United States Department of Agriculture

Soil Conservation Service

Program Aid Number 341

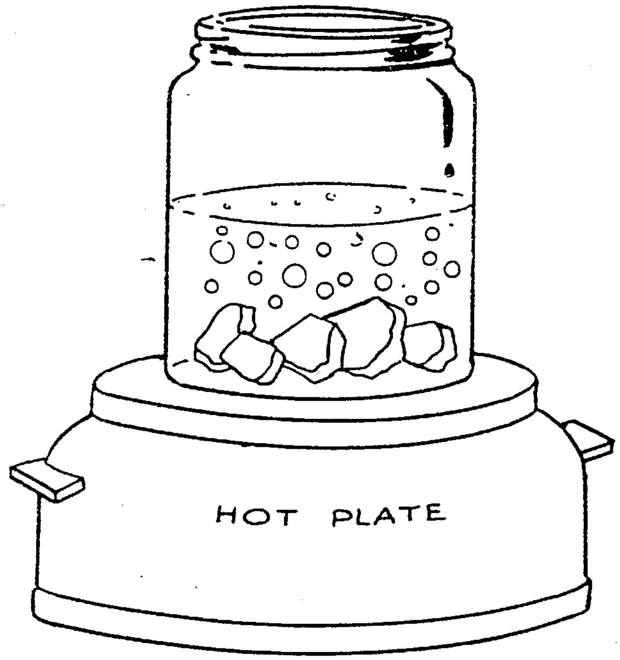
Teaching Soil and Water Conservation

A Classroom and Field Guide

CONSERVATION ACTIVITIES

Washington, D. C.

Issued December 1957
Slightly revised July 1986
Reviewed and approved for reprinting February 1992



soil as they are deposited in some flood plain or at the bottom of a lake.

When you put the limestone in the vinegar, you were duplicating in a small way what plants do. Plant roots take in oxygen from the soil air and give off carbon dioxide gas. This gas is one of the important end products in the decay of organic matter.

Carbon dioxide gas dissolves in the soil moisture, forming weak carbonic acid. This acid reacts just as the acetic acid in vinegar did with limestone rock and will decompose limestone and marble. The dissolving effect of this carbonated water is several times that of pure water. Since the lime in limestone is soluble, it gradually washes away leaving only the other materials as soil. It takes 40 to 50 feet of limestone to make only a few inches of soil.

There are other physical and chemical factors that also aid in soil formation. For example, wind blows small rock particles against larger ones, wearing both down. As explained later, even plant and animal life play an important role in soil formation.

INTERPRETATION

Soil is formed from rocks very very slowly.

When you rub two rocks together, small particles rub off. It takes a long time to accumulate even a spoonful. When large sheets of ice (glaciers) moved over the land thousands of years ago, they ground rocks together, rubbing off tremendous quantities of rock particles of all sizes. Much of the north central United States is made up of soils that were formed by the action of these glaciers.

Changes in temperature also help to make soil. The sun warms the rocks during the day. At night the rocks cool. The expansion and contraction chips off particles of rock just as you saw when you dropped the hot limestone into cold water.

Freezing water expands with tremendous force. Water that finds its way into cracks in the rocks freezes and breaks the rocks into smaller and smaller pieces.

Most of the soils we see today developed from rock material that was moved by water or wind either after this "weathering process" or while it was going on.

Soils are also formed as rocks are rolled along by streams. Note how smooth the pebbles are you see on beaches and along streams. They have been rubbed together until the rough parts are knocked off. These rubbed-off particles make up

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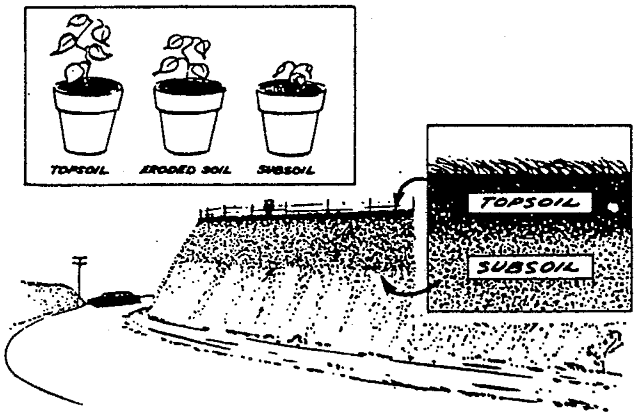
This dark, deep layer of topsoil is the product of centuries of weathering, accumulation of plant and animal remains, and the work of many living organisms. The less fertile subsoil, which is lighter in color, has little or no organic matter.

III. Compare Soils by Growing Plants in Them

Fill flowerpots with soil from the following places: (1) Topsoil from an old fence row or from a pasture that has never been plowed; (2) soil from an eroded hillside; (3) subsoil from a depth of 3 to 4 feet, which may be taken from a roadbank where the different layers of soil can be easily distinguished; (4) another sample or



two of different soils in your community, for example, from an old lakebed or a woodland.

If you live in the city, take samples from a flowerbed, from an excavation for a building, and from an eroded roadbank.

Plant a few beans in each pot—3 or 4 will be plenty. (Soaking the beans overnight in water hastens germination.) Keep the pots watered and place them where they will be warm and have some sunshine.

At the same time plant 3 or 4 beans in cotton and keep moist.

Compare the rate of growth. Keep a record of how fast the beans in each pot grow and how each plant looks. Compare these plants with the ones grown in cotton.

INTERPRETATION

Plants take all their mineral nutrients from the soil. They are made available for plant use through weathering and other soil-forming processes. The minerals found in a soil—except those added in the form of fertilizer—depend mainly on what was in the rock the soil came from.

Some minerals decompose more rapidly than others and even though they occur in small quantities in the soil they set free their nutrient content readily.

Plants also vary in the combination of minerals they can use as plant nutrients.

In general, soils that are above average in organic matter are more productive than soils low in organic matter. Organic matter improves soil in many ways—it makes the soil more crumbly; it increases its water-holding capacity; it serves as a storehouse for plant nutrients such as nitrogen; and it provides food for the countless bacteria and other living things in the soil. Some of these organisms produce acids that in turn help break down soil minerals.

This explains why plants usually grow better in topsoil than in subsoil.

It is possible, however, to find a subsoil that is more productive than the topsoil. This might be true where water percolating down through the soil has leached plant nutrients from the topsoil and deposited them in the subsoil below. It may also be true in desert soils where organic matter seldom accumulates in the surface layer or where alkali forms at the surface and makes the soil toxic for plants.

