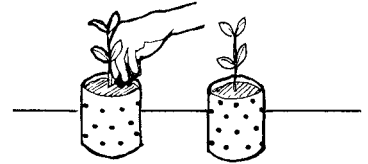


Preparing seeds for planting

Some seeds, usually those with soft coverings and which are mealy or juicy, must be planted soon after they are collected. Other seeds may need to be stored for many months before you will plant them. (For information about storing seeds, see page 303.)

Most seeds need water to sprout. When a seed is covered with a thick or hard skin it may also need to be softened or cut before the water can soak in. Some seeds may need more treatment before planting.

- If the seed covering is not too hard (you can dent or break it with your fingernail) and not too thick (not thicker than the cover of this book), plant it directly into moist soil.
- If the covering is hard but thin, wrap the seeds in a piece of cloth. Let them soak for 1 minute in water that is too hot to touch, but not yet boiling (80° C). Take them out of the hot water and quickly put them in cool water to soak overnight. Plant them the next day.
- Another way to treat seed coverings that are hard but thin is to soak seeds in cold water for 1 full day, then cover them with moist cloth sacks for another 24 hours. Repeat this procedure for 6 days. On the 7th day, plant the seed.
- If the covering is hard and thick, rub the seeds with a piece of rough stone or sandpaper until you see the soft, inside part of the seed. Be careful not to rub too deep and damage the seed.
- If the seed covering is soft but thick, cut a thin strip of the covering away from the soft inside of the seed, being careful to cut the seed as little as possible.
- Some hard-coated seeds are best treated by soaking overnight in water mixed with cow dung, then dried in the sun for 1 day. Repeat this process for 3 to 4 days. The good seeds will sprout and be ready for planting. The seeds that do not sprout can be discarded.



Some seeds need more complicated treatments, such as being heated in a low fire, chilled, or being eaten and passed by animals. Experiment to find what works best. After many attempts, you will be an expert at starting tree seeds.

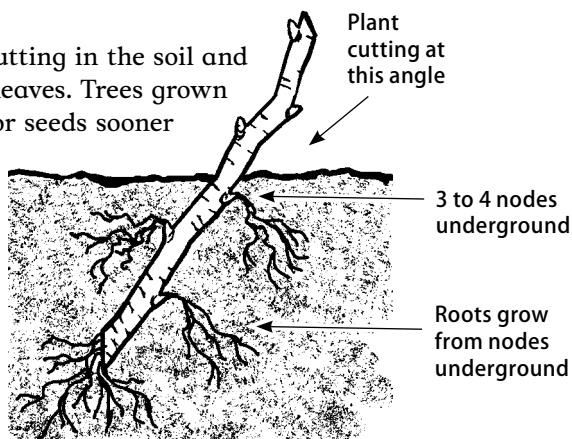
Preparing tree cuttings

Some trees grow best by putting a cutting in the soil and watering it until it grows roots and leaves. Trees grown from cuttings usually produce fruit or seeds sooner than trees grown from seeds.

Some cuttings can be planted directly into the soil where you want the tree to grow. Others should be planted in a nursery until they have sprouted plenty of leaves and roots and can survive on their own.

Make cuttings from the middle of a branch where the wood does not bend too much but is not too rigid. Select a piece with about 6 to 10 “nodes” (bumps on the branch where the leaf grows or used to grow.) Gently remove the leaves, being careful not to damage the nodes. Cut the branch at an angle instead of straight across, to help roots form properly.

Whether the cuttings have been planted in a nursery or directly into the ground, be sure they have plenty of water and are protected from pests until they have grown enough roots to find water on their own.



Collecting seedlings from the forest to transplant

Transplanting wild seedlings

Another way to create a forest is to dig up wild tree seedlings and replant them where you want them to grow. Find healthy parent trees and choose seedlings growing near or under them.

Dig up small seedlings, careful not to damage the main, long tap root. If this root is damaged, the tree will not grow well. Dig in a circle around the seedling and as deep as you think the tap root has grown. Use your hand or a tool to bring the seedling up without shaking off the soil around the roots.

Keep the soil around the roots of the tree seedling moist until it is planted in the ground. Continue watering it until its roots have grown into its new place and it can find water for itself.

Growing trees in a nursery

Tree nurseries give trees a healthy start before they are transplanted to other places. But creating and caring for a nursery can be a lot of work. It makes sense to grow trees in a nursery when:

- The seeds or cuttings of the trees you want to plant are scarce.
- Pests would damage the young trees if they were not protected.
- People have enough time to take care of the nursery.

