

SOIL CONSERVATION

Iowa is known around the world for being a food producing state. The abundance and diversity of plant and animal life throughout thousands of years is an essential element in maintaining Iowa's rich soil...some of the richest soil in the world. More than 90% of Iowa land is in agricultural production, a higher percentage than in any state in the United States. How we care for Iowa's natural resources such as soil and water, and all the plants, animals and people that share our space is important now and for the future.

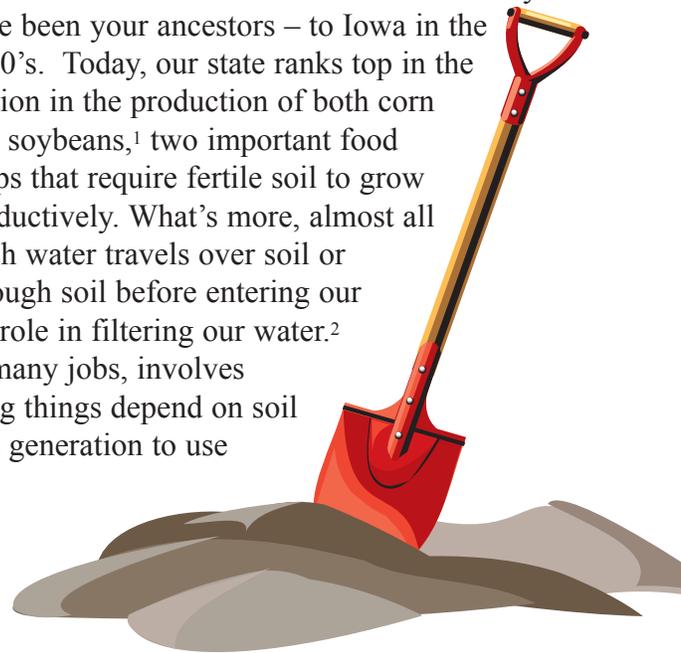


Water washes topsoil down a field not farmed on the contour, which allows the sediment or soil residue, to collect at the low spot in the field.

rivers, lakes and aquifers, so soil plays an important role in filtering our water.² Finally, a large share of Iowa's economy, including many jobs, involves agriculture, which is dependent on the soil. All living things depend on soil as a source of food, so it is the responsibility of each generation to use soil wisely.³

Why is Iowa's soil important to you?

Soil is a precious resource. And perhaps nowhere on earth is it more precious than in Iowa. It was the rich, fertile soil made from prairie grasses and the diversity of plant and animal life that drew the first settlers – who may have been your ancestors – to Iowa in the 1800's. Today, our state ranks top in the nation in the production of both corn and soybeans,¹ two important food crops that require fertile soil to grow productively. What's more, almost all fresh water travels over soil or through soil before entering our



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www.ag.iastate.edu/departments/aged/

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**Iowa Agricultural
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To produce corn and soybeans – along with alfalfa, small grains like oats, vegetables and other crops that grow in Iowa – requires a lot of land. In fact, more than 90 percent of Iowa’s land, or 26 million acres, is used to produce agricultural crops.^{4, 5} The soil that supports those crops helps to feed animals and feed and clothe people both here in Iowa and in the rest of the world. In fact, almost all of the food you eat, fiber for the clothes you wear, and lumber for the house you live in cannot be produced without soil.⁶

How do Iowa farmers protect the soil?

Of the millions of acres used to grow crops in Iowa, about 90 percent is farmed using some type of “soil conservation” practice. In other words, almost all of Iowa’s farmland is used by farmers who are concerned about protecting the soil, and are taking actions to provide that protection.

The formation of soil

Soil is the top layer of the earth’s surface, like the frosting on a birthday cake. It is made from rocks that are broken up into tiny mineral pieces, as well as dead leaves, roots, twigs, dead bugs and other natural materials. Soil also contains air and water.⁷

The weather helps create soil. When the weather gets hot, rocks can get bigger. When the weather



Planting fields right up to streambanks without allowing a buffer strip encourages soil to wash down the stream.

turns cold, rocks can get smaller. If this happens often enough, the rocks will crack and break up into small pieces that then break into even smaller pieces. When they get really small they turn into soil. Rain and ice also can get into rocks and help break them apart.⁸

But this is no speedy process. It can take 1,000 years to form one inch of soil.⁹ If people grew that slowly, it would take 80,000 years to grow a basketball player!¹⁰ Just think – soil that is in your garden now may have begun to form when Columbus was sailing to the New World.¹¹

We should all be concerned about protecting the soil, because once lost, it is not easily replaced. We can't just call up the soil factory and order more.¹² Farmers, especially, know the importance of keeping soil where it belongs. Without soil conservation measures, this precious soil that took thousands of years to develop can blow or wash away in a matter of days or even minutes.