IV. How Fast Do Soils Take in Water?

You will need 6 large fruit or vegetable-juice tin cans; board 4 inches wide, 1 inch thick, and 12 inches long; hammer; 12-inch ruler; pocket watch with a second hand; pencils and paper; quart measure; and 2 gallons of water. It may take 2 to 3 hours to complete this activity.

Cut the bottom out of one end of the can just below the rim. This leaves a sharp edge that will drive into the ground easily. Cut out the other end, leaving the rim on for added strength.

Avoiding sandy soil, find a spot in each of the following places:

1. An ungrazed and unburned woodland where there are dead leaves on the ground, ½ to 1 inch or more deep.
2. A grazed woodland where livestock have packed the soil.
3. A fence row or park where the grass has never been plowed up.
4. A pasture that has been grazed heavily and the ground is packed.
5. A cultivated field where topsoil has all eroded away, leaving subsoil exposed.

Try to locate places close together so that as nearly as possible the same kind of soil is used.

Mark the outside of each can 2 inches from the end without the rim. In each of the spots you have selected, set a can so that the end closest to the 2-inch mark, is on the ground. Place a board on each can and tap with the hammer until the

V. How Does Organic Matter Help Soil Structure?

Take two wide-mouthed glass jars. Make two small baskets or wire racks of ¼-inch hardware screen. For each rack you will need a piece of screen about 3 by 10 inches. Bend the wire, as shown in the illustrations, so that it extends, basketlike, down into the jars.

Collect lumps of soil (not sandy) just under the sod from (1) a natural sod fence row or park and (2) a cultivated field that has been farmed heavily and where the soil is light in color. These lumps should be about twice the size of an egg.

Fill the jars with water within an inch of the top.

Place the lumps of soil in the baskets and lower them gently into the jars.

Watch closely and make notes of what happens.

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INTERPRETATION

Why does the soil from the heavily cultivated field fall apart and drop to the bottom of the jar while the other one holds its shape and clings together? The answer is largely the difference in the amount of organic matter and the effect it has on the soil.

Organic matter has a marked effect on both the physical and chemical properties of soils. It helps soil hold water and, therefore, decreases the amount of water that runs off. It improves aeration, especially on the finer textured soils. And it makes the soil easier to work—improves soil tilth, as farmers would say.

While these are all related, improving soil tilth is the one most clearly illustrated in this simple activity. Organic matter improves tilth of soils—makes the soil crumbly—causing the individual soil particles to stick together tightly in granules. These granules act, in effect, like much larger particles, in letting water and air move through the soil more readily. The large granules tend to stick together, too, because of the binding effect of the decomposed organic matter, or humus, and because of tiny roots under sod layers.

Since organic matter reduces water-runoff losses, damage by water erosion is greatly reduced.

When raindrops strike a bare soil with little organic matter, like the soil samples from the heavily cultivated field, or even when water runs over this bare soil it breaks down and washes away readily.

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These two samples of soil were taken only 25 feet apart. The one on the left from a cultivated field; the one on the right from an undisturbed fence row. Tests show the crumbly soil takes in water 20 times faster than the other.

VII. Find Out How Much Alive Soil Is

Take 3 large, heavy paper shopping bags, a ruler, a small spade, and 6 or more small bottles with lids or corks. A small magnifying glass will also be helpful. Measure off an area 1-foot square and collect the soil to a depth of 2 or 3 inches from each of the following places:

1. Below the leaves in an ungrazed and unburned woodland.
2. A pasture or fence row, just below the surface.
3. A badly eroded field where subsoil is exposed.

As you remove the soil watch for burrows of worms and other animals. You may also find the eggs of certain insects singly or in masses or pods.

Examine the samples, either indoors or outdoors. If you examine them indoors, small specimens will not be blown away by the wind and you can use a microscope to look for small organisms.

Pour out the samples on separate sheets of white paper the size of an opened newspaper.

Carefully sort the soil, watching closely for small living things. One-foot squares of ¼-inch hardware cloth or window screen will be helpful in making this examination. Place the different kinds of animal life in separate bottles. Count the animal life belonging to each of the following groups:

1. Worms (such as earthworms or night crawlers having no legs).
2. Grubs (any wormlike animal with legs).
3. Snails. (Snails without shells are called slugs.)
4. Insects (any hard-shelled, soft-bodied, or winged (not all have wings) animal with 3 pairs of legs).
5. Spiders, mites, ticks, (animals with 4 pairs of legs).
6. Animals with more than 4 pairs of legs.
7. Others (any animal not falling into one of the above groups).

Which soil sample has the most small animal life? Does this seem to be related to the rate these soils absorbed water in Activity IV?

Does the amount of animal life and the burrows the animals make appear to have any relation to the looseness of the soil?

Figure the total number of animals per acre for each group from each of the sampled areas. (There are 43,560 square feet in an acre.) Also figure the grand total of all of the animals for 1 acre. No matter how large the total number of visible animals you find in the soil, it is small compared to the number of microscopic plants and animals, particularly bacteria, present.

This activity is best suited to spring.

INTERPRETATION

The soil is the home of innumerable kinds of plant and animal life that range in size from those too small to be seen with a powerful microscope to large ones such as earthworms. Most of the living organisms in the soil are so small you will not be able to see them without a microscope.

These living organisms have a marked effect on the characteristics of the soil itself. At the same time, such soil characteristics as the granulation (structure) of soil, how well air moves through it, how wet it is, how much organic matter it contains, whether it is sweet or acid, how the farmer handles his soil, all strongly affect the number of organisms in the soil.

Plantlife that is too small to be seen without a microscope includes bacteria, fungi, and algae. Bacteria, 1-celled organisms, alone may be present to the extent of 1 to 4 billion per gram of soil. Fungi, which include molds, do not contain chlorophyll and therefore cannot manufacture their own food. A gram of soil contains from 8,000 to 1 million of these. Soil algae are microscopic plants that contain chlorophyll and may run as high as 100,000 per gram of soil under favorable conditions.