Planting trees directly is easier than growing them first in a nursery and transplanting them. However, many more tree seedlings die using the direct method than when you grow them in a nursery.

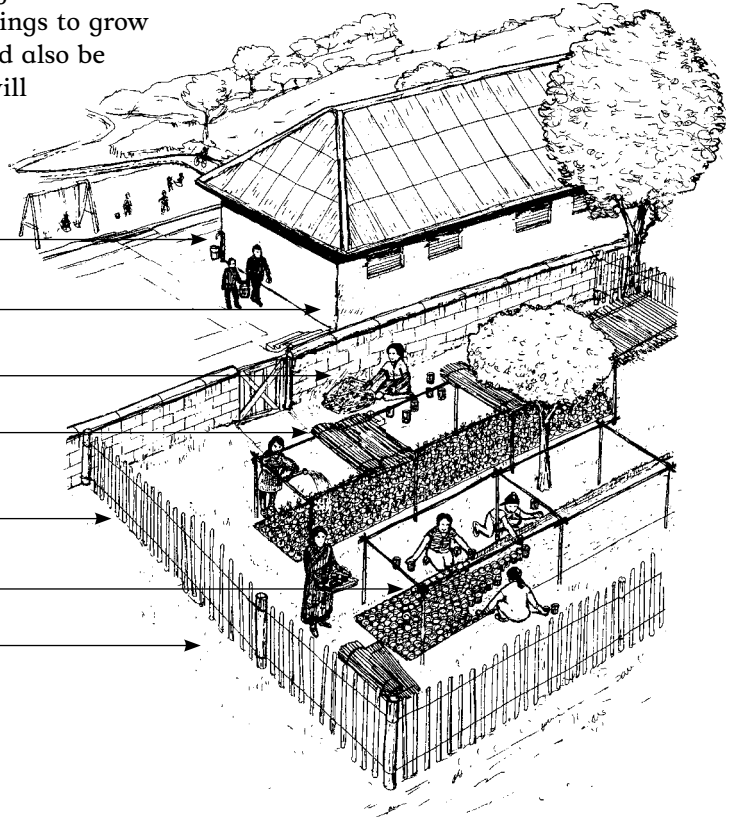
When to start trees

The time of year you plant will depend on how long the trees need to be in the nursery. If your area has a wet and a dry season, plant your trees just as the wet season starts so you will not have to water them as much. Most trees need 3 to 4 months in the nursery before they are big enough to plant outside.

Where to put a tree nursery

A nursery should be easy to get to and available for as long as it takes for tree seedlings to grow and be transplanted. It should also be accessible to everyone who will work there. Every nursery needs these things:

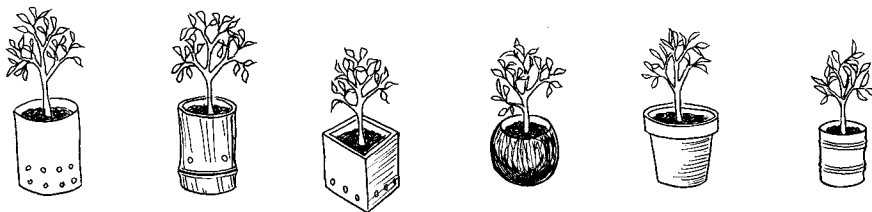
- A water source and a way to store water
- Safe tool storage
- A place where soil can be mixed and containers filled
- Protection from too much sun, rain, and wind
- A fence to keep out large animals and vandals
- Space for all the seedlings
- Level ground or terraces if on a hillside



Growing tree seedlings in containers

Growing tree seedlings in containers makes them easy to transport and to plant. Containers should be wide and deep enough to allow the seedling to grow a root ball, but not so big that they are very heavy or soak up more water than the tree will need.

The longer a seedling needs to be in the nursery, the bigger the container should be. A good size for most trees is about 6 inches wide at the top and 9 inches deep. They should be strong enough to stand upright when filled with soil, and have holes to allow excess water to drain out.

