

Our Water

Keeping it Clean

North Dakota Department of Environmental Quality

Soil Erosion Darkens the Skies The Impacts

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One of 30 truckloads of topsoil removed from a North Dakota rest area at taxpayer expense.

“The writer, after 24 years spent in studying the soils of the United States, is of the opinion that soil erosion is the biggest problem confronting the farmers of the Nation over a tremendous part of its agricultural lands.”

~ 1928 ~

Hugh Hammond Bennett

March 29 and 30, 2021: “The winds came and soils left unprotected blew - relocated across the state’s landscape including vegetated areas, farmsteads, streams, rivers and lakes ... and even highway rest stops.”

Unfortunately, 93 years after Bennett’s quote, soil erosion is still a significant problem in North Dakota. The impacts are felt by all citizens of the state.

Impact #1

The rich topsoils found across the state are being lost. In some areas, 50% or

more of topsoil has been lost since agriculture appeared. Wheatland soils which once measured two to three feet in topsoil thickness, now measure six inches or less, says Dr. Dave Franzen, soil specialist for NDSU Extension. Lost topsoil is neither easy nor quick to replace, threatening the sustainability of future agricultural production.

Impact #2

In addition to soil, erosion carries away organic matter and essential nutrients like nitrogen, phosphorus and potassium. This reduces the productivity of remaining soils, requiring producers to spend more on fertilizers to achieve the same yields and reducing already narrow profit margins.

Impact #3

Soil health and water quality are linked. Soil degradation results in both direct and indirect degradation of surface water and groundwater quality. Poorly managed soils are more likely to erode. The eroded soils and nutrients are deposited in streams and lakes. The soils fill up the waterbodies and the nutrients feed blue-green algae that cause harmful algal blooms (HABs).



1936



1976



2016



2021

HABs can make people ill and can kill pets and livestock that ingest the toxins produced by the algae. Also, nutrients promote weed growth that can choke shorelines and deplete oxygen levels when they die and decay.



A harmful algal bloom limits recreation activities on Brewer Lake in Cass County and several other lakes across the state.

The Cost of Erosion

Samples were collected from windblown deposits in the eastern half of the state in an effort to quantify

the loss of nutrients and the cost to producers. The chart below illustrates the average equivalents of nutrients lost in the areas the samples were collected. The results are reported as per acre equivalent. For example, the south-central samples (grey bars) averaged the equivalent loss of:

- 305 lbs/acre nitrogen (N),
- 71 lbs/acre phosphorus (P) and
- 726 lbs/acre of potassium (K)

Research indicates the total amount of nutrients lost is much higher. The total N is calculated by adding the organic N and Nitrate N. The total P and K is a standard value as indicated by research by Franzen, et al. The table below shows the estimated total N, P and K

lost and the economic value of each nutrient.

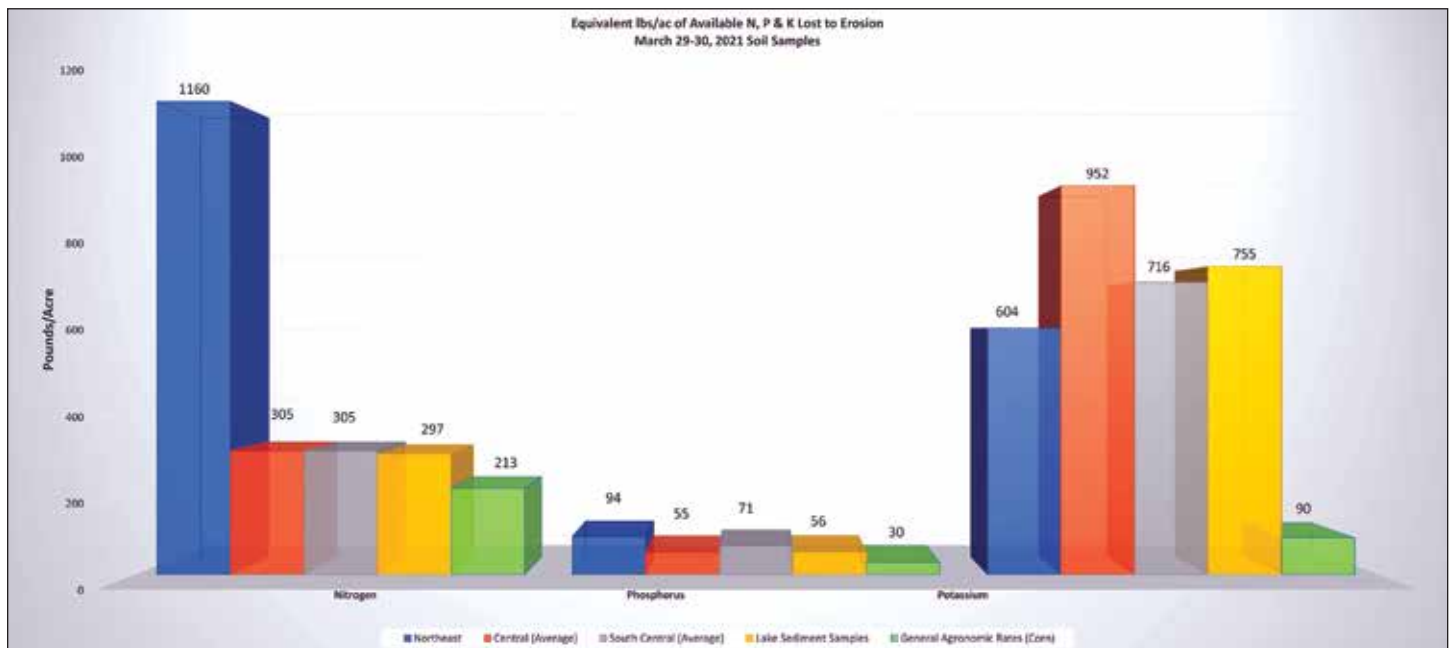
It is extremely important to note that this does not include the value of the soil itself.

