SIERRA CLUB **IOWA CHAPTER**

Carbon Sequestration: Soil Rejuvenation and Preservation

Iowa farms fields have lost significant amounts of soil, through water erosion and by wind carrying it off the fields. The United States Department of Agriculture (USDA) estimates that Iowa loses 5.2 tons of topsoil per acre of cultivated cropland every year due to sheet and rill erosion, in essence water erosion.[1] USDA also estimates that Iowa annually loses 0.5 ton of topsoil per acre of cultivated cropland due to wind erosion. [2] On their own, soils form at an average rate of 0.24 tons per acre, with a range of 0.01 to 0.08 tons per acre, annually.[3] Over half of Iowa's topsoil has been lost since the land was first cultivated, and over half of the organic material in the soil has been lost.[4]

What that means for Iowa is that cultivated farmland is losing soil at a significant rate every year and that methods need to be introduced to restore the topsoil and to preserve it on the land. Failing to do so will result in a significant reduction in soil fertility, exhausted soil and compacted soil. All of this means that the yield of crops will be significantly reduced.

Soil loss is exacerbated by over-grazing and excessive tillage. Also commercial fertilizers, pesticides and herbicides have reduced the amount of organic material in the soil. The challenge is to rejuvenate the soil and to preserve the organic material in the soil.

Compost made of manure and other organic solids.
Photo courtesy USDA NRCS

Soil consists of organic material, sand, silt and clay. Organic material is decomposed plant material, insects, worms, fungi and microbes. Organic material acts like glue holding the soil particles together. Healthy soils have small pockets of air and water interspersed among soil particles.

Organic material can provide the chemical elements or soil nutrients that plants need to grow. Those elements are released from soil organic materials and made available to plant roots by soil microbes.

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[1] U.S. Department of Agriculture. 2013. Summary Report: 2010 National Resources Inventory, Natural Resources Conservation Service, Washington, DC, and Center for Survey Statistics and Methodology, Iowa State University, Ames, Iowa. www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1167354.pdf, page 88

[2] U.S. Department of Agriculture. 2013. Summary Report: 2010 National Resources Inventory, Natural Resources Conservation Service, Washington, DC, and Center for Survey Statistics and Methodology, Iowa State University, Ames, Iowa. www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1167354.pdf, page 101

[3] Rick Cruse, "Soil Erosion – What will the future bring?", Power Point, Iowa State University, http://extension.agron.iastate.edu/soybean/documents/SoilErosion.pdf

[4] Francis Thicke, A New Vision for Iowa Food and Agriculture, Mulberry Knoll Books, 2010, page 8

When the pockets of air and water are no longer present in the soil, the soil is compacted. When the organic material is no longer present, the soil is exhausted. Without soil microbes, organic material and pockets of air and water, artificial fertilizers must be applied to the land to provide nutrients to the plants.

Rich organic soil results from adding organic materials, including manure, crop residues and compost, and from less tilling of the soil which releases soil nutrients in the atmosphere. Healthy soils can sustain plants when conditions are dryer. They can also absorb more water and slow the flow of water during rains and snow melts, which reduces flooding and flood risks. Organic material also reduces erosion making soils more cohesive.

Enriching carbon in soils increases water retention, reduces carbon in the air, and increases soil fertility and crop yields. Another benefit is storing carbon, thus keeping it out of the atmosphere, helps to mitigate climate change.

Techniques to increase or maintain carbon in the soil include:

- **No-till agriculture**. Keeping crop residues on the land and leaving the earth largely undisturbed during planting.

A field showing no-till agriculture. Soybeans were planted without plowing the cornstalks into the ground. Photo courtesy Lynn Betts, USDA NRCS

- **Conservation tillage**. Farmers practicing conservation tillage leave 30 percent of the crop residue on the fields.

- **Biochar**. Also called charcoal, biochar can be put into soil to increase its fertility and to allow it to hold water. Biochar stays in the soil for long periods of time, thus sequestering carbon in the soil. It is produced by heating organic material (manure or plant leaves, stalks, roots, husks, shells, seeds) in a low oxygen environment.

- **Compost**. This organic material, such as leaves, stalks and roots that have decomposed, is added to soil as a fertilizer and to rejuvenate soil.

- **Integrated crop-livestock systems.** Farms that include livestock on the landscape as well as crops are more beneficial in returning carbon to the soil and maintaining healthy soils.

- **Rotational grazing**. Rotational grazing is a practice where grazing land is divided into segments, called paddocks, with the grazing animals (cattle, sheep, goats, chickens, turkeys) moved from paddock to paddock every few days. The forage grasses, both introduced and native grasses and forbs, are allowed to rejuvenate while the paddock is resting between grazing periods. This results in less soil erosion. It also results in higher quality grasses and a greater output of grasses. Although labor is required to move the animals from paddock to paddock and to reconfigure fences and water sources for the move, the resulting grasslands are much healthier.

- **Use of cover crops.** Cover crops are planted with the intent to prevent soil erosion after the primary crop has been harvested. Side benefits include improved water quality, reduced need for fertilizers, reduced soil compaction and increased soil fertility due to the carbon held in the cover crop. Cover crops are also called green manure.

- **Manure application**. Manure consists of organic material. When applied to the land, manure will increase the amount of carbon held in the soil.

- Reducing the application of synthetic chemicals. Synthetic chemicals can and do destroy soil microbes, which reduces soil health.

- **Organic farming.** Organic farmers do not use pesticides and artificial fertilizers but instead use organic fertilizers and natural pesticide control. These techniques include the use of compost, manure and cover crops – techniques that enhance carbon retained in the soil.

Cover crops on a field in Black Hawk County, Iowa. Photo courtesy Lynn Betts, USDA NRCS

Carbon Sequestration Process:
Converting airborne carbon into organic material in plants and soil

Plants and soil hold carbon which reduces the amount of carbon dioxide in the air. Increasing the amount of carbon held in soil and plants will mitigate the effects of green house gases.

Soil loses carbon when it is tilled and when it is devoid of crops. When wetlands are filled, forests are felled and prairies are plowed, they no longer are able to sequester carbon and the carbon is released into the air.

Plants extract carbon from the atmosphere in the photosynthesis process

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The carbon is stored in the plant tissues including leaves, stems, branches, trunks, roots, and seeds

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Plants die, shed leaves, develop and drop seeds (such as pods, nuts, fruits)

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The plant material turns into organic material in the soil

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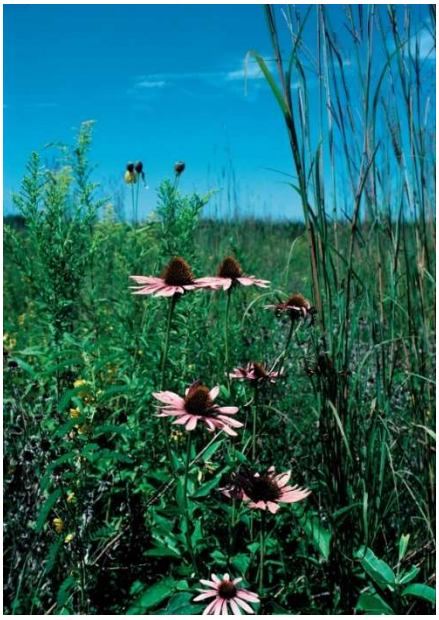
Eventually the carbon stored in organic material returns to the atmosphere



Prairie plants. Photo courtesy Lynn Betts, USDA NRCS