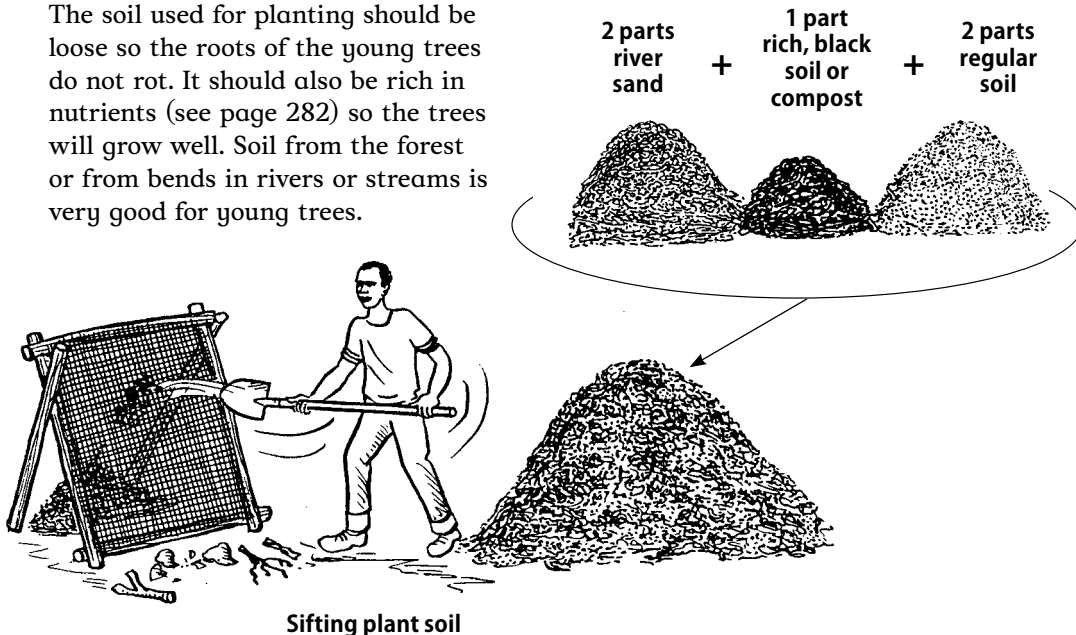


Containers that will rot (newspaper, leaves, cardboard) can be planted directly in the ground along with the seedling. Containers made of plastic, glass, or wood must be removed before planting, but can be used again many times.

Young tree seedling need to be protected against too much sun. Many grow best under some shade during the heat of the day.

Soil for planting

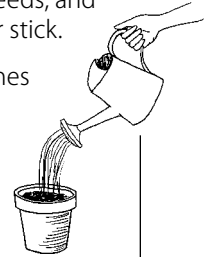
The soil used for planting should be loose so the roots of the young trees do not rot. It should also be rich in nutrients (see page 282) so the trees will grow well. Soil from the forest or from bends in rivers or streams is very good for young trees.



How to plant seeds or cuttings in containers

- 1 Water your planting soil the day before you plant so it will be moist but not wet. Treat the seeds before planting, but not so long before that they will begin to sprout or rot (see page 304). Fill your containers with soil.
- 2 To plant very small seeds, scratch the surface of the soil, sprinkle 5 or 10 seeds, and cover them very lightly with dirt by scratching the soil again with a fork or stick.

To plant larger seeds, make a hole in the center of the soil about 2 to 3 times as deep as the width of the seed. You may want to plant more than one seed in each container. Cover the seeds with dirt and press down lightly. Pressing the dirt removes air pockets where fungus could grow.
- 3 Water the containers after planting. If the seeds are very small, this must be done carefully so the seeds are not washed away.
- 4 When the seeds have sprouted 1 or 2 leaves, choose the seedling that looks strongest and cut away any others, leaving one seedling in each container. By cutting the seedlings you do not want rather than pulling them out, you will not disturb the roots of the seedling you do want.



Watering tree seedlings

Watering tree seedlings is one of the most important activities in a nursery. Water your trees in a way that gently sprinkles the water like rain, instead of in a single stream like a tap that might wash away soil and uncover roots.

The amount of water a seedling needs depends on how deep its roots have grown. Water seedlings as soon as their leaves begin to droop. But it is best that they never get to this point, because it is stressful for the plant.

Until seedlings have 2 or 3 leaves, water whenever the top of the soil appears completely dry.

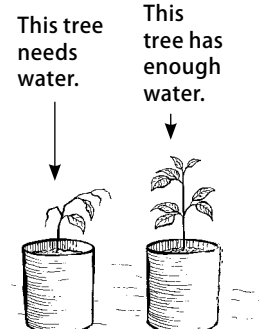
Then, until they have 5 or 6 leaves, water when the soil is dry as deep as the fingernail on your thumb.

Then, until the roots push against the bottom of the container, water when the soil is dry as deep as the first joint of your thumb.