What's more, the most valuable soil – called the topsoil – is at greatest risk for erosion. Topsoil is the upper layer of soil. It contains the most plant nutrients and has the best structure to help plants grow. It is usually darker and looser than lower layers.¹³ Deeper layers of soil are much firmer, may contain gravel and rock pieces, and lack the nutrients and organic matter to support healthy plant life. Loss of topsoil makes fields more susceptible to drought, and causes farmers to rely more heavily on commercial

fertilizers. Because the richest topsoil is only a few inches thick, it's critical to keep it in place so plants can use it.¹⁴

How soil is lost

The loss of soil from its original site of development is called “erosion.” There are two basic types of erosion -- (1) “natural” (also called “geological”) erosion; and (2) “accelerated” erosion.^{15,16}

Natural erosion occurs when soil is in its natural environment, surrounded by its natural vegetation. This type of erosion has been taking place over millions of years.¹⁷ While existing soil is gradually lost, new soils can be formed through the slow weathering of parent rock material, and from soil particles moved in by air and water. Under normal climate conditions, and with stable ground cover, soil losses from this type of soil erosion often can balance out, or even be less than, the rate of soil production.¹⁸ A classic example of natural erosion is the Grand Canyon.¹⁹

Accelerated erosion is caused by the activities of human beings.²⁰ By removing surface vegetation and plant residue cover, the soil becomes more vulnerable to removal by wind or water. Agricultural production can contribute to accelerated erosion, as can forest harvesting, surface mining, housing and construction, and urban highway construction, all of which eliminate stable plant cover.²¹



Wind erosion blows away topsoil from the field and deposits it in this roadside ditch.



This riparian buffer strip was planted between a soybean field and small stream to protect the soil from washing into the stream.

The following causes of soil loss fall under the category of accelerated erosion:

(1) **Wind erosion** – Loss of soil due to wind occurs mostly in flat, dry areas, or areas of moist, sandy soils along bodies of water. Wind erosion removes soil and natural vegetation, and causes the remaining soil to become dry and deteriorate.²² Wind erosion causes about 40 percent of all soil erosion in the United States, and can increase substantially in drought years.²³



Wind causes 40 percent of all erosion.

The “Dust Bowl” of the 1930s is an extreme example of wind erosion. Several consecutive years of drought made the soil in the Plains states extremely dry, and farming practices in those days left a great deal of bare soil exposed to the elements. Storms whipped up the dust, stripping the plowed earth of fertile soil, filling the air with dust, and destroying millions of acres of farmland. Thousands of farm families were forced to abandon their ruined land during the Dust Bowl.²⁴ We occasionally see miniature “dust bowls” on windy spring days when the soil is tilled for planting and exposed without cover of vegetation.



Water erosion can occur in three ways.

(2) **Water erosion** – Raindrops can contribute to soil erosion when they strike bare soil. With an impact of up to 30 miles per hour, rain can blast apart good soil structural units and splash the soil into the air. If the ground is on a slope, the flying soil is easily picked up by water flowing overland and can be carried far away.²⁵ Melting snow and ice also can carry soil particles with it.²⁶ Water erosion can occur in the following three consecutive ways:

(a) **Sheet erosion** – This type of erosion usually happens first. It is defined as uniform removal of soil in thin layers from sloping land. It happens when loose soil runs off the land’s surface with rain or melting snow.²⁷



Sheet erosion removes soil from the field in thin layers.

(b) **Rill erosion** – Rill erosion is the next step and can take place almost unnoticed. It occurs when soil is removed by water from little streamlets that run through land with poor surface drainage. Rills often can be found between crop rows.²⁸

(c) **Gully erosion** – Finally, this is a dramatic type of soil erosion that you can definitely see. Gullies are large wash ways, resembling small streams, that carry heavy loads of water and topsoil out of fields. Gully erosion is an advanced stage of rill erosion, just as rills are often the result of sheet erosion.²⁹



Rill erosion causes little streamlets in a field.

