

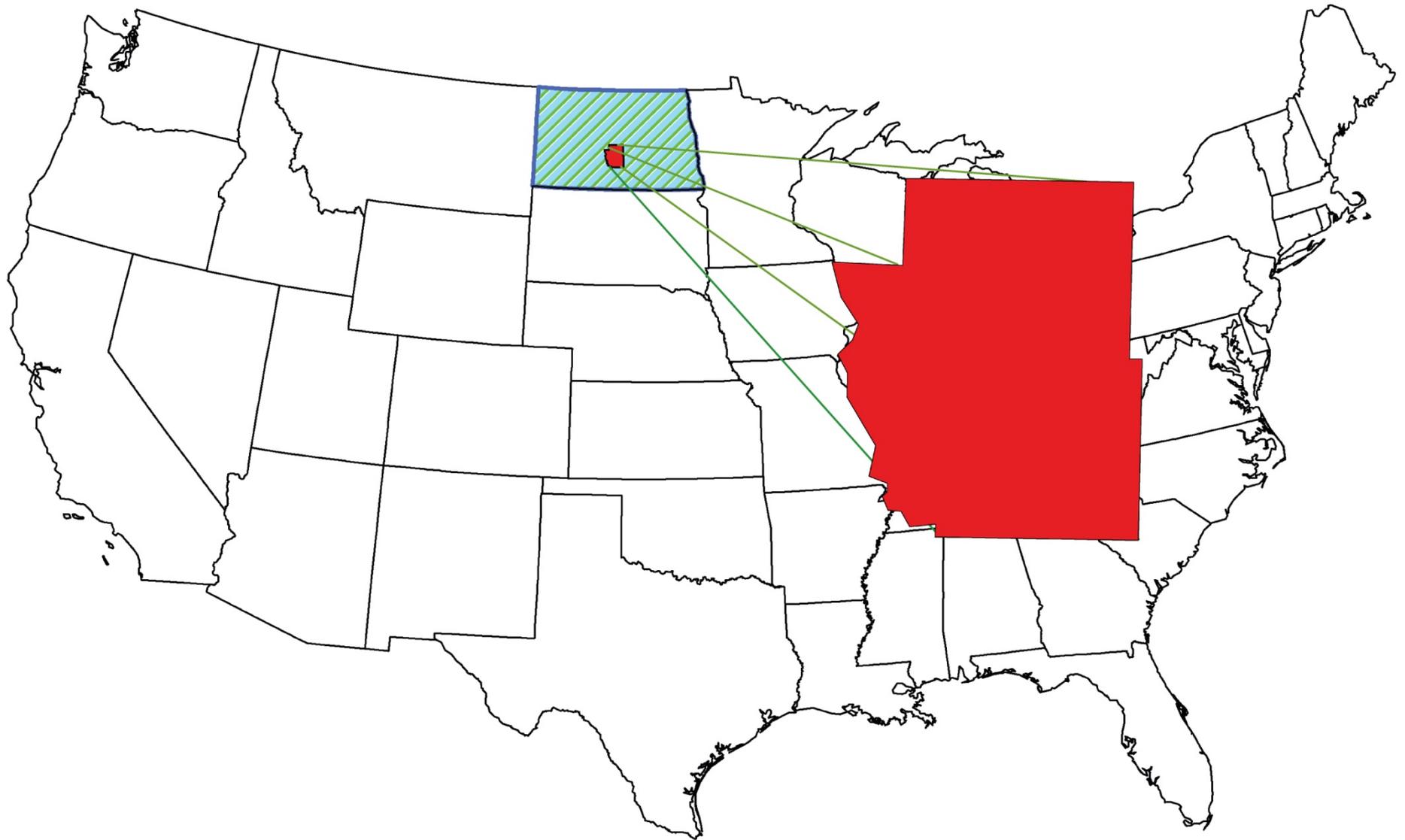
A wide-angle photograph of a lush green field filled with numerous small white and purple flowers. The plants are densely packed and extend to the horizon under a clear blue sky. The overall scene is bright and vibrant, suggesting a healthy agricultural or natural landscape.