Weeding and fertilizing

Weeds compete with tree seedlings for light, water, and nutrients from the soil. A few small weeds in a container will do no harm. But if there are more, cut them away at their base to not break up the soil.

If your soil is fertile, seedlings should get the nutrients they need. If fertilizer is needed, make natural fertilizer from manure, compost, or urine (see Chapter 15).



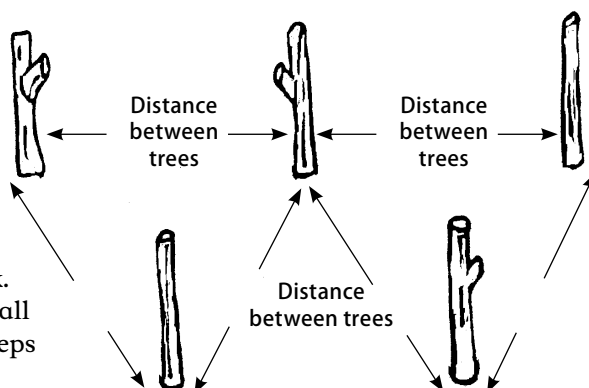
Transplanting seedlings

When the roots of the seedlings begin to push through the bottom of the containers (usually 3 to 4 months after planting) it is time to transplant them. If you cannot plant at this time, trim the roots back once a week. This helps the tree form a full ball of roots in the container and keeps it from rooting in the ground.

A month before planting, gradually remove the shade over the seedlings until they have the same amount of sun as the site where they will be planted. This gets the seedlings used to the sunnier and drier conditions of the planting site.

The day before planting, water the seedlings so the containers will be wet. Transport them carefully, being sure not to damage the roots. Mark where you want to plant each seedling. The distance between trees depends on the type of tree and the reason for planting. As a general rule, plant trees so their branches will just touch when full grown.

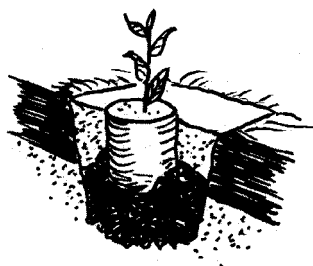
Clean all weeds or brush that might shade the seedlings or compete with them for water in a 1 meter circle around the planting area. Plant in early morning or the cool hours of the late afternoon to protect the trees from sun. Avoid damaging or drying out the roots while planting.



Planting in a triangular design allows many trees to grow in a small area.

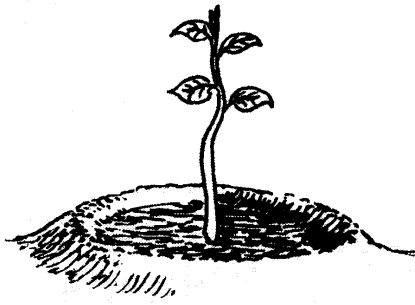


Dig square holes $1\frac{1}{2}$ times as deep as the containers. Round holes prevent roots from reaching into the surrounding soil.

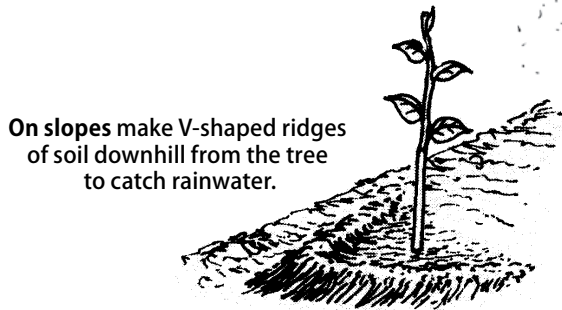


Fill the hole with soil so the base of the trunk will be level with the ground when the hole is filled. You may want to add a few handfuls of compost or rich, black soil to help the tree get started. After planting, soak the soil around the tree with water.

Transplanting in difficult places

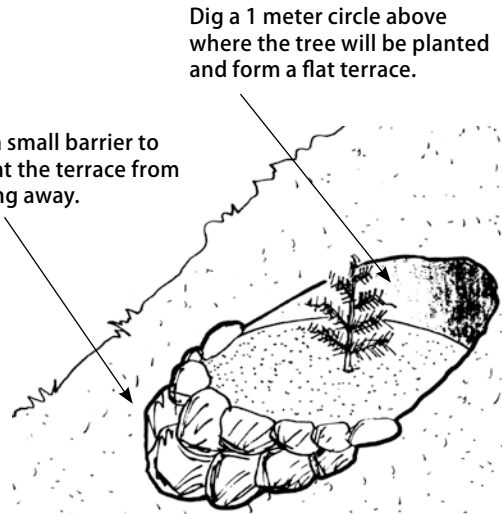


In dry places, make small hollows around trees to catch water.