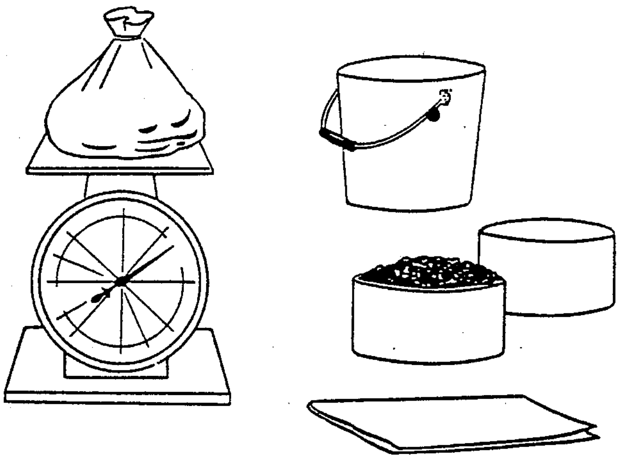
Animal life in the soil includes protozoa, microscopic animals larger than bacteria; nematodes, larger and more complicated than protozoa but some still too small to be seen without a microscope; and earthworms, ants, snails, spiders, mites, and various other worms and insects. It is only specimens of this last group, and possibly some of the larger nematodes, that you will see in this study.

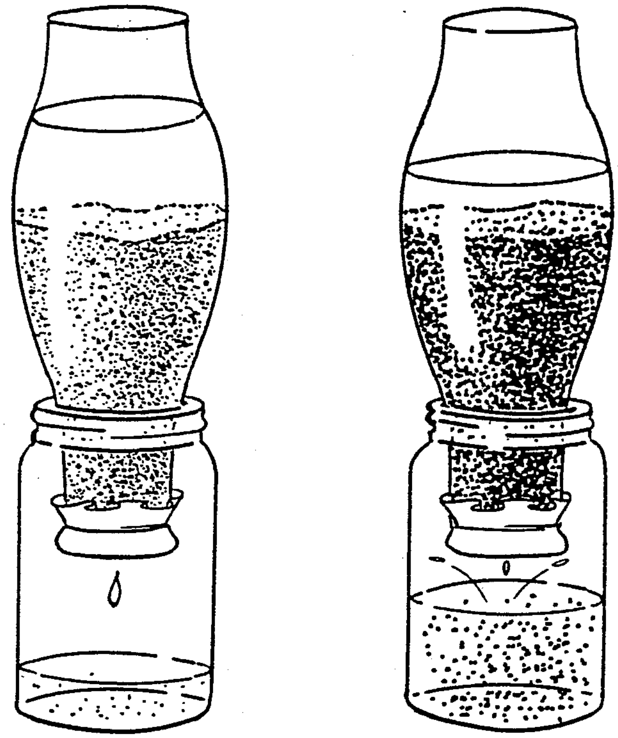
Earthworms are the most important group of the larger animals. They live in soils that are high in organic matter and not too sandy. The number of earthworms may range from a few hundred to more than a million per acre. Under favorable conditions between 200 and 1,000 pounds of earthworms may be present in an acre of soil.

The earthworms in an acre of soil pass several tons of soil through their bodies each year and in so doing make certain nutrients available to plants. Burrows left by earthworms let water and air move

IX. Compare How Much Water Different Soils Hold

You will need 2 cans of equal size (coffee cans will do); two 18-inch squares of cloth; some heavy string; a package or similar scale that weighs up to 64 ounces or 2,000 grams; and a container of water, such as a 2- or 3-gallon bucket or a 5-quart oilcan with the top cut out.





Put equal volumes of soil in the two cans. Take the soil for one from a field or garden that has been cultivated for several years and that shows lack of organic matter. This sample should be hard and cloddy. Get the other from a well-managed field where grasses and legumes have been grown, or from a good pasture or similar location. This sample should be crumbly and free from clods.

First allow the soils to dry.

Empty the two soil samples on the cloth squares, pull the corners together, and tie with a heavy string. Weigh each sample and record the weight.

Saturate each bag of soil by holding it in the water long enough to soak thoroughly. Remove the soil samples from the water and allow them to drain off the free water for a few minutes. Then weigh again and record the weights.

Calculate the difference in weight.

Another way to measure the water-holding capacity of soils is to use two old-fashioned lamp chimneys or cylinders as in the previous activity. Tie a cloth over the top, turn them upside down, and fill them about two-thirds full with the same two soils.

Be sure the soils are equally dry.

Place the chimneys in small-mouth fruit jars, as shown in the drawing.

Pour a pint of water into each chimney. Then note how long it takes the water to begin to drip into the jars, how much water comes from each soil, and how long the water continues to drip.

INTERPRETATION

When organic matter is used up, soil packs together. Thus, a cloddy soil has fewer air spaces, its particles do not cling together in granules, and the lack of organic matter means that it weighs more than an equal volume of crumbly soil from a well-managed plot.

Not only does a crumbly soil take in water faster than a cloddy one, it holds more. The thoroughly decomposed organic matter (humus) in a crumbly soil can absorb lots of water. On a dry-weight basis, this humus has a water-holding capacity of several hundred percent and may act like a sponge. In addition to the water held by the organic matter itself is the water held in the pores between the soil particles and between the soil granules. Hundreds of very fine soil particles are glued together by the organic matter into soil granules.

This increased water-holding capacity of soils high in organic matter under natural conditions makes a big difference in the intake of water. These well-managed soils can absorb most of the rain and snowmelt (if the soil is not frozen). This means there will be less erosion. Streams will run clear. Of course, when the soil is saturated by a long period of rainfall, any additional water then runs off. But until the soil is saturated it will a foot will be satisfactory, although you can get various results with different heights.

INTERPRETATION

You will find that the water will rush off the bare soil into the fruit jar, taking soil with it. The flow will stop soon, but the jar will contain muddy water.

The water that flows from the sod will be reasonably clear. It will take longer for the flow to start and it will continue longer. Also, not as much water will reach the jar. The amount of water in the two samples before the experiment will affect the results somewhat. Unless the soils are waterlogged, however, the activity will be successful. The samples need not be completely dry.

This activity illustrates one of the most fundamental principles of soil and water conservation—the protection grass gives soil against the pounding of raindrops and the movement of running water.

The grass breaks the force of the raindrops so that the soil is not pounded and broken apart by this impact. The grass roots open up channels to let water get into the soil. Organic matter furnished by decayed grass crops also lets water enter more readily, as we learned in Activity IX. And as the water runs off, the stems of grass slow it down so that it does not have enough speed to disturb the soil.

Grass protects the soil and increases meat and dairy products.

Experiments show this is true. For example, on one plot at La Crosse, Wis., where corn had been grown every year for 6 years, the annual soil loss was 89 tons per acre. On a plot in bluegrass sod, however, the annual soil loss was only 0.2 ton per acre.

XI. How Does Mulch Prevent Soil Loss?

Use the same boxes you made for Activity X. This time fill them both with the same kind of soil.