The loss of soil means a loss for Iowa’s farmers. Soil erosion increases the cost of farming because fertilizer need is greater, crop yields are lower, and farm profits diminish on eroded soil. This in turn increases



Gully erosion removes a large section of soil where the water then travels each time it rains.



During the peak years of soil erosion losses, 7.3 tons per acre of soil was lost each year.

the price of food that we all must pay.³⁰

Soil erosion also causes more damage than just the loss in crop productivity. If soil is lost from one area, it has to go somewhere. Eroded soil particles, also referred to as “sediment,” also are the largest cause of

water pollution in the United States.³¹

Ironically, Iowa’s greatest asset – its soil – has become its worst pollutant.³²

Soil erosion creates a dual problem because soil is removed from the area where it is wanted –

productive farmland – to areas where it is not wanted, like ditches, streams, lakes and municipal water systems.³³ Counties must repair roadbeds and clean sediment from road ditches, culverts and tile outlets.

Municipal water systems have to undertake expensive procedures to filter sediment out of drinking water. Sediment pollution also may require extensive work on recreational areas or wildlife habitat, to dig out or re-dam overfilled lakes. All are costly procedures, and add to the expense of living in Iowa.³⁴

The loss of synthetic crop additives is another double-edged concern. When topsoil is washed away, farmers lose some of their investment in crop protection chemicals and growth-enhancing fertilizers. In addition, those substances are undesirable and sometimes even unsafe when they are carried via sediment into drinking water.³⁵

At the peak of soil erosion losses during the late 1970s and early 1980s, it is estimated that approxi-

mately 3.3 tons per acre of land was lost due to wind erosion, and 7.3 tons was lost due to water erosion, each year in the United States.³⁶ At that rate, soil was being depleted at approximately twice the rate it could replace itself. How did this happen? A lot of it has to do with the way our country – and especially Iowa – has changed over the years.

The problem began in Iowa when the prairie cover was broken and land was tilled, exposing it to the effects of wind and rain. Farmers in the early years of our country did not realize that the native grasses held the soil in place.³⁷ Then, between 1940 and 1970, changes in farming practices that included more tillage with bigger equipment, and farming highly erodable land in row crops, put our soil at tremendous risk. Soybeans also became popular during that time, replacing pasture and cover crops such as oats and alfalfa, which were better at sustaining the soil.³⁸ While farmers were working hard to produce an abundant supply of food, the way they did it unfortunately took a toll on the soil.

During that same time, more houses, businesses and highways were built in Iowa, exposing more soil to erosion risk as well.

Fortunately, the dramatic rate at which soil was being lost in Iowa was recognized and addressed. Farming practices in Iowa have changed considerably compared to 20 or 30 years ago, and lawmakers have created programs that make it easier for farmers to protect the soil. Today, the total erosion on rural lands in Iowa has been trimmed from 10.6 to 7.4 tons per acre per year or less.³⁹ While more improvement still is needed, Iowa farmers have noticeably curbed the amount of soil leaving their farmland due to erosion and runoff.

In fact, from 1982 to 1992, it is estimated that Iowa farmers applied conservation practices to save 100 million more tons of topsoil than in 1982. That’s enough to fill a convoy of dump trucks 105 wide, parked bumper-to-bumper, on Interstate 80 from Council Bluffs to Davenport.

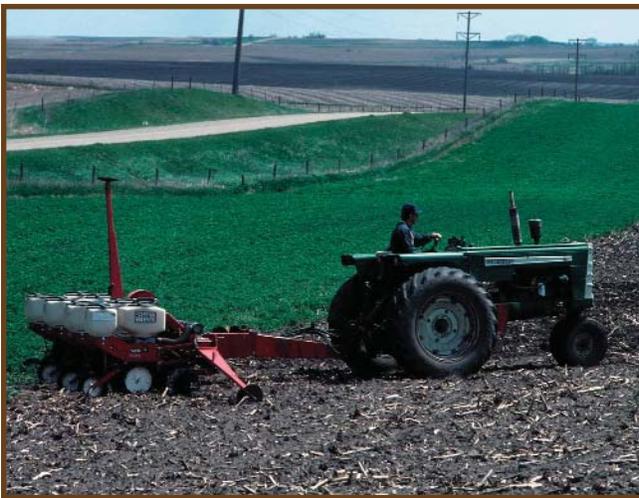
Soil erosion can never be stopped. It only can be controlled.⁴⁰ Let’s take a look at the things Iowa farmers are doing to curb the effects of soil erosion in our state.

