Saving Soil

EXTENSION SERVICE
North Dakota Agricultural College and U. S. Department Agriculture Cooperating. Fargo, North Dakota
E. J. HASLERUD, DIRECTOR
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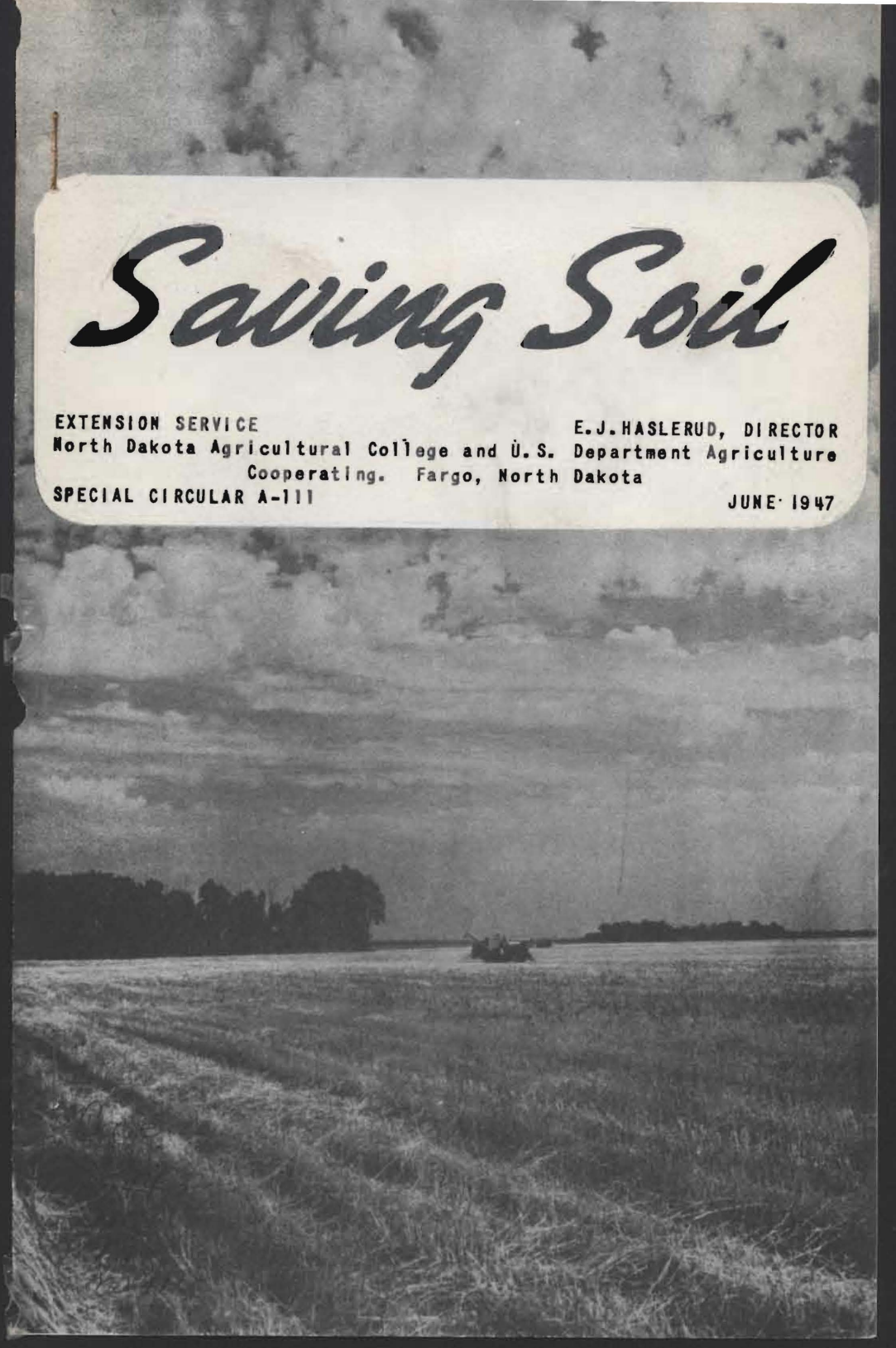


Food for the whole world.