Set them on the table as before, placing the sticks under one end to make a slope.

Cover one box of soil with a thin layer of straw, grass, wood shavings, or sawdust; leave the other one bare. Sprinkle water on both boxes, using the same amount of water and pouring at the same rate from an equal height.

Note how much and how fast water runs off into each fruit jar.

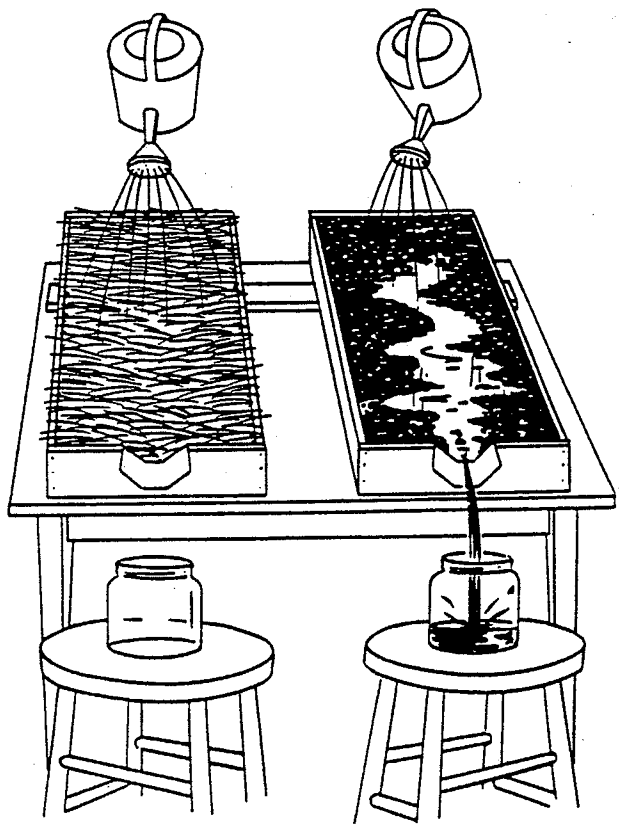
Another way to study the protection of mulches on the soil is to drop water from a short height on soil that is not protected and on soil that is protected with a mulch.

For this you will need two small tin cans. With an 8-penny nail, punch a hole in the bottom of each can and fill the hole loosely with cotton.

Put one-half inch of soil in two small fruit jars or water glasses. Put a light layer of dry grass clippings on one of the soil samples. Leave the other one bare.

Arrange the tin cans so that they are about 4 feet above the jars of soil. Put about one-half inch of water in the cans. Large drops of water will form through the holes in the cans and drop on the soil in the jars. Note the amount of soil that is splashed on the sides of the glass.

The third activity shows the effect of mulch on water intake of soil as well as the value of mulch in conserving soil and water.



vents the puddling or "running together" of the surface soil under the impact of raindrops. Dead plant materials protect the soil from being detached by raindrops. As long as the soil is granulated water will soak in rapidly. However, water soon softens the binding material that holds the granules together, and then the granules and clods disintegrate. The impact of raindrops separates the fine particles, splashing them into the air. Then these particles accumulate on the soil surface and fill the spaces between larger particles and granules. The result is a "seal" over the surface that permits water to enter the soil very slowly, if at all. Water must then run off. If the land is sloping, it causes erosion during hard, beating rains.

Mulches also reduce evaporation by shielding the soil from the wind and from the direct rays of the sun. In addition to mulches, high organic-matter content of the soil itself is needed.

XII. What Does Contouring Do?

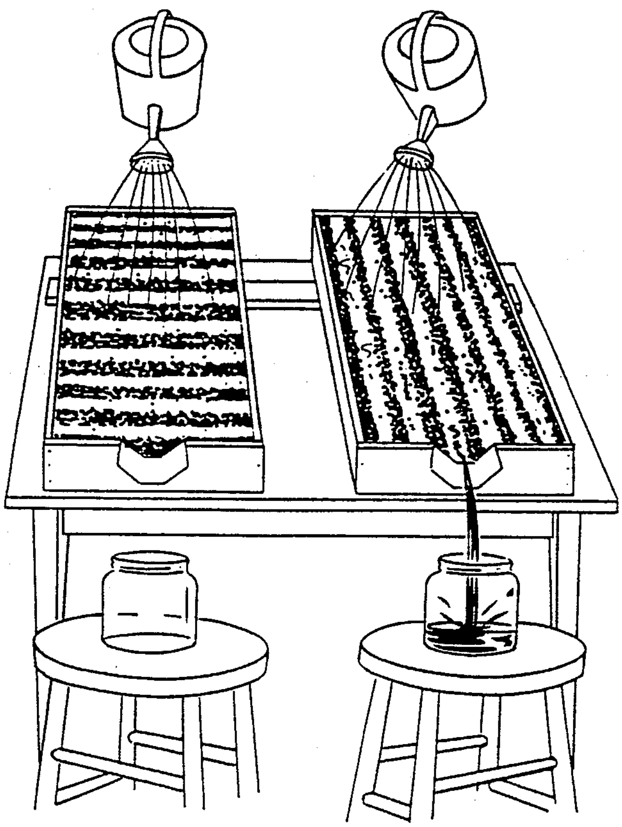
Fill both boxes used in Activities X and XI with soil taken from the same place. Set them on a table and place the sticks under the end to make a slope. Place fruit jars below the spouts of the boxes as before. Using your finger or a pencil, make furrows across the soil in one box and up and down the soil in the other.

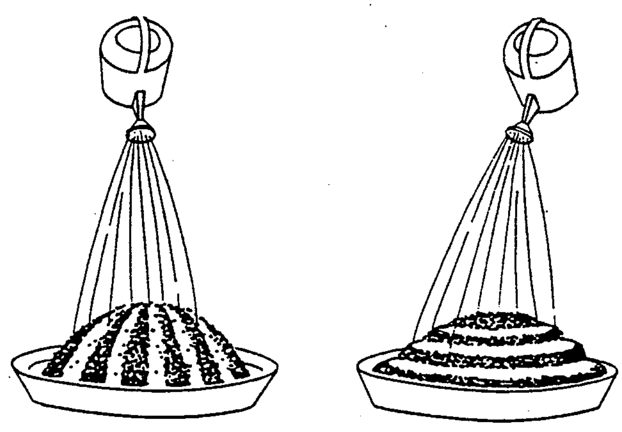
Fill two sprinklers with water and slowly sprinkle the two boxes at the same time. Hold the sprinklers the same height above the soil and pour at the same rate. Compare the rate of flow into the two jars and note the difference in their contents.