On slopes make V-shaped ridges of soil downhill from the tree to catch rainwater.

Build a small barrier to prevent the terrace from washing away.



On steep slopes, make a small terrace for each tree.

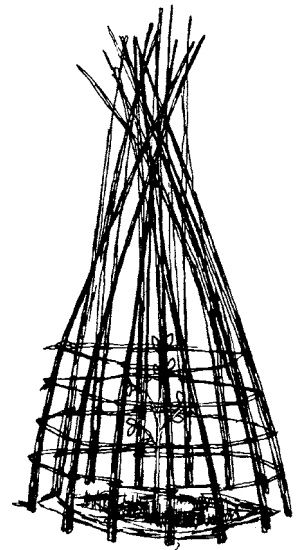
Caring for young trees

A tree needs to be protected through its first year of life. Many tree planting projects fail because no one takes care of the young trees.

If the weather is hot and dry, seedlings need to be watered first once a day, and then every 2 or 3 days. After a few weeks, the tree roots should find water. But if the weather is still hot and dry, water as the trees need it.

Cut back weeds until the tree is taller than the weeds. If animals or children might damage the young trees, construct barriers around the trees.

If a tree is not growing well, or the leaves look yellow or unhealthy, it may help to spread natural fertilizer (see page 287) in a circle as wide as the tree branches.

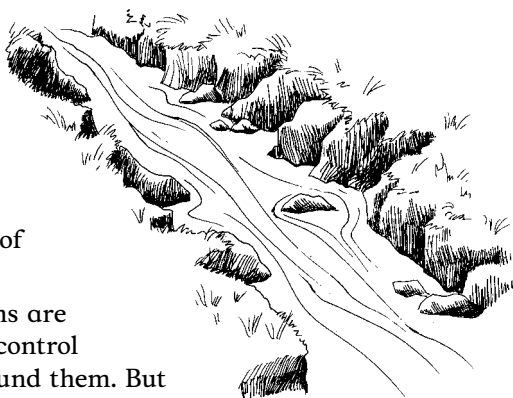


Make barriers to protect young trees.

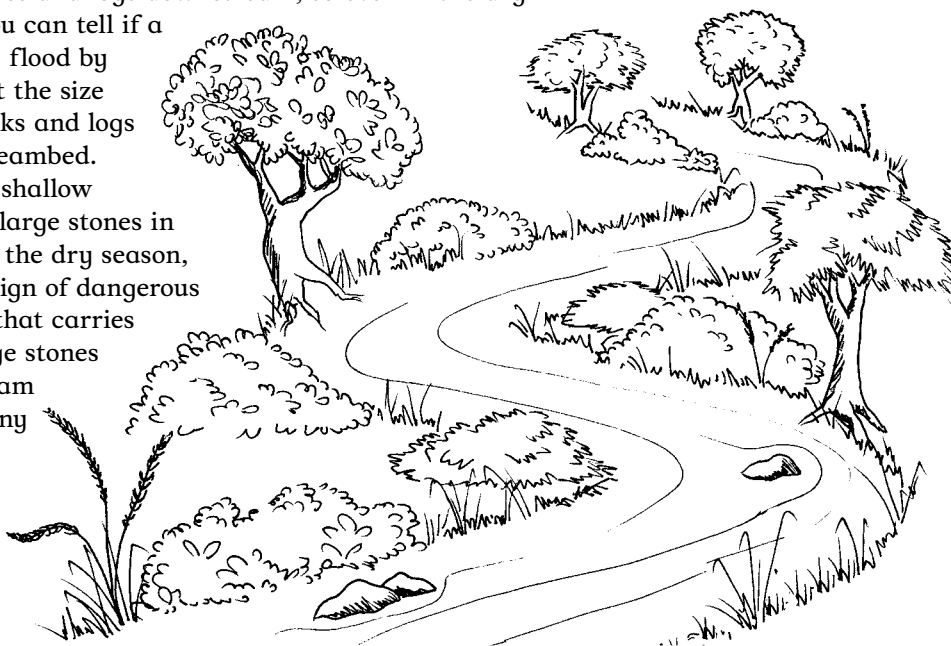
Restoring Waterways and Wetlands

The plants and trees that grow along the banks of streams and rivers and in **wetlands** (areas where the ground is wet or flooded all year), do many important jobs in the watershed. They control floods, clean water, help surface runoff sink into the ground, and provide homes to a variety of animal and plant life.