NORTH DAKOTA

a farm state

Ours is a great farm state!

In one year its soil grew more durum wheat, barley and flax seed than any other state in the Union. That was North Dakota's record in 1945. Only one state grew more wheat of every kind and only two states raised more potatoes. Besides these crops we send to market each year thousands of fat cattle, hogs and sheep; tons of wool, dairy and poultry products.

The soil that grew these crops and livestock is the future of North Dakota. It is our duty to know it--to guard and care for it.

Soil

We have many kinds of soil in North Dakota. Some are sandy; others are mostly clay. There are deep top soils and thin top soils, well-drained soils and water-soaked soils. No matter how good or how poor we may think a soil to be, it is a good soil for some purpose.

When we know the different soils on our farm, each soil's good and bad points, we have learned the first and most important lesson in soil saving.

Our soil is made up of rock material, the remains of dead plants and animals, living things, water and air.

THE ROCK MATERIAL

Most of our soil is rock material. Some of the pieces of rock are large enough for us to see, but most of it is broken into such a small size that we do not know it as rock. Large pieces we call stones or rocks; smaller pieces, about the size of marbles,

Poor soil for plowing and cropping but good for grass.

we call gravel. Even smaller pieces - the ones we can just barely see - we call sand. The next smaller sized pieces of rock are so small that we can see single grains only when we look at them through a microscope. This is silt. The grains of clay are tinier yet--much smaller than silt.

The smallest bits of the clay act as a "colloid". A colloid is a jelly-like material that can absorb many times its own weight of water. The gelatin powder your mother buys at the grocery store is a colloid. Notice next time she makes gelatin dessert how much water it takes up.

ORGANIC MATERIAL

The organic matter, or dead plant and animal part of our soil, has a great influence on our soil. Organic matter takes up several times its own weight of water. Soil colloids and the organic matter are a storehouse for water and for many of the other things our growing crops need. Humus is one form of organic matter. It is the residue of well decayed organic material.

Organic matter loosens up clay soils, making them easier to work. It firms sandy soils and gives them greater water holding capacity.

SOIL AIR

Although the bits of our soil seem to fit tightly together, there is always open space between them. In dry soil this space is filled with air. In many soils about one-half of the soil's volume is made up of air space. Much of the life in the soil could not continue if air was absent.

SOIL WATER

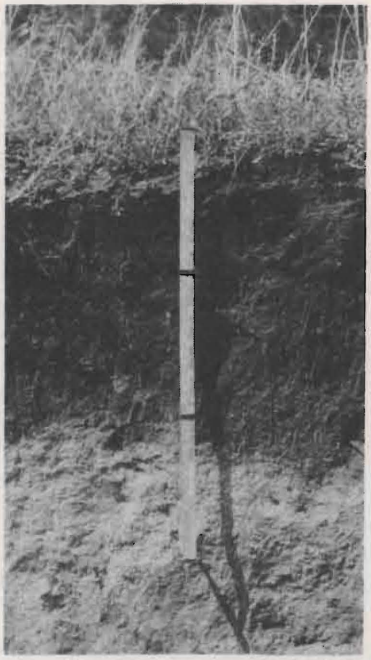
Water is part of our soil. We find it in the air spaces, replacing part of the soil air. It clings to the outside of the soil grains and is also taken into the organic matter and soil colloids.

LIFE IN THE SOIL

The living part of our soil includes plants and animals, many of them which we can see, but many more that we can't. We can see grass roots, worms and insects, but we need a microscope if we're going to watch the doings of most soil plants and animals. These tiny plants and animals are so small that there are sometimes several billion of them in one lump of soil.

These soil organisms, as the tiny plants and animals are called, have a big job to do in the soil. They make plant food available. The soil organisms decay the organic matter and free plant food so that it can be used by growing plants. They also work on the small grains of rock, breaking them down to make minerals available to our growing crops.

Special kinds of these organisms live in little "bumps" on the roots of legume plants such as sweet clover, alfalfa and beans. They are able to take free nitrogen from the soil air and put it into a form the growing plants can use. This is known as "fixing" nitrogen. Fixing nitrogen is also done by other kinds of organisms; kinds which live in the soil, but do not need the legume roots to live on.