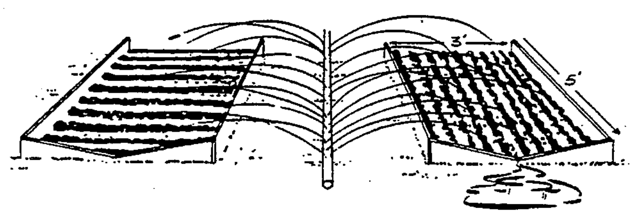
Another way to do this is to put mounds of soil in the middle of the boxes or in 2 large round low dishpans. With a pencil or your finger make furrows up and down one of the mounds and circles around the other mound. Sprinkle an equal amount of water on each mound and observe the water. Remember though, that such mounds probably have much steeper slopes than most cultivated land.

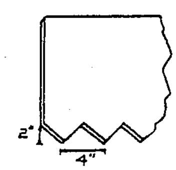
You can do this in the yard if you have a sloping area where there is no grass or where the grass is badly worn by walking or playing. By doing this outdoors, you can use a larger area. Make two plots 3 feet wide and 5 feet long with 1 or 2 feet between them.

With a regular garden hoe cut grooves 4 inches apart and about 2 inches deep across the slope









Drive the sharpened boards into each of the two spots to a depth of 6 inches.

Leave them there and observe them after the first rain.

Or fill a sprinkling can and, holding it the same height (3 to 5 feet) above the two spots of ground, sprinkle an equal amount of water an equal distance from each stake (about 1 foot).

After the rain, or after using the sprinklers, note the difference in the amount of soil splashed and the height it is splashed on each board.

Another way to note the removal of soil by splash erosion is to place some coins or flat stones on bare soil and use a sprinkler as before. Observe what the falling water does to the soil around the coins.

You can show this indoors if you place a jar lid full of soil in the center of a white sheet of paper or cardboard about 3 feet square and hold a sprinkler over it.

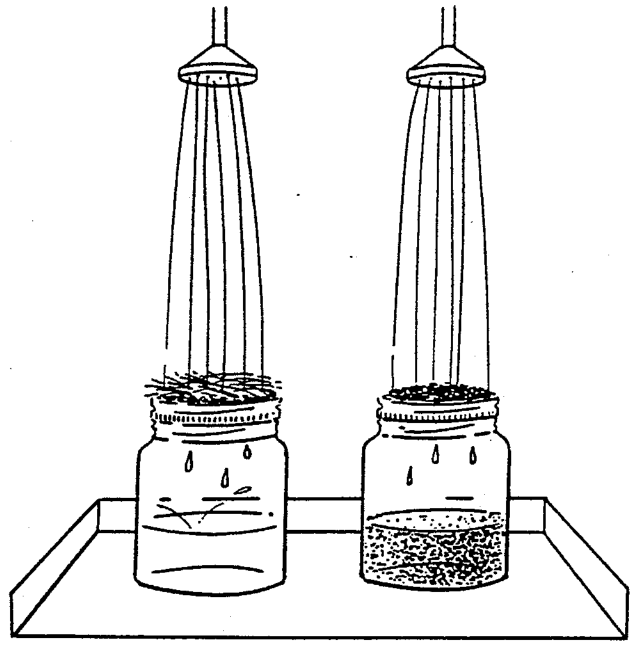
You can show the value of soil cover in preventing splash erosion by placing perforated fruit-jar lids, topside down, over two pint fruit jars. Fill each lid with the same kind of soil, level full. Place grass clippings on one and leave the other one bare. Set the lids side by side and hold a sprinkler over both, letting the water fall about 3 feet. Observe what happens to the water.

The bare soil will be splashed out of the lid. More water will soak through the sample with the grass clippings.

INTERPRETATION

You can observe the effects of splash erosion after any hard rain. Small pebbles will be perched on pedestals just as the coins were.

You can also see splashed soil in gardens and schoolyards, on sidewalks, on vegetables and



flowers, on basement windows and picket fences. One of the reasons for mulching strawberries is to keep splash off the fruit.

Soil particles must be dislodged before they can be moved. This is one part of the erosion process. When raindrops fall on bare soil, much energy is expended. Small clods and soil granules are broken down by the impact of the falling drops of water. Studies made by the Soil Conservation Service show that from 1 to 100 tons of soil per acre may be splashed into the air during one rain. This splashed-up soil consists of single particles that have been dislodged from the soil mass. Thus, they are easily transported from their original location by any water movement on the surface, no matter how slight. There need not be a steep slope for this kind of erosion since fine particles can be carried by slow-moving water.

You will find that soil particles are splashed to

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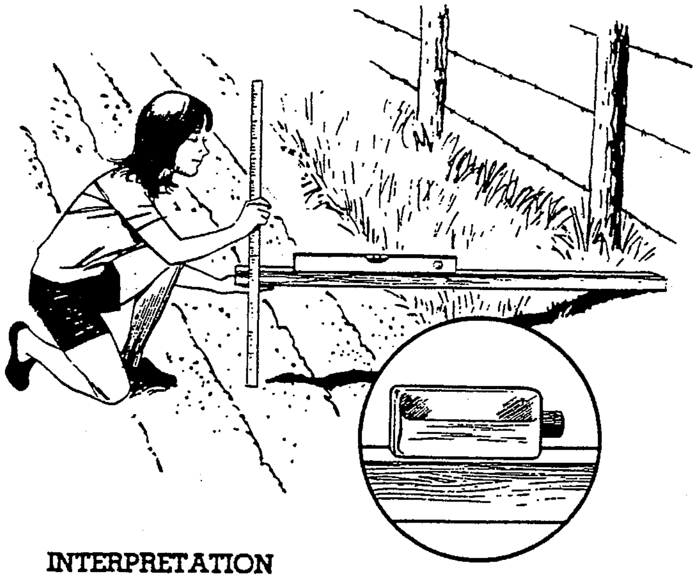
Small pieces of stone are left on pedestals of soil after beating rain has carried away the soil around them.



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Serious erosion on unprotected soil in foreground compared with grassed lawn that prevents soil loss.

INTERPRETATION

Slope is a very important land feature. It often determines whether a piece of land should be used for grass, trees, or cultivated crops.

The size of particles moved by water ranges from the smallest clay particles, carried in suspension, to large stones and boulders that slide or roll along on steeply sloping stream beds.