Soil Health

Our Shared Journey

By
Jay Fuhrer

Burleigh County, North Dakota



Soil Health: the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans.

Soil Health Principles:

- Minimize soil disturbance
- Soil armor - keep the soil covered
- Maximize diversity of plants in the rotation – 4 crop types
- Maintain living roots in the soil - cover crops
- Integrate livestock

Terms:

- Conservation Tillage
Used from 1985- 1992
- No-till
Used 1993 – 2005
- Soil Health
Used from 2006 - Present



Cropland Soil Health Timeline

1985 - 2014



- Tillage with low crop diversity (1-2 crop types)
- Direct Seeding with low crop diversity (sweep opener)
- No-till with low crop diversity (single disk opener)
- No-till with high crop diversity (3-4 crop types)
- No-till with high crop diversity and cover crops
- No-till with high crop diversity, cover crops & livestock integration

Rangeland Soil Health Timeline 1985 - 2014



- Predominately Season Long Grazing with some 2-5 Pasture Systems.
- Moved into Higher Recovery Periods using 10 Pasture Systems
- Grazing Systems are now up to 45 Pasture Systems using Shallow Pipelines and are Integrated with the Cropland by using Cover Crops.
- Mob Grazing and Grazing Tall are used as tools not systems.

1st Half of my Career

Treating Symptoms

- Waterways
- Diversions
- Terraces
- Stripcropping

2nd Half of my Career

Treating Problems

- Too much Soil Disturbance
- No Armor (surface litter)
- Lack of Crop Diversity
- No Cover Crops

Last Waterway Constructed in Burleigh County
Was 11 Years Ago

2003 11 21

The Journals of Lewis and Clark
Undaunted Courage, Steven Ambrose
Pierre, SD to Bismarck, ND
(Original Landscape)

- Animal diversity 125 species
- Plant diversity 178 species
- September 17, 1804 “The scenery already rich pleasing and beautiful, was still farther heightened by immense herds of buffalo, deer, elk, and antelope which we saw in every direction feeding on the hills and plains. I do not think I exaggerate when I estimated the number of buffalo which could be comprehended at one view to amount to 3000.”
- October 20, 1804 “in the vicinity of present Fort Lincoln State Park, across the river from Bismarck, ND, Private Cruzatte was the first to encounter a grizzly bear.”

An aerial photograph of a vast, uniform green agricultural field, likely a cornfield. The rows of crops are perfectly straight and extend to the horizon. A single, small orange marker is visible in the center of the field. The overall appearance is one of a highly simplified and controlled landscape.

Present Day Simplified Landscape

What can we do to more closely mimic the original landscape?

...Enter the Burleigh County Soil Health Team
formed in the late 1990's



Burleigh County SCD Supervisors Speaking for the Resource
All implemented soil health on their farms and ranches.



Our team used a “boots on the ground” approach.

For example:



All of these events created opportunities for “boots on the ground”, and the gathering of supporting data such as NutBal, Haney Test, PLFA Test (Biology), Bulk Density, Infiltration, etc.

- Conservation Planning (symptom vs problem)
- No-till Agreements (80 acres)
SCD Equipment & personnel
- Cover Crop Agreements (25 acres)
SCD Equipment & personnel
- Soil Health Workshops (annually in January)
- Soil Health Tours (one per summer)
- Winter Grazing Tours (one per winter)
- Garden Tours (one per summer)
- Hosting Groups (weekly during the summer)
- Shop Talks
- Speaking Engagements (anywhere)
- Soil Health Walks (crop, range, garden, etc)