This is good crop growing soil. Notice the two feet of dark, rich topsoil and below that the light subsoil. The topsoil is dark because it has in it the organic matter that makes our plants grow.

SOIL RICHNESS

The dark rich color of our soil is caused by the rotted plants and

animals that grew and died in the soil.

There has been less plant growth where the dark soil is thin and heavy growth where the dark soil is thick. There is always some top soil washed from high places to low places. That is why dark soil is usually only 2 to 6 inches thick on hill tops and sometimes 2 or 3 feet deep in low spots. The average depth of the dark crop growing soil in North Dakota is about 16 inches.

The lighter colored soil which we find under the dark colored top soil is called the subsoil. Subsoils may be mostly gravel and sand or they may be silt and clay. Silt and clay can hold much more water than sand or gravel.

Soil Erosion

WHAT IT IS

WHAT IT DOES

Since we're going to use the word "erosion" a lot from here on--let's see what it means. Erosion is the removal or wearing away of the soil by the action of wind or water.

It took Nature hundreds, even thousands of years to build up the 16 inch average of dark rich soil that covers our North Dakota farm lands. It takes us only a few years to ruin this same crop growing soil if we don't use it with wisdom. Soil and soil fertility are lost every day from some of our farm lands and overgrazed pastures and ranges.

There are two big reasons for this loss:

1. Marketing of Crops and Livestock.

2. Wind and Water Erosion.

Growing crops draw needed plant food chemicals from the soil and air. At least fourteen food giving chemical elements are needed for the plants to grow, blossom and fruit as they should. Most important of these are nitrogen, phosphorus and potassium, or potash as it is often called. Eleven of these plant food elements come from the soil, and three, including nitrogen, are taken from the air.

Later when we eat these crops or feed them to our livestock, we too, get these important elements. They build bones, teeth and tissue.

The farmer, by spreading the livestock manure back on the land, returns some of the main plant food elements to the soil. Prepared commercial fertilizers do the same thing for us--that is, replace elements in the soil that the crops need for normal growth. If we plow under a green crop, such as sweet clover, we add nitrogen and organic matter to the soil.

Wind and water erosion is the more serious reason for our soil loss. Soil scientists judge that soils over the whole United States lose an average of 21 times as much plant food from erosion as is used by growing plants. Some of these elements are carried by water erosion into the streams and rivers; finally, into the oceans. The rest is carried from our farmlands by high winds. Erosion is our great enemy not only for what it does, but because it is hard for us to recognize and sometimes does great harm before we can control it.

In North Dakota wind erosion is more serious than water erosion. In the dry years of the early 1930's the dust blown from our farms mingled with dirt from other Great Plains farms to darken the sky over Washington, D. C. and fall on the decks of ships in the Atlantic ocean.

Each year since, the smaller dust storms have kept reminding us that wind erosion does not need dry years to do its damage.

Water erosion, although held down by our moderate North Dakota rainfall, does much soil damage in some places. Summer thundershowers that reach cloudburst size, damage our unprotected slopes and hills. Here again, soil types are important. Some soils wash away rapidly in a downpour while other soils are sticky and hold together better. The steepness of the slope is important, too. The steeper the slope, the faster the waters run down and the more of our soil it carries with it.

Straw and stubble on the surface of the soil slows the running water and cuts down the washing away or erosion.

LEACHING

Leaching is a third kind of soil fertility loss. Leaching occurs where a heavy rainfall provides more water than growing plants can use. In these rainy places the soil stores up as much moisture as it can and then the extra water starts working its way downward.

As it moves down, it carries with it some of the soil's organic and mineral fertility.

In North Dakota, our average rainfall is low--about 14 to 20 inches a year--so we seldom lose soil fertility by leaching.

KNOWING EROSION

We have six kinds of erosion in North Dakota. They are wind erosion; sheet erosion; rill erosion; gully erosion; streambank erosion, and shoreline erosion. Look for these. Perhaps you'll find them on your own farm.