What's Being Done

Some of the ways farmers used to work the land – like moldboard plowing and tilling fields in the fall – are not done much anymore, because they caused too much soil erosion.

Other, more soil-friendly practices, have taken their place. Farmers and conservationists have learned a lot about how to minimize soil erosion. They have developed practices that conserve soil and water and protect the land's long-term productivity. Most importantly, they now know the difference between the types of soils that can be tilled without serious danger of soil erosion, and those that are better left alone.⁴¹

The next time you're riding through the country, you may recognize one or more of the following methods that Iowa farmers now use to curb soil erosion:



Conservation tillage includes planting crops on fields that have had minimal tillage to prepare the soil.

- **Conservation tillage** is any crop-farming system that leaves about one third of the soil covered after planting. Some types of conservation tillage you may hear about are no-till, strip-till, ridge-till and mulch-till. In all of these systems, some of the residue from the previous year's crop is left on the field. This leaves more organic matter on the field to build new soil, while helping to hold current soil in place rather than blowing or washing away. Conservation tillage also helps soils maintain moisture, and helps minimize the loss of nutrients and crop-protection products that farmers apply to fields. Those products remain in the soil to help the crops and stay out of water systems.⁴² A 90-percent reduction in soil erosion can be expected when using no-till versus an intensive tillage system.⁴³



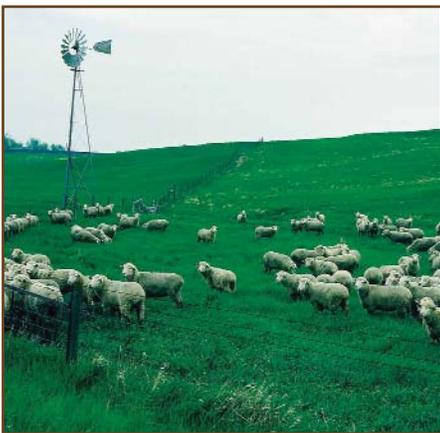
Corn is planted in last year's soybean field. The soybean stubble was left on top so the soil itself was not disturbed.

Tilling the soil less also saves fuel and machinery wear, and prevents the soil from becoming pressed down and hardened, called "compaction," which can otherwise be caused by heavy farm equipment driving over fields many times.⁴⁴ Soils protected with residue warm more slowly in the spring, so farmers using crop residue management must adjust farming practices to these changed field conditions.

- **Crop rotation** is performed when crops grown in a field are changed from year to year. Some crops, like corn, leave a lot of plant residue behind, so the next year's crop can be planted with very little disturbance to the soil. Crop rotation is a common practice on sloping soils because of its

potential for soil saving.

Rotation typically reduces fertilizer needs, because crops such as alfalfa or soybeans add the plant nutrient nitrogen back into the soil, so no (or less) chemical fertilizer is needed if a crop like corn is grown the next year. Crop-protection chemical use also is usually reduced because rotating crops helps to naturally break the life cycles of insects, weeds and plant diseases.⁴⁵



Pasture on steep soils slows the flow of water better than row crops.

from eroding. Pastures and hayland protect water quality because the dense plants and roots filter runoff water. They also provide a good habitat for wildlife, and, as their plants recycle and roots die, organic matter enriches the soil.⁴⁶



This rotational grazing system prevents erosion. Cattle are moved to a new section of the pasture when the current section is grazed down.

- **Pasture** and hayland are often grown on soils that are too steep for row-crop production. The heavy plant cover and tiny, dense root systems of grass or alfalfa slow water flow across the land and help keep soil in place, just the way native prairie grasses kept soil

- **Planned grazing systems** are used by cattle and sheep farmers to keep their pastures healthy and prevent them from becoming erodible. Large pastures are divided into sections or paddocks with fencing, and animals are moved from one section to the next in a planned rotation as plant

material is eaten off. This gives previously grazed sections time to recover plant growth, ensuring that no area of the pasture is grazed so heavily that plant life is lost and its soil becomes exposed. Rotating livestock also evenly distributes manure nutrient resources on the land.⁴⁷



Cover crops, such as alfalfa, add organic matter to the soil and protect from erosion.

trap nutrients. They also improve soil tilth, the chemical and physical condition that is beneficial to soil management, because their small roots help break up soil particles. Weed competition for future crops also is reduced when cover crops are in place.⁴⁸



Fertilizing with manure makes the soil fertile, reducing chemical needs.