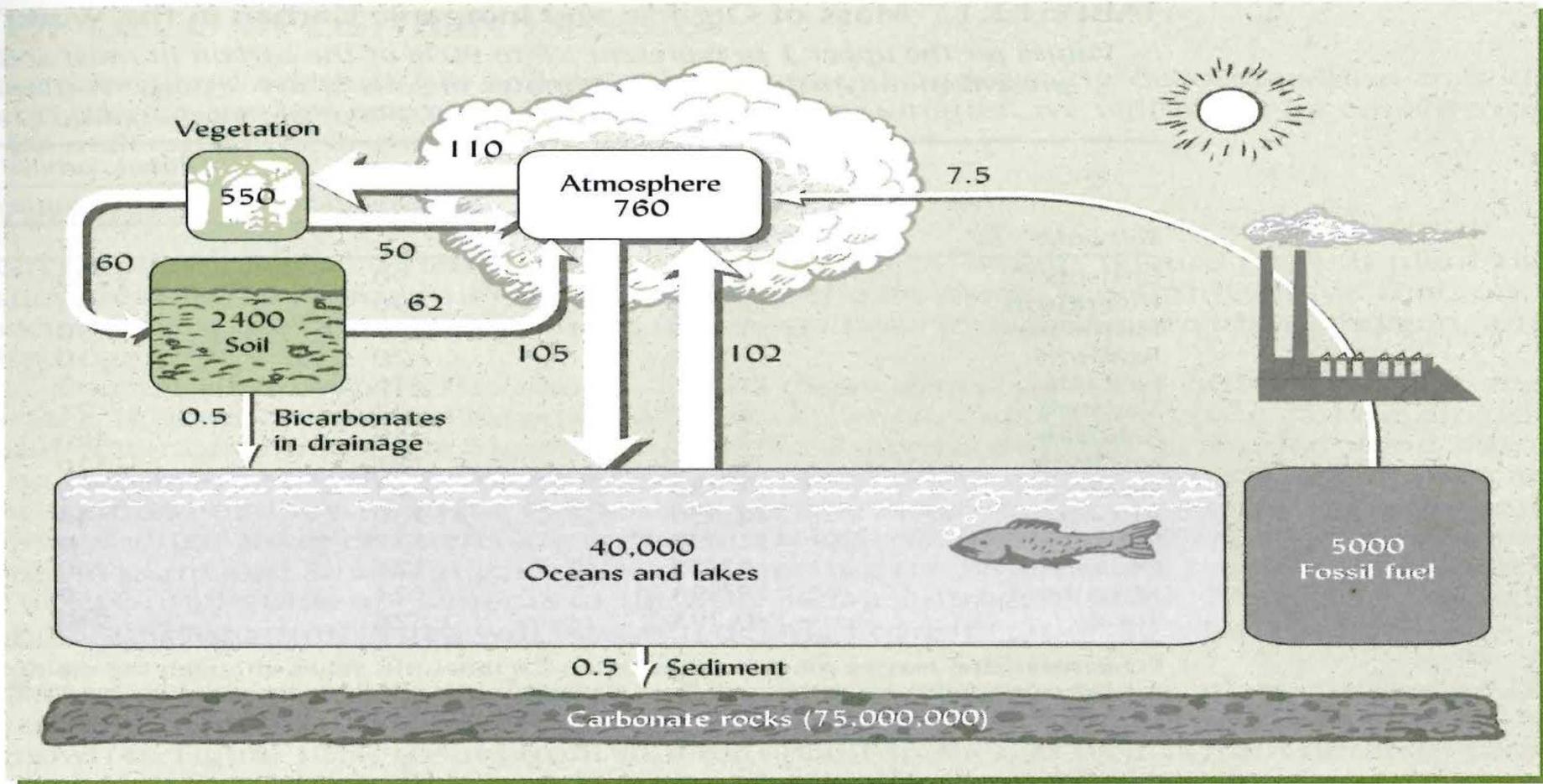
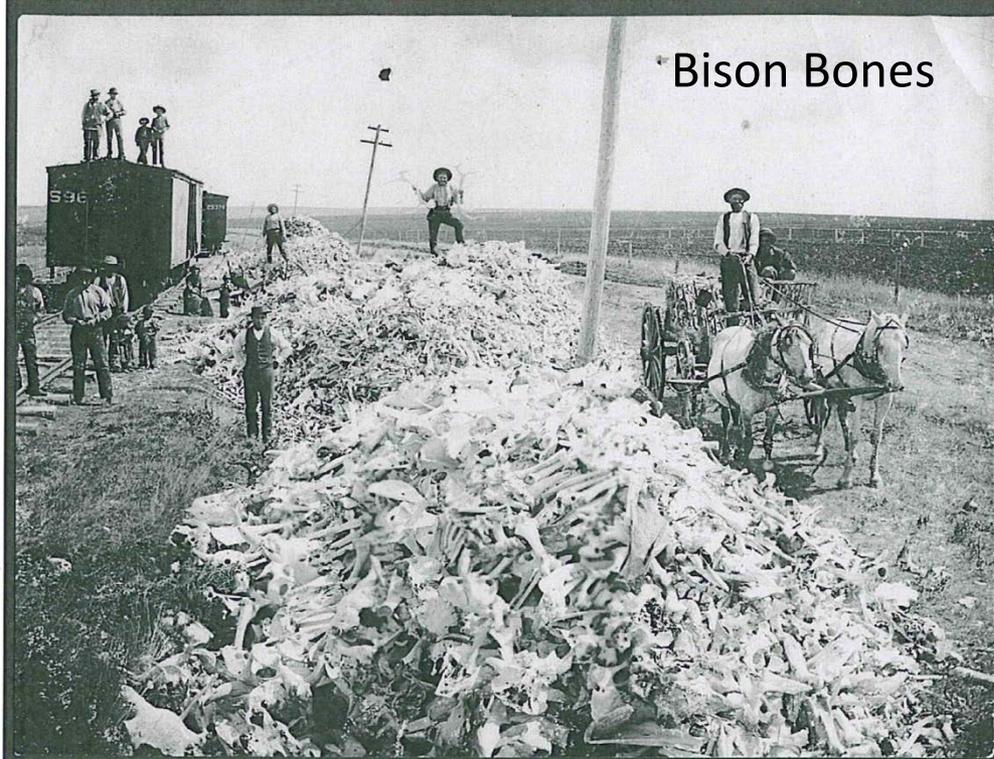