WIND EROSION

There is wind erosion when high winds blow over dry soil that does not have a cover of grass, crops or crop remains such as stubble or straw. It is most common and most severe on large areas of sandy soil.

Wind erosion hurts the soil by carrying away the finer soil pieces and bits of organic matter. Coarse grains pile up into hummocks in the field or drifts at fence rows, along road grades, or near other obstacles.

When our crops are young and too small to cover the soil, wind erosion does great damage. Sharp sand grains carried by the wind cut the tender, green plants. The soil is lost, sometimes the young plants killed and the crop must be re-seeded.

Air we breathe, laden with the dust of wind erosion, harms our health. During the dry years, wind erosion caused dust pneumonia.

Wind erosion. Much of the topsoil blew off of this land taking with it the land's fertility. Here most of what we see is the sandy part of the soil.

SHEET EROSION

Sheet erosion, during long, heavy rains, occurs on all sloping fields that we have plowed or stripped of protecting plants. It is the most common and dangerous type of water erosion in North Dakota. It is so dangerous because it is hard to see. We can tear page after page off a writing tablet, hardly noticing the effect until suddenly, the paper is all gone. That is the way with sheet erosion.

Our dark soil washes away, a thin layer at a time. Sometimes the damage is not noticed until the black soil on the hilltops is all washed away leaving the less fertile, light colored subsoil. Subsoil, at its best, grows weak, stunted crops.

Here's a way for you to see how sheet erosion takes the soil. First, find a sloping field that has been cultivated for 20 to 30 years. Dig straight down in this field until you come to the light colored subsoil. It should be gray or yellow, but in any case, lighter than the black topsoil. This change in color - from dark to light - is due to the lack of rich, plant-growing organic material that makes the top soil black. Now, measure the depth of the dark soil,

Next, choose a prairie or roadside that has never been plowed. Dig down in this soil and measure the topsoil. You'll find the topsoil is both deeper and darker in color. The difference in depth of dark soils is the measure of erosion.

Dig holes in other fields on the farm and find how much soil erosion has taken from each of them.

Another way for you to tell soil loss from wind and sheet erosion is by noticing the color of soil in the fields right after they have been plowed. Where erosion has been severe, the color of the soil is lighter. On some fields gray knolls and hilltops may tell you the story. If erosion has removed all of the topsoil, the soil may be yellow in color.

Both sheet and rill erosion have been at work on this field.

RILL EROSION

Now, let's find a cornfield that's plowed up and down hill. After a rain, notice how the soil has been carried away from around stones and pebbles, leaving little pillars of dirt. Around these stones and pillars are hundreds of rills or tiny gullies running down the slope. If erosion has been severe, there may be corn roots washed entirely free of soil. This is rill erosion.

If up and down hill cultivation is continued, more topsoil will be carried away by rill and sheet erosion until the field becomes barren and unable to grow good crops.

GULLY EROSION

Gully erosion in fields and along roadsides is so common that we all know it. Gullies develop on sloping land often as a late stage of rill erosion. Natural drainage ways in cultivated fields, road ditches, furrows up and down hill; any of these can be the start of a gully. Running water, confined to gullies, flows faster and cuts deeper into the soil. With each rain the gully becomes bigger. Unless we guard the land to prevent gullying or check it after it starts, great lasting harm will be done.

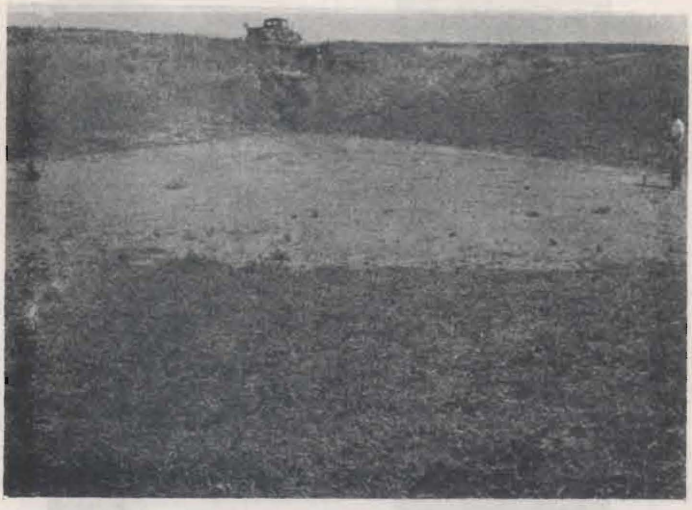
Gullies can destroy parts of fields by cutting them into a patchwork of shapes and sizes, hard to work with machinery.

The soil washing out of gullies can bury our fertile fields under silt, gravel and trash. Fish and their eggs in reservoirs, lakes and streams are killed by silt and sand from eroded fields. Roads, highways, bridges, farm buildings; even city buildings, streets and playgrounds are affected by gully erosion.

STREAMBANK EROSION

The fast flowing water in streams and rivers cuts away land by streambank erosion. It usually occurs at the outer bends or loops of the stream as it wends through fields or woodland. The greatest damage from streambank erosion comes during spring floods.

Most streambank erosion takes place on the outer stream bends because flowing water is not easily turned. You know how a car will swerve if you turn at high speed. That is the way with fast flowing water, too. When a stream bends, the water strikes



A gully. Running water from melting snow cut this gully out of the cropland.

the outer bank with great force, gradually cutting it away, undermining the soil above the water level.

SHORELINE EROSION

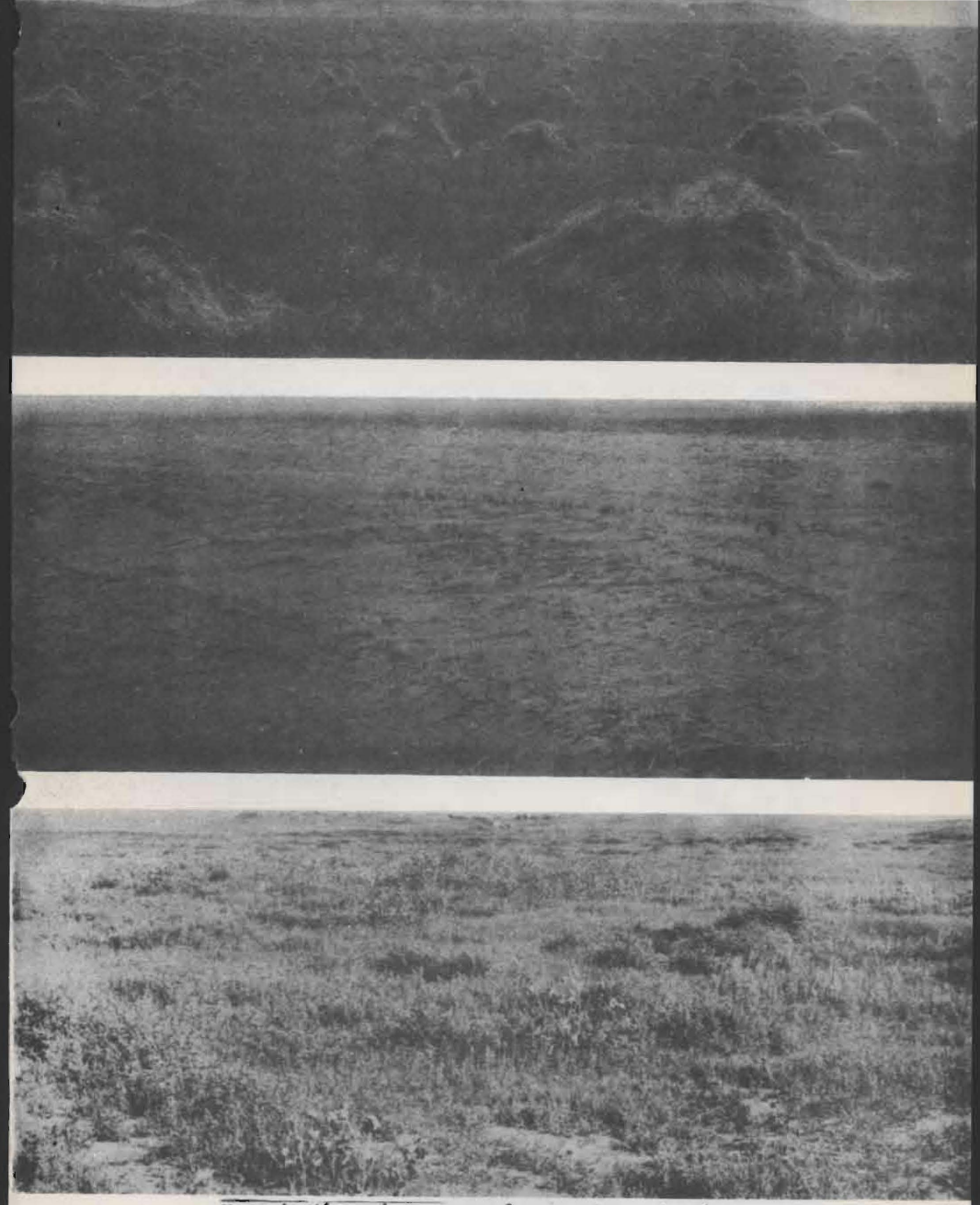
Shoreline erosion is the cutting away and undermining of the banks and shores of our lakes, ponds and reservoirs by waves. It is caused by strong winds blowing over wide expanses of water. Like stream-bank erosion, it is most severe where the shores have been stripped of plant growth.

In North Dakota, thousands of lakes and reservoirs have been made to hold run-off water for fish and birds, irrigation, livestock water and recreation.

We must guard the earthen dams of these man-made lakes. Overgrazing by livestock destroys plant cover and lays an earthen dam open to shoreline erosion.

Our farm crop yields drop as erosion grows. When the top soil becomes so thin that our plows turn up heavy, sticky clay or gravelly subsoil, the cost to raise a crop goes up. Lower crop yields, higher growing costs and continued erosion spell ruin for any farmer. Even rich and powerful nations have been beaten down by erosion.

Erosion is not confined just to the farm on which it occurs. It affects people living thousands of miles away. Poor health comes to people eating foods grown on eroded soils that lack needed plant food elements. There is poverty and unhappiness from working land that won't grow good crops. That, in turn, leads to poor schools and neglected society that once depended upon the fertile soil for their prosperity.



Here is the price we pay for erosion. In the top picture taken in 1928 we see a wheat field that yielded 28 bushels of grain to the acre.

The next picture was taken of the same field nine years later--in 1937. Wind erosion had been active for several years.

The lower picture is the same field in 1940. Wind erosion took from 3 to 6 inches of the topsoil.

Controlling Erosion

Now that we know what erosion is and what it does, we can take steps to stop it. Nature holds the soil with trees, bushes and grass. We can do that, too. In North Dakota our best tool is grass, although bushes and trees have a part in it.

Here are three ways we use grass:

We seed grass in waterways to heal or prevent a gully.

We seed grass on sand areas or on shallow hill-tops to guard the soil from the wind.

We use grass in rotation with crops.

Grass not only does its chore against erosion, but it is pasture and hay for our livestock. Grass improves the soil.

KINDS OF GRASSES

Early grasses, like crested wheat, brome and Russian wildrye start to grow early in April. They make our best pasture in April, May and June.

The medium early grasses such as slender wheat, western wheat, Mandan wildrye and green stipa-grass are good pasture in May, June and early July.

The summer grasses grow best for us in July

Grass roots hold the soil.

Making grass into beef. This is a well managed native prairie pasture. These fat beef cattle were grazed on crested wheat and brome grass until about June 15. They had been on this native pasture a month when the picture was made in July, 1946.

and August. Blue grama, big blue stem and switch-grass are summer grasses. These summer grasses and medium early grasses also are a part of our native prairie. The early grasses come to us from northern Europe and Asia.

A special kind of prairie plant is the legume which makes nitrogen into plant food. Alfalfa and clover are tame legumes. Legume plants have bumps or nodules on their roots in which friendly bacteria live. These bacteria take nitrogen from the soil air and make it into plant food. This bacteria-made nitrogen plant food then becomes available to other growing plants. That's why our grasses grow better when legumes are growing among them.