Fertilizers. Over time, manure adds valuable organic matter to the soil and improves its structure, making the soil more capable of holding water and supporting plant life. Manure is especially useful in improving the soil tilth and crop yields on heavily eroded soils.⁴⁹

- **Cover crops** are used to add organic matter to the soil while protecting topsoil from wind and water erosion. Small grains like rye, oats and winter wheat usually are used for cover crops. They keep the ground covered when other crops aren't growing on it, and help to

- **Fertilizing with manure** may be one of the oldest ways farmers have helped to save and improve the soil. When livestock manure is applied to fields, it makes the soil more fertile by naturally adding nitrogen, making it unnecessary to add chemical fer-



Grass field borders surround a soybean field and prevent soil erosion by wind and water.



Filter strips slow runoff of the field in a field border system or alternating with crops on sloped fields.



Grassed waterways are planted where water drains or flows from a field.



This riparian buffer uses grasses and small trees to stabilize a streambank edge and provide a buffer prior to the field's edge.

• **Conservation buffers** are small areas or strips of land planted in permanent vegetation, which is usually a type of grass and/or legume like alfalfa. Trees and shrubs also are sometimes used. Some common types of conservation buffers are:

■ **Field borders** – Permanent vegetation planted in strips at the edge of fields.

■ **Filter strips** – Strips of grass or other vegetation used to slow run-off from a field. Often, filter strips serve as field borders.

■ **Grassed waterways** – Strips of grass planted in areas of fields where water naturally runs through or off fields or where water is concentrated, such as lower, field-draining areas of the land.

■ **Riparian buffers** – Planting of trees, shrubs and grasses on the edge of streams. Riparian means at a stream edge.

The purpose of planting buffers is to slow water run-off from fields, and to trap sediment, nutrients, pesticides and other pollutants before they reach a lake or stream. They provide good habitat for wildlife. They also can help to stabilize stream banks, reduce the risk of gully erosion, and prevent downstream flooding.⁵⁰

Conservation buffers have been shown to reduce up to 75 percent of sediment and 50 percent of plant nutrients from reaching surface water by trapping it in vegetation. Buffers also can reduce windborne pollutants.⁵¹



Contour farming farms around the side of the hill, rather than up and down, slowing water flow and erosion.

- **Contour farming** means farming steep land in nearly level rows around a hill, instead of planting straight up and down the hill. Following the contour of a hill, ridges are tilled and planted, creating hundreds of small dams that slow water run-off by giving it more time to filter into the surrounding soil. Sometimes, strip-cropping is used in contour farming, so that corn or soybeans are planted alternately with strips of grass, oats or alfalfa. In addition to slowing water erosion, these buffer strips also improve infiltration, reduce wind erosion, protect young plants from wind damage and conserve moisture. Contour farming can reduce soil erosion by as much as 50 percent.^{52, 53}

- **Terraces** also are used to protect the soil on hilly land. An agricultural terrace is an earthen embankment built around a hillside to slow and redirect water flow off the hillside. These “stair step embankments” then either hold water in place until it can infiltrate into the ground, slowly channel the water to a stable outlet such as a grassed waterway, or have direct tile conduits that carry collected water directly to drainage outlets. Terraces help to prevent gully erosion and decrease sediment pollution in water.⁵⁴

- **Grade control structures** are earthen, wooden or concrete structures built across a drainage way, like a grassed waterway, to prevent gully erosion by absorbing the water’s energy, and reducing sediment carrying capability. Sometimes these structures are built to break up long waterways to slow water flow and prevent erosion and stream bank damage.⁵⁵



Terraces utilize earthen embankments on slopes to slow and redirect water flow off the hillside.



Grade control structures, including filter strips, trees, waterways and earthen dams slow water flow.



Windbreaks at the edge of fields prevent soil erosion by wind across wide areas.