FIGURE 12.3 A simplified representation of the global carbon cycle emphasizing those pools of carbon which interact with the atmosphere. The numbers in the boxes indicate the petagrams (Pg = 10^{15} g) of carbon stored in the major pools. The numbers by the arrows show the amount of carbon annually flowing (Pg/yr) by various processes between the pools. Note that the soil contains almost twice as much carbon as the vegetation and the atmosphere combined. Imbalances caused by human activities can be seen in the flow of carbon to the atmosphere from fossil fuel burning (7.5) and in the fact that more carbon is leaving (62 + 0.5) than entering (60) the soil. These imbalances are only partially offset by increased absorption of carbon by the oceans. The end result is that a total of 221.5 Pg/yr enters the atmosphere while only 215 Pg/yr of carbon is removed. It is easy to see why carbon dioxide levels in the atmosphere are rising. [Data from IPCC (2007); soil carbon estimate from Batjes (1996)]



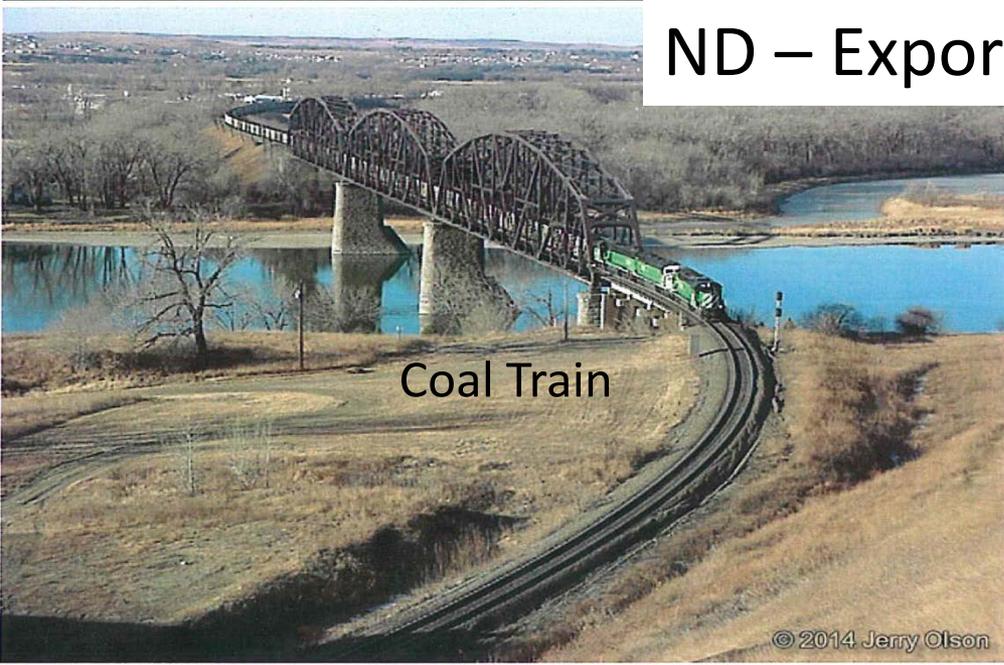
Bison Bones



SOM

FALL PLOWING, DALRYMPLE WHEAT FARMS, RED RIVER VALLEY, D.T., 1876. This shot of plowing on a bonanza farm, taken on his first contract for the Northern Pacific Railroad in October 1876, carried the comment, "Heel to ice plows tear up the Red River Valley soil." The railroad hoped to show easterners the extent and productiveness of the bonanza farms by using such photographs at fairs and exhibits.