Heavy grazing kills the native legumes on our prairies. It also weakens the grass. A farmer finds it pays to graze only as many cattle as will allow the grass and legumes to remain healthy. More milk and more meat come from good pastures.

USING TREES

Trees not only hold the soil, but protect us and our farm animals from the snow and winter storms.

Planted as farmstead windbreaks the trees lower the

amount of fuel needed to heat the home and save feed costs. As field windbreaks, they protect the soil from the wind. Some kinds of trees and bushes give us fruit for our table.

Trees are homes for our birds. The birds return the favor by eating grasshoppers, worms and flies.

But there is a job for us to do, too. Some years there is not enough rainfall in our state to keep the trees alive, so we must do more than just plant them and hope they'll grow.

A thoughtful farmer summerfallows the field on which he will plant his trees next year. This kills the weeds and stores water in the soil for the trees. After the trees are planted he cultivates between the rows of trees and hoes around them. Dead weeds can't rob the tree roots of moisture they need.

The outside row, on the north and west sides, of his windbreak he plants to caragana or buckthorn, both hardy, close growing shrubs. These are a wall to the wind and, as a result, much snow is drifted into the tree belt. The water from the melting snow is stored in the ground for the trees to use in the summer.

The farmer plants hardy trees that can live through dry summers and cold winters.

The boys and girls who go to school here will enjoy this tree windbreak guarding their schoolhouse. This is the same kind of windbreak which our farmers plant on the north and west sides of their farm homes.

A young tree windbreak planting that will help protect our cropland.

Wind strip cropping with a two year rotation of wheat and corn.

STRIP CROPPING, TILLAGE AND CROP ROTATION

These three are used together to grow good crops and prevent erosion.

In crop rotation we grow a different crop on a field each year. For example we'll plant corn on a field this year, seed wheat on it next year, corn the third and wheat the fourth. This is called a two year rotation. Or, if we plant corn this year, wheat next year, barley the third and then corn, wheat and barley the next three years, we'll be using three year rotation.

Summerfallow is used in crop rotation in place of corn on many North Dakota farms. Clean summerfallow stores water and kills weeds so there is more water for the next crop. The first tillage on summerfallow is done before June 1 to save the most water. Otherwise, the weeds that grow in June will use all the water.

One thing for us to remember though; wind erosion can do great harm to the black soil of summerfallow. That's why new tillage ways are being tried. The best of the new ways are those that cut the weeds just under the surface and leave the stubble and straw on top to cover the soil. Blade type tillage

machines and rotary rod weeders are both being used this way. If we leave stubble and straw on top, our soil will be protected and the summerfallow will be useful without waste.

Contour strip cropping is another soil saving practice. It's a way of farming on the level around hills. The crop fields are of even width and the uneven areas between are seeded to grass. The crop fields are about 15 rods wide and the grass buffer strips vary from two or three feet to several rods in width. It is easier for us to farm around the hills and is good protection against wind and water erosion. Contour strip cropping is best suited for use in Southwestern North Dakota.

Wind strip cropping holds erosion to small areas. The use of crop rotation and better tillage with strip cropping is the key to wind erosion control.

DIVERSION DITCHES

Diversion ditches keep the water, coming off higher lands, from running across crop land. The diversion ditch carries the water away from the cropland and spreads it on grass land.

This summerfallow field has some straw and stubble on the surface to hold the soil and help prevent wind erosion.

An aerial view showing contour strip cropping in the foreground; wind strip cropping in the background.

Contour strip cropping. Farming on the level around hills saves soil and water.

GRASSED WATERWAYS

When water cannot be stopped from running down small coulees in cropland, we seed the coulees to sod forming grasses. The tame grasses, brome grass and western wheat grass give the best protection to the soil in waterways and keep the coulees from becoming gullies.

This diversion ditch carries the water away and spreads it on grassland.

The grass in this newly seeded waterway will protect the soil when water runs in this coulee.

In this flood irrigation system snow and rain runoff water is trapped behind the earth dike or dam. About 28 acres of this field are flooded this way each spring. The water is held for a week or two and then the gate is opened to let loose the water that hasn't soaked into the soil. Notice the big stacks of rich alfalfa hay that were grown on the flooded area.