Streams and rivers in cities and towns are often made to flow in a straight line to control flooding and make it easier to build around them. But the straighter a stream or river, the faster water flows through it. When water speeds up, it causes more erosion of streambeds and banks and is more likely to cause flooding downstream. Floods carry large stones and logs downstream, so even in the dry season you can tell if a river may flood by looking at the size of the rocks and logs in the streambed. If a slow, shallow river has large stones in its bed in the dry season, this is a sign of dangerous flooding that carries these large stones downstream in the rainy season.



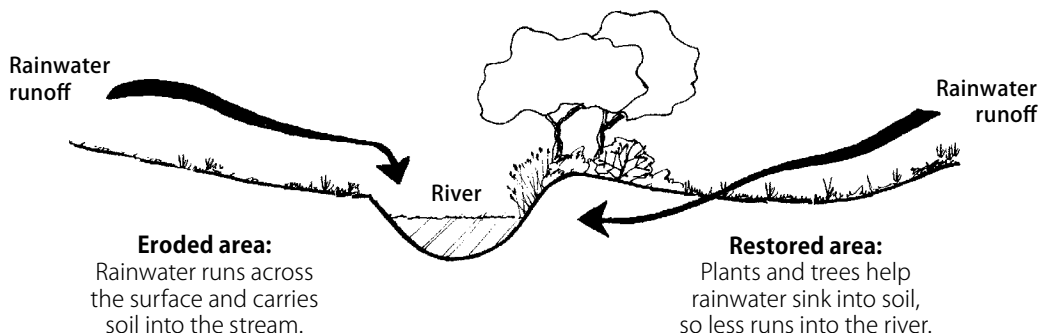
This river will flow fast and could cause erosion and flooding downstream.



This river will flow slower, allowing water to sink into the ground.

Restoring plant life

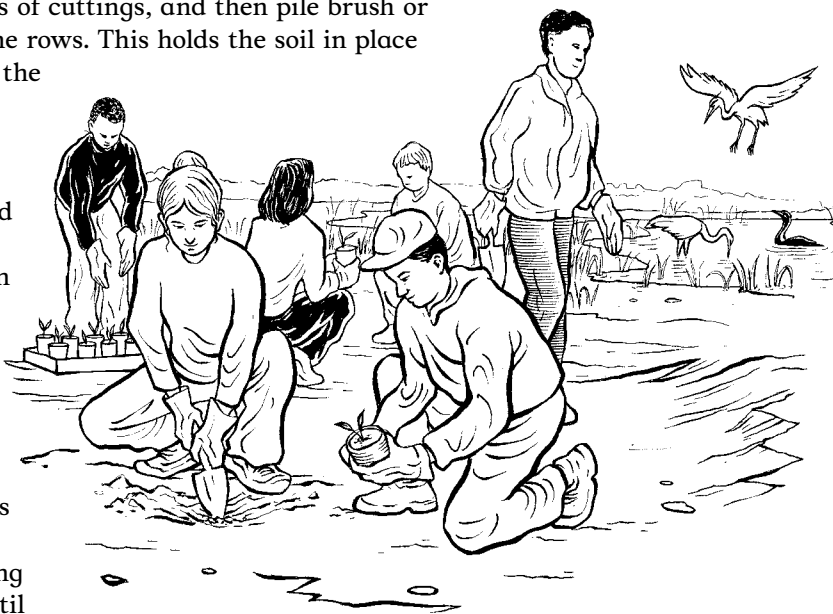
Plants that grow along waterways help to slow, spread, and sink rainwater into the ground and hold soil in place.



One way to stop soil erosion along streams and rivers is to plant trees alongside them. Planting in an area 20 to 50 meters wide on each side of a waterway will usually reduce erosion.

Trees that like to have wet roots grow easily from cuttings. Plant 2 or more rows of cuttings, and then pile brush or branches between the rows. This holds the soil in place and starts to create the conditions for other plants and animals to return.

Trees, shrubs, and grasses may begin to grow on their own once the sides of the river or stream are stable. If they do not, you may want to plant them. If possible, fence the area to keep animals out and to prevent people from gathering wood in the area until trees are fully grown.



Preserving and restoring wetlands is an important part of watershed protection.