ND – Exporting Carbon



Coal Train



Bakken Oil Train

Nurture Nature with System Synergies



No Tillage

Minimum carbon loss



Cover Crops

Maximum carbon input

Carbon management

Sustainability

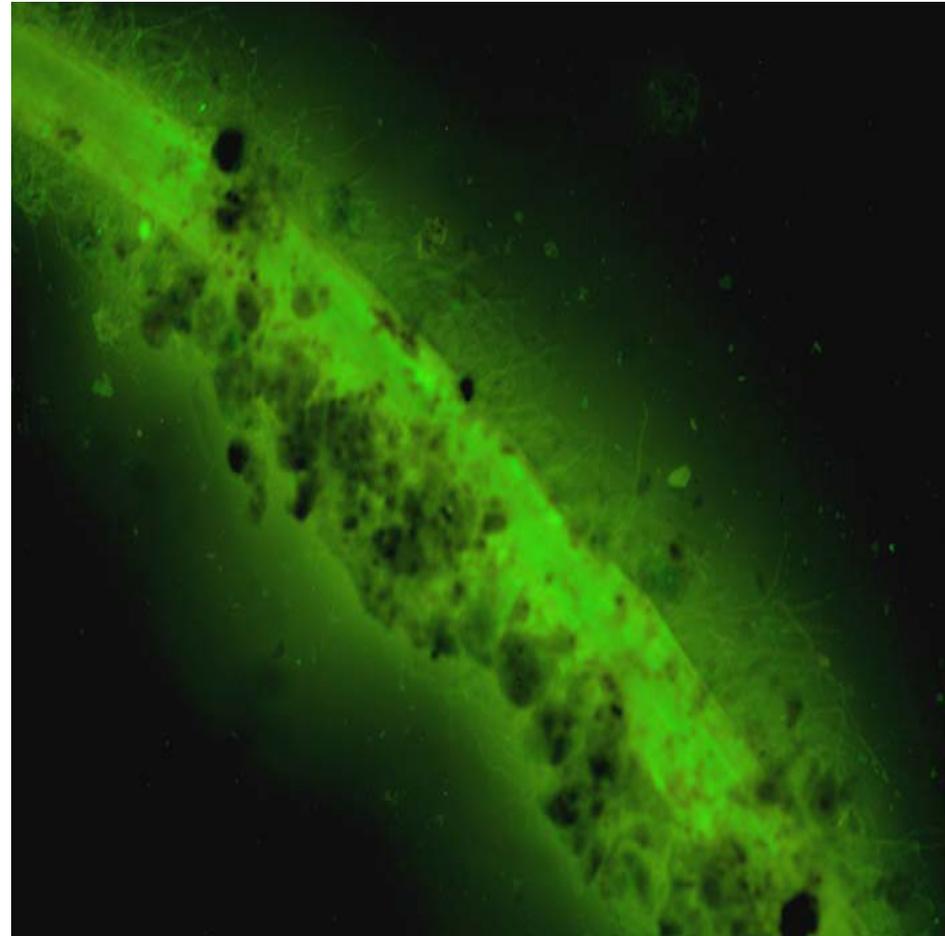


10/18/2013

Soil Aggregates
on a millet root.
Richter Farms



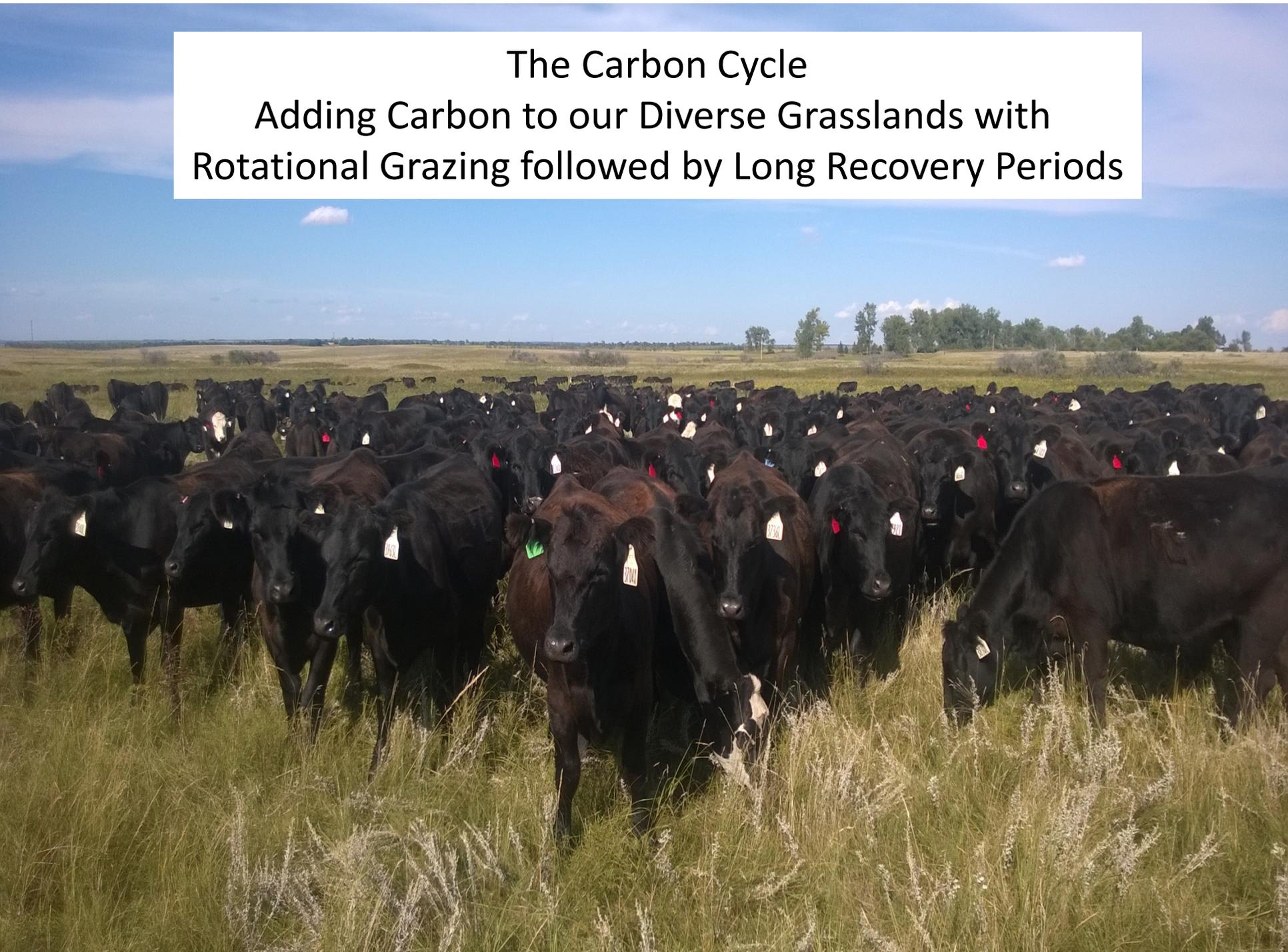
Glomalin and hyphae
show well with a green
color in the lab.