FLOOD IRRIGATION

Coulees or small creeks are dammed. Water is carried through a ditch to a flat piece of land where it is held for a time. Melting snow in springtime or heavy rains in June provide the water. Large crops of hay are grown this way.

DAMS, PONDS AND SPRINGS

Our cattle and sheep need good water in each pasture. Well or spring water piped to stock tanks is best, but dams or dugouts also furnish good water. If we dig our wells next to the dugout with a sand filled trench in between to clean the water, the dugout will furnish good water to the well. Then, we can fence off our dugout from the livestock and insure clean well water for them.

This dam provides good water for livestock. Perhaps you can pick out the broods of young ducklings on the water when this picture was made.

A spring was developed here and the water piped to this tank. The spring area is completely enclosed by a fence which keeps the livestock from trampling the ground and possibly ruining the spring.

DRAINAGE

The Red River Valley in Eastern North Dakota is so flat that water does not drain off fast enough. Sometimes it is so wet in the spring that crops cannot be planted. At other times, the land floods during the summer or at harvest time and ruins the crops.

Valley farmers built drainage ditches and will build many more to carry the flood waters away. They also use small ditches or field laterals to get the water off the farm land into the large drainage ditches. The farmers must keep these ditches clean. If trees or bushes grow in them, the ditches become clogged and useless. Planting grass on the ditch banks, killing young trees and bushes in

A large drainage ditch in the flat Red River Valley. It carries surplus water to the river.

This workman is building a field lateral that will carry unwanted water from fields to the bigger drainage ditches.

the ditch and guarding against crop soil blowing into the ditch are the ways farmers keep their drainage ditches doing their job.

POTHOLE DRAINAGE

Sometimes our cropland has so many small sloughs or potholes that orderly farming is difficult. But in these cases, we can make engineering surveys that will often show how ditches can be built to drain several of the sloughs into a lower lying slough. This gives us fewer but deeper ponds, makes farming easier for us and gives us more land to farm.

This is a shallow ditch which drains a small slough or pothole.

BURNING

Burning is a lot like soil erosion. The bad effects don't show up all at once. Straw and stubble lying on the fields contain organic matter that good soil needs. The farmer who, year after year, burns this off, instead of returning it to the soil, may some day have to make good on the plant food he has destroyed. This will cost money, either in the cost of adding more organic matter to improve the soil or by poor crops on worn out land.

HOW NATURE HELPS

Many insects attack our crops. Rabbits cut off young trees and gophers, ground squirrels and rats eat our grain and grass. We can control some of these pests with poison, but poison is costly and does not always do the job.

The songbirds, grouse, pheasants, Hungarian partridge and some hawks eat great amounts of insects. We sometimes hear bad things about hawks and owls, but most of ours in North Dakota are a big help to the farmers. They eat the mice, gophers, ground squirrels, rabbits and rats, and seldom bother chickens or tame birds. Most North Dakota farmers know the worth of these birds and give them protection.

This dam was built by one of our first water conservationists -- the beaver.

Community Action

against erosion

Our state and federal lawmakers are helping us control erosion.

In 1937 the North Dakota state legislature passed the State Soil Conservation Districts law. This law sets up the machinery under which our Soil Conservation districts are organized. At the end of 1946 there were 65 of these districts covering 70 percent of North Dakota.

These districts are political subdivisions of our state. They are like our counties in legal standing, differing only in that they cannot levy taxes or make assessments.

The farmers in each Soil Conservation district elect three of their own group as district Supervisors. These men are chosen Supervisors, because they know the needs of their district and can help the other farmers in planning their conservation work.

The roadsides have been seeded to grass. There are no tall weeds to trap the snow on the road and water can flow in the ditches without cutting the soil.

The state of North Dakota and the United States government also aid the Soil Conservation District in other ways. The state, through the Extension Service, supplies a county extension agent to each North Dakota county, trained to carry out an educational program on soil conservation and other agricultural programs.

The Soil Conservation Service of the U. S. Department of Agriculture furnishes trained conservationists who make soil and engineering surveys and help our farmers to plan and use conservation.

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