- **Windbreaks** are important tools for preventing wind erosion. You’ll often see windbreaks planted around farmsteads to shelter the home and protect livestock from wind, but windbreaks also can be

planted at the edge of fields to prevent soil from blowing away. Windbreaks usually are planted in rows of evergreen-type trees, or a combination of evergreen and leafy trees. Windbreaks will slow the wind speed on the protected side of the windbreak for a distance of 10 times the height of the trees. They also provide excellent habitat for wildlife.⁵⁶

- **Wetlands restoration** is being practiced throughout Iowa, especially in the north-central part of the state. Wetlands are marsh-like areas of shallow water that usually lie between cropland and lakes or streams. Farmers restore wetlands by stopping farming and installing small dikes in these low-lying regions, then planting water-loving grasses, shrubs and/or trees in the areas instead. Wetlands act as a buffer, catching water as it runs off fields and stopping soil erosion. They also provide wildlife habitat, and can help reduce flooding and replenish groundwater reserves.⁵⁷

- **Farm ponds** are formed by building a dam across an existing gully or low-lying area. Ponds help prevent soil erosion and protect water quality by collecting and storing run-off water. They also provide water for livestock, fish, wildlife and recreation.⁵⁸

- **Wildlife habitats** and food plots are good for the soil and good for wildlife, too. Habitats are created by planting a small plot of land with trees, shrubs and other vegetation that provide shelter and food for wildlife. Food plots are created by simply leaving a few rows of crops like corn standing in fields. Wildlife habitats and food plots prevent soil erosion by acting as temporary windbreaks and by leaving rough, undisturbed soil in place to reduce overland flow sediment which keeps the soil in place, and adds organic matter to the soil.⁵⁹

- **Diverting acres** means taking land completely out of crop production, usually for many consecutive years. During that time, cover crops such as dense-rooted grasses and trees are planted. This land receives the benefits of reduced wind and water erosion, increased organic matter, improved soil structure, better moisture retention and improved water infiltration.

Top right: Wetlands act as a buffer and holding spot for water before runoff becomes a problem in fields.

Second photo: Farm ponds collect and store water runoff and provide wildlife habitat.

Third photo: Wildlife habitats and food plots hold the soil in place and act as windbreaks for soil erosion.

Bottom right: These acres were diverted to tree production from row crops, which hold the soil in place better.



Cooperation Produces Results



Soil conservation is a high priority of the U.S. and Iowa governments. The Conservation Reserve Program, where farmers have been paid to divert highly erodible lands from crop production for consecutive years, has been a successful example of the commitment and the positive impacts soil conservation brings to Iowa.

incentives for farmers to divert highly erodible acres out of agricultural production for periods of 10 to 15 years. As a result of the CRP, today about 30 million acres of fragile cropland across the United States is seeded to grass or planted to trees and is not being farmed.⁶⁴

Government support promotes soil conservation in other ways, too. State and federal programs provide low-interest or no-interest loans to help farmers implement soil conservation practices. Some programs also pay for part of those improvements through cost sharing. Many programs help farmers plan their conservation projects. They also involve farmers in setting up local demonstration plots and experiments to try new soil conservation practices and show them to other farmers and the public.

As the result of efforts by farmers and soil conservation agencies, Iowa leads the nation in establishment of conservation buffers, and ranks second in wetlands development and no-till farming.⁶⁵

These efforts need to continue, and, fortunately, farmers are applying conservation practices to their land at record rates.⁶⁶ The results mean improved land quality to help make farming more profitable. What's more, water quality is protected, and our soil is more capable of continuing to produce an abundance of food, which is good news for us all.

Recognizing the need to protect the soil, one of our country's most valuable natural resources, the governments of both the state of Iowa and the United States are actively involved in soil conservation efforts.

The Natural Resources Conservation Service (NRCS) is a division of the United States Department of Agriculture that provides leadership in a partnership effort to help people conserve, maintain and improve our natural resources and environment, including our soil.⁶⁰ In Iowa, the Division of Soil Conservation of the Iowa Department of Agriculture and Land Stewardship also works to preserve and improve Iowa's soils and nutrients.⁶¹

Leaders from these agencies cooperate with researchers of other government and private organizations also devoted to soil conservation, including the National Soil Erosion Research Laboratory, and the Conservation Technology Information Center. Together, these groups work to monitor existing soil, discover new ways to conserve soil, and educate farmers and the general public about soil conservation.^{62,63}

One major government effort that has had a tremendous impact on soil conservation is the Conservation Reserve Program (CRP). This program has provided financial

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