Water flows slowly over a gentle slope and rapidly over a steep one. Since the slope of a field itself cannot be changed, a farmer needs to do what he can to slow the movement of water down his slopes. Growing grass or trees, or using conservation measures like contour farming and stripcropping will help. Or he may shorten the length of slope by building terraces and diversions.

But reducing the speed of the water is essential.

Increasing the velocity of a stream increases its cutting or eroding power. The greatly magnified power of swift currents as compared with that of slow ones explains the work of streams at flood stage on steep slopes.

XV. Measure Amount of Soil Loss

You can measure how much soil has been eroded away in several ways. You may want to try one of the following in your neighborhood:

1. Find a cultivated field where the slope has at least a 5-foot fall in 100 feet of horizontal distance. Try to find a field that has been in cultivation for some time. You can check this information about the farm with the owner or the neighbors.

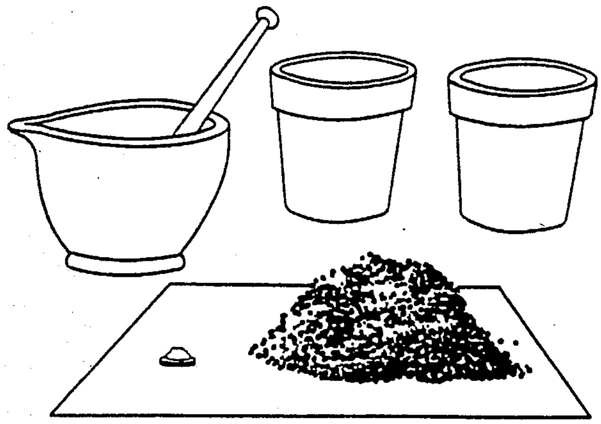
Dig a small hole deep enough to get below the topsoil layer. Then cut off a slice an inch or more thick along the vertical side of the hole. Lay this slice on the ground and study it. Note the depth of the topsoil layer. Study the structure—how the particles are held together. Are they tight and does the soil hold together in large lumps (clods)? Or is it crumbly like cake?

Dig another hole in the fence row at the edge of the field or just across the fence in a pasture that has not been plowed. Try to dig the second hole at about the same point on the slope and as close to the first one as possible. Study the soil layers as you did with the first sample. Lay the two samples side by side and compare them. Compare the depth of the topsoil layer and the structure of the soil.

2. Find a field where there is a fence built *across* the slope. Compare the height of the land at the fence row with that in the field down the slope. To do this attach a string to a stake driven in the ground above the fence row. From a spot down the slope (see drawing), pull the string parallel

XVI. How Does Fertilizer Affect Plant Growth?

You will need two flowerpots and a mortar and pestle. Try to get pots that hold about a quart.



You will also need soil of low fertility; seeds of tomatoes, beans, corn, or wheat; nitrogen and phosphorus fertilizers; and clean sand.

Get the soil from an eroded bank or from an eroded field that has been farmed heavily. Or dig into the soil a foot or more and get subsoil.

For the nitrogen fertilizer use ammonium nitrate or ammonium sulfate. And for the phosphorus fertilizer use superphosphate.

Grind the fertilizer materials in the mortar until they are very fine. Place about 1 pint of soil on a sheet of paper. Add to this soil one-half as much nitrogen fertilizer as can be heaped on a dime. Then add the same amount of phosphorus fertilizer. Mix these fertilizers thoroughly with the soil.

If the pots hold a quart, then put a pint of the original soil in one pot and finish filling it with the fertilized soil.

Fill the other pot with unfertilized soil.

Plant a few of the same kind of seeds in each pot and cover with about one-fourth inch of sand to prevent soil crusting. When the plants are well established, thin them to the same number in each pot. Watch their growth for several weeks.

INTERPRETATION

Soil fertility is a major factor in soil conservation. By adding fertilizer and lime when needed to keep soils highly productive, we not only help conserve the soils themselves, but aid conservation in general.

Dr. Emil Truog, famous soil scientist of the University of Wisconsin, points out several ways in which high soil fertility aids conservation.

1. High soil fertility produces a heavier plant growth that protects soil from washing and blowing. Land that is protected with a good cover of grass or trees does not wash. In fact, under such conditions, soil is being formed faster than it is eroded away. Where native vegetation is removed and cultivated crops are grown, leaving the land bare part or all of the time, erosion takes place.

Keeping the land covered as much as possible is one of the best ways to prevent erosion but plants will not grow abundantly unless the soil is fertile.

2. Heavy plant growth resulting from high fertility uses more water than the growth on poor soil. This leaves room for the soil to hold more water from each rain, thereby reducing runoff.

All growing plants remove tremendous amounts of water from the soil and then allow it to escape as vapor through tiny holes in the leaves. The higher the fertility of the soil the larger the amount of water put to good use and the greater the crop yields.

3. Fertile soil takes in water from rainfall readily, thus reducing the amount that runs off.

Well-managed soils develop a granular structure in which the finer particles join together and form granules or crumbs. These crumbs vary in size up to that of buckshot. Each is made up of hundreds of small particles, some so small they cannot be seen even with a microscope.

Clay soils especially must be granulated to take in water readily. Generally, the most practical way to increase granulation is to provide organic matter.

Farmers can provide organic matter by growing legumes, such as clovers, alfalfa, peas, and beans. These plants take nitrogen from the air and store it in their roots, stems, and leaves. When the plants are plowed into the soil, they supply organic matter.

Of course, other plant materials add organic matter too. An abundant growth of weeds, if plowed under, adds organic matter. But legumes have the advantage of adding extra nitrogen taken from the air. The supply of nitrogen in the air over 1 acre would be worth more than $5 million, if it were transformed into nitrogen fertilizer.

Soils high in fertility can produce larger amounts of plant growth and, hence, larger amounts of organic matter to add to the soil. Even the roots and residue left on the soil after harvesting a heavy crop of legume hay add organic matter. And when the hay is fed to livestock, more organic matter is returned in the form of manure.

4. Higher soil fertility increases crop yields on the more level fields, thus reducing the need for growing row crops on sloping fields where water erosion takes its heaviest toll. Sloping fields that erode easily can be kept in grass and trees.

By improving the fertility of soils, needed agri-

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A border planting of trees, shrubs, and legumes protects the edge of the field against erosion and makes good wildlife food and cover.

They usually consume as much or more than their own weight in soft-bodied insects every day.

Young robins have been observed to gain 8 times their original weight the first 8 days of their life.

Insect-eating birds must fill their stomachs 5 to 6 times daily because they digest their food so fast and because of the large amount of indigestible material in insects.

One young robin, weighing 3 ounces, consumed 165 cutworms weighing 5½ ounces in 1 day. If a 10-pound baby ate at the same rate he would eat 18⅓ pounds of food in a day.

Of course, birds cannot control insects completely, but they are of great value. By using soil- and water-conserving practices farmers and ranchers could probably double the population of helpful birds. Field and farmstead windbreaks, living fences, shrub buffers, grass waterways, and farm ponds are only a few of the many land use practices useful in attracting and increasing beneficial forms of wildlife.

Some birds are also valuable as enemies of mice, rats, gophers, and other destructive small animals.

Other animals that help keep a balanced living community on the farm are rabbits, squirrels, deer, muskrats, woodchucks, opossums, and raccoons. These animals are valuable for their meat or fur, too.

XVIII. Plant a Tree

This activity is best suited to springtime in the North and to fall in the South. It may be made a part of an Arbor Day observance.

Plan in advance the kind of trees you are going to plant and where they will be planted. Soil and moisture conditions will determine to a great extent the kind of trees to plant. How the trees will be used will also have a bearing on the kind of trees selected.

Check with local specialists about the best time to plant and the kinds of trees best suited to the soil and location.

In addition to the seedlings or transplants, you will need buckets for carrying the seedlings, water, grub hoes or mattocks, spades, and shovels or specially constructed dibbles or planting bars. The size of planting stock will help determine planting method and tools needed.

If the area is covered with grass sod, use the grub hoe to strip the sod away from a spot 12 to 18 inches square. If the ground is hard, dig it up and crumble the clods.

Carry the seedling trees in a 12- to 14-quart pail half filled with water, or in boxes containing wet moss or burlap.

1. Take only one tree at a time from the container and leave the roots exposed no longer than necessary.

2. Set the tree in the hole no deeper than it grew in the nursery.

3. Do not put pieces of sod or undecomposed trash in the hole where it will be in contact with the roots.

4. Tamp the soil thoroughly around the roots; do not leave any air pockets.

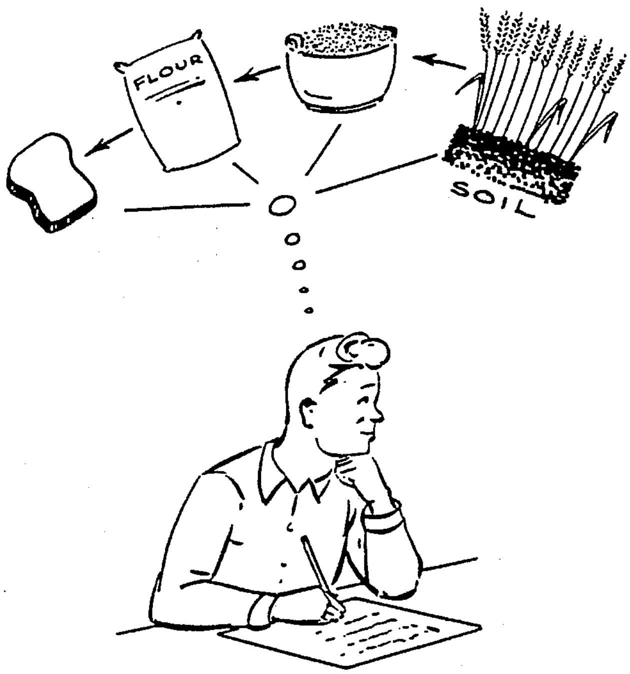
5. Water thoroughly.

You will need to water the tree frequently if the ground is dry.

Also, the young trees will need cultivation 1 or more years in many sections of the country to eliminate grass and weed competition for moisture. A straw or grass mulch spread 1 to 2 feet around the tree will, in areas of high rainfall, eliminate or reduce the need for cultivation. For information on the best way to plant and care for trees in your area, see your county agent, extension forester, or soil conservation technician.

INTERPRETATION

Forests have played a big part in building and maintaining our cities, States, and Nation. As our young Nation grew, timber was needed in greater and greater quantities until much of the original woodlands were harvested.



INTERPRETATION

Soil is one of our most useful natural resources. From the soil we get food, clothes, and materials for the houses we live in.

From gardens and truck farms we get vegetables. Fruit grown on trees and vines comes from orchards, groves, and vineyards. Wheat and corn for making flour and meal for our bread comes from planted field crops. Nuts and berries come from farms and forests.

Our animal food comes from the soil too. Cows eat grass, hay, silage, and grain to produce milk. Hens eat grain and other feeds to produce eggs. Beef, pork, lamb, and poultry come from animals that eat plants or feeds that come from plants.

The fuel that warms our houses comes indirectly from the soil. Coal is made from plants that grew ages ago. Oil and gas also originated from the organic materials possibly including the remains of animals. All of these things grew in the soil at one time or lived on things that grew in the soil.

Fish from the sea, rivers, and lakes live on plants. And these plants live on dissolved minerals that washed into the sea, rivers, and lakes from the soil.

Scientists have found that in the United States it now takes 1 to 2 acres of good land to grow the food and clothing for one person. (An acre is about the size of a football field.) Some land will produce more than other land, of course, but this is an average.

If you could live on potatoes or corn alone, you would need only two-thirds of an acre. But when you feed the corn to animals to produce meat, eggs, and milk, then about 2 acres are needed.

XX. How Many Uses for Wood Do You Know?

All you need is a pencil and paper for this activity. Make a list of all the items used about your home or your farm that are made from wood and wood products.

INTERPRETATION

Wood is a universal material and no one has ever been able to make a satisfactory count of its many uses. The Forest Products Laboratory, a research institution of the United States Forest Service, at Madison, Wis., once undertook to make an official count of wood uses. When last announced, the number was more than 5,000 and the argument had only started over how general or how specific a use had to be to get on the list.

Just one well-known wood-cellulose plastic, including its conversion products, claims 25,000 uses—among them such different items as dolls' eyes and advertising signs. The use of wood fiber as the basis for such products is increasing every day.

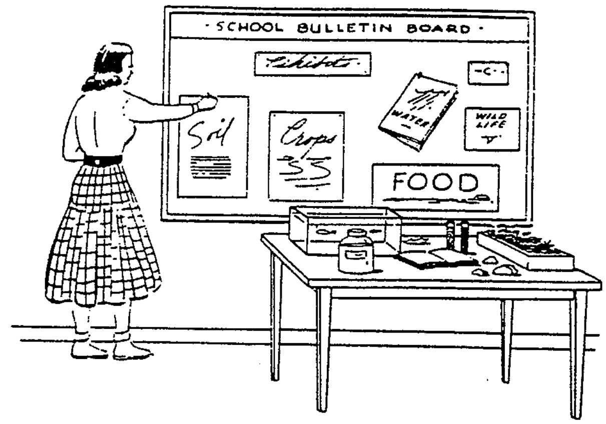
We often hear the question: How much lumber is used in the United States during an average year? The answer is: About 48 billion board-feet. Visualize a boardwalk 40 feet wide and 1 inch thick; imagine the boardwalk extends from where you stand all of the way to the moon. That's 48 billion board-feet.

Nearly two-thirds of that amount goes into building construction—not only for shelter, but for protection, comfort, and beauty as well. The rest is used for all sorts of manufactured articles—boxes, furniture, matches, millwork, toys.

Another important use of wood is paper for printing our books, magazines, and newspapers. A high point in our culture came less than a century ago with the discovery that wood fiber could take the place of cotton or linen in paper manufacture. Today we use more than 73 million tons of paper and board each year. Of this amount each person's annual share of all kinds of paper and board is about 660 pounds. When paper was made chiefly of rags, each person's annual share was less than 10 pounds.

the pictures. For example, group the pictures so they show the kinds of erosion and the control measures used—terraces, contouring, grass, trees, farm ponds, and others. Collect pictures of birds and other wildlife that benefited in the change from an eroded to a well-managed farm.

Have a bulletin board and keep it interesting and attractive with pictures and articles on conservation from newspapers and magazines. Have a special section where students can report observations, such as birds, first spring flower, and others.



INTERPRETATION

The collection of materials for a conservation corner can be a vital, absorbing part of the conservation study. It can be made to show how soil, water, plants, and animals make up the living community.

Make the program a *doing* one. For example, children are much more interested in conservation when they are experimenting with seed germination and plant growth than they are in merely staring at objects laid in a row. Let the children build the conservation corner; let them run it.

Keep the conservation corner neat and give the specimens easily read labels. Change the corner to fit the seasons and to fit your teaching plans. Let the children help plan these changes.

MASS-245

A nature study area serves as an outdoor classroom for this fifth grade class.

Clover, alfalfa, and grass—The best way to simulate these crops is to paint the areas and sprinkle sawdust of appropriate colors over them. Sawdust coming from different kinds of machines, such as sanders, saws, chippers, and jointers, has different textures. The texture can be altered by screening. Coarse-textured sawdust is best for crops like alfalfa and clover; fine sawdust would be best for grass. Color the sawdust with a mixture of about one-fourth paint and three-fourths turpentine. Pour this over the sawdust and then spread it out to dry.

Bare soil—Fine sawdust, or the modeling material itself will give about the right texture if painted the right color.

Terraces—Loosely twisted heavy cord or small rope can be glued to the model. The areas above and below the cord or rope can be filled with crack filler shaped to give the form desired.

Corn—You can represent young corn by gluing strips of stiff burlap vertically in rows. After the glue has set, pull out the horizontal threads. Then split and curl the remaining vertical threads.

Shrubs—Cut sections from colored sponge and glue them in place. You can make isolated trees in the same way, but to represent a woodlot treat the whole area as a mass, using colored sponge.

Models of farms can also be made with papier mache. On a sturdy base make the shape of the farm you want by bending and shaping chicken wire. Then cover it with layers of paper dipped in paste, until you have the right amount for strength and form. Add the buildings, fences, and crops as explained above.

For younger children, don't overlook the sandbox. It offers a good opportunity to make a less elaborate model. Even with sand, it is best to copy an actual farm even though you will need to exaggerate the topography.

INTERPRETATION

If the farm or ranch model can be based on local land use problems and conservation needs, it will be most effective in helping children relate conservation to their own home and community welfare. Teachers in city schools can relate wise use of soil and water to the everyday lives of urban children by pointing out that food, lumber, wool, cotton, and other necessities come from the soil.

Your model farm can represent the conservation plan on the farm you are studying.

The successful conservation farmer follows a plan that was designed for his particular farm much the same way a tailor cuts and fits a suit to a particular man.

The first step in preparing this conservation plan is to find a good use for each acre on the farm. The physical characteristics of the land, in combination with the climate, limit how the land can be used safely.

No two acres of land are alike. The differences include variations in slope, soil depth, inherent productivity, stickiness, wetness, texture, amount of erosion, and many other features.

Some soils may be so shallow that cultivated crops will not yield enough for profit. This kind of soil is naturally best suited to grass or trees.

Some soils are sticky when wet and form hard clods when dry. Such soils are hard to farm and may take more work to prepare for seeding and cultivating. They let water in slowly and give it up to plants slowly. This characteristic may determine what the use should be.

How much soil has been lost by erosion has a lot to do with how land can be used safely. Severely eroded slopes will need maximum plant-cover protection. Grass and trees or shrubs for wildlife are usually the best use here, although some eroded land can be reclaimed for cultivated crops if the soil is deep enough and if the slope is not too steep.

Some land slopes so much that any cultivation of the soil will result in serious erosion in spite of all the farmer can do to protect it with mechanical measures. Even just a little too much grazing or too heavy cutting of timber will have bad effects. Steep slopes will be more profitable to the farmer in the long run if used for grass or trees.

Gentle slopes, provided the soil is satisfactory in other ways, can be safely cultivated and used for crops like corn, cotton, and truck crops.

Level land that is well drained, does not overflow, has deep soil, and has no physical impediments like outcropping rock makes the best land for growing cultivated crops. Such land can be worked frequently without serious erosion hazard. Even this land needs good management to keep it productive.

After a careful study of the land and soil characteristics the farmer makes a plan to use each part of his farm within its capability as imposed by nature. This plan becomes the farmer's blueprint for his farming operations. It includes a field arrangement that puts each acre of land to work at a safe use. The field arrangement takes into consideration convenience of work for the farmer. It provides for separating cropland from grassland and from woodland. Some wildlife may be separated but all the land on the farm will be used by wildlife in some way.

After the farmer plans for the safe use of each acre of land he then plans the necessary supporting conservation practices like crop rotations, terraces, grass waterways, stripcropping, contour farming, pasture rotation, and woodland protection.

Such planning as this makes a soil conservation plan for a farm—a plan that fits the farm because it was made according to the physical nature of the land and a plan that suits the farmer's needs and abilities.