Additional costs of poor soil health include:

- Potential for poor crop health.
- Potential yield loss.
- Increased input (fertilizer) costs.
- Salaries to clean road ditches, waterways and public use areas.
- Increased potential for flooding.
- Increased costs for drinking water treatment.
- Lost recreational revenues due to poor water quality and HABs.

	Loss in lbs/acre	Cost/lb	Cost/acre
Nitrogen	4,128	\$0.40	\$1,651.20
Phosphorus	333	\$0.52	\$173.16
Potassium	6,000	\$0.35	\$2,100.00
Total Cost/Acre Loss			\$3,924.36

Total amounts of nutrients estimated to have been lost with one-inch of topsoil during the event.



Samples were collected in the eastern half of the state from eroded soils, analyzed and compared to sediment samples from a North Dakota lake and agronomic rates for east river corn. *Note – this chart does not represent the total nutrients lost, only those that would have been available for crop growth that year.

“Soil needs to be protected just like the skin on our bodies. Just as we don't like to be poked, prodded, cut, burned or frozen in any fashion, the soil doesn't like that either ...”

~ 2014 ~

Rick Bieber - Steward

Saving Our Skin

Soil Health Management

Given the daunting challenge of minimizing soil erosion, there is a path to success. To improve soil health and minimize erosion, it is recommended producers adopt the five principles of soil health:

- Soil armor
- Minimizing soil disturbance
- Plant diversity
- Continual live plant/root
- Livestock integration.

Soil Armor

Leaving the previous year's crop residue on the soil or planting a cover crop to cover bare soil. Benefits include protecting the soil from wind and water erosion, moderating soil temperatures, reducing compaction and suppressing weed growth.



Residue armors the soil protecting it from erosive forces, keeping it in place, in the field.

Minimizing Soil Disturbance

Tillage, “roughing” the surface, was once encouraged to prevent erosion. Tillage implements reduce and remove pore spaces, restricting water infiltration and destroying the substances that hold the soil together, leading to increased erosion. In addition, tillage increases the ponding of water because of reduced infiltration, depletes organic matter and allows soil to crust over and inhibit plant emergence.



Strip tilling a bean field after harvest minimizes soil disturbance.

Plant Diversity

Crop rotation, including cover crops, is extremely important in building soil health. Plants have different nutrient and moisture needs, rooting depths, disease resistance and more.

Benefits of increasing crop diversity include improving the soil food web, reducing disease and pests, increasing water infiltration and nutrient cycling.

Continual Live Plant/Root

Maintaining for a continual live plant provides carbon exudates (fuel) to the soil food web during the entire growing season.

Our cropland systems typically grow cool- or warm-season annual cash crops, which have a dormant period before planting and/or after harvest. Cover crops are able to fill in the dormant period and provide the missing live root exudate, which is the primary food source for the soil food web (Fuhrer, NRCS).



Some of the plants from a 9-way cover crop mix that was grazed after the corn was harvested in 2020-21.

Additional cover crop benefits include:

- Salinity management.
- Pollinator food and habitat.
- Weed suppression.
- Wildlife food, habitat and space.
- Adding crop diversity.

Livestock Integration

Often, the most difficult principle to incorporate into a soil health management system can be the addition of livestock.

Livestock can reduce nutrient export from our croplands by grazing the material in place and recycling the majority of nutrients, minerals, vitamins and carbon.



Integrating livestock by grazing a cover crop and adding value. (Photo by Paul DeLaune, Texas A&M)

Citation: Jay Fuhrer, *Soil Health: Principle 4 of 5*. Online by NRCS.



Sediment from the March 2021 event equals lost topsoil, lost nutrients, lost productivity. Central North Dakota.

The Bottom Line

Today, we are on the verge of seeing soil types become extinct due to poor soil health management. The Red River Valley, once known for multiple feet of rich topsoil, now has only inches left in areas.

The erosion event of March 2021 was extraordinarily bad. The problem is that every year we have several smaller events. We may not lose an inch of topsoil in two days, rather we lose a quarter inch here, another half inch there. Sometimes rain sometimes wind. It happens so regularly that many people say, “It’s normal. It always happens.” While it happens much too often, it is preventable.

In North Dakota, there is a wealth of technical expertise to assist producers in building soil health. Staff from NDSU Extension, NRCS and the Menoken Farm near Bismarck provide presentations, workshops and café talks to assist in working out specific problems producers face.

Leopold Award winners, Grazing Land Coalition members and others readily share their experiences, good and bad, to mentor others as they implement the five principles.

Sanskrit text: “Upon this handful of soil our survival depends. Husband it and it will grow our food, our fuel and our shelter and surround us with beauty. Abuse it and the soil will collapse and die, taking humanity with it.”
1500 BC

Millions of dollars are available to assist producers in improving soil health. Unfortunately, many of those funds go unused due to the lack of producers willing to visit with their local soil conservation districts and make soil management changes.

To learn more about your soils, soil health and management techniques you may visit the new website:

www.soil.nd.gov

Or contact:

- Local Soil Conservation District
- Local watershed coordinator
- Local NDSU extension agent
- NDSU Extension soil health specialists
- NRCS district conservationist
- Menoken Farm - Burleigh County
- ND Grazing Lands Coalition

Or you may contact the NDDEQ Watershed Management Program at 701-328-5161.



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