The Carbon Cycle
Adding Carbon to our Cropland with Crop
Diversity and Cover Crops

The Carbon Cycle
Adding Carbon to our Diverse Grasslands with
Rotational Grazing followed by Long Recovery Periods



The Carbon Cycle

Our Road to Build Soil Organic Matter

CO₂ loss from the soil is accelerated by tillage on cropland; and the intake is restricted due to lack of cover crop use.

CO₂ intake is restricted on grasslands due to reduced photosynthetic capacity (short leaf length)



North Dakota landowners, Chevrolet make nation's first carbon deal

November 17, 2014 1:00 am • By [Brian Gehring](#)



Although the carbon credit transaction program requires landowners to sign perpetual easements, the program is designed for working lands where grazing and haying are permitted.

About 11,000 acres of North Dakota grasslands in six counties are at the center of a first-of-its-kind transaction to conserve grasslands while reducing carbon releases into the atmosphere.

In this groundbreaking deal, Chevrolet has purchased nearly 40,000 carbon credit reduction tons on working grasslands in the Prairie Pothole region of the state known as the Missouri Coteau, according to an announcement made today by the U.S. Department of Agriculture.

Robert Bonnie, USDA's undersecretary for natural resources and environment, said it's hoped the public-private partnership will open the door for additional grassland conservation in the future.

"Our hope is it serves as a model," Bonnie said.

Innovative deal

The program allows private companies to buy carbon credits while private landowners are compensated for agreeing to not till grasslands.

When ground is tilled, underground carbon reserves are released into the atmosphere.

The land involved in the deal is located in Sheridan, Burleigh, Kidder, Emmons, McHenry and McIntosh counties, according to Billy Gascoigne, a Colorado economist and market specialist with Ducks Unlimited, which launched the project with the help of a \$161,000 grant from USDA's Natural Resources Conservation Service.

A total of 23 landowners are involved in the project, according to the NRCS.

Gascoigne said avoiding the conversion of grasslands to croplands benefits farmers and ranchers as well as the environment.

A new market

Carbon credits — a generic term for a tradeable certificate or permit as part of the American Carbon Registry — and carbon markets are part of national and international attempts to mitigate the growth of greenhouse gases thought to be linked to climate change.

The carbon storage potential of land can be scientifically measured, and the carbon credits are available to companies interested in purchasing carbon offsets.



Soil Health Tours and Workshops





2014 International Groups
France
Slovakia
Germany
Denmark
South Africa
Australia
United Kingdom
Belgium
World Congress Tour

Soil Health Tours and Workshops





The Menoken Farm
Garden Tour



Growing People



Anna, Bethany, and William Small
Honey Bee Monitoring

08/01/2014

NDSU Wheat Fertilizer Recommendations - January 2010

SF-882 (Revised)

North Dakota Fertilizer Recommendation Tables and Equations

D.W. Franzen
NDSU Extension Soil Specialist

The following soil test recommendation tables are based on field research data obtained in North Dakota, South Dakota, western Minnesota and the Canadian Prairie Provinces.

In the case of some crops, data in the literature also were used to supplement data available from this area. This publication contains changes from previous publications. Please dispose of older editions. Changes to tables were based on new or re-evaluated data.

The major changes are:

- Separation of spring wheat and durum recommendations from winter wheat and rye
- Spring wheat and durum nitrogen (N) recommendations
- Simplification of winter wheat and rye N recommendations
- Wheat and rye potassium (K) recommendations

Recommendation Tables

Fertilizer needs should be determined after carefully evaluating the current fertility level of the soil and the nutrient needs of the crop to be grown, and setting realistic yield expectations. We strongly suggest that yield potential be based on a historical yield tendency for a field or a

region. Recent research has shown that more productive areas of fields require less fertilizer, particularly N, than less productive areas of the field because they tend to be higher in organic matter and have a higher seasonal moisture content. The exception to this would be saline areas that are commonly high in residual N. Several of our N recommendations are "capped" at a maximum rate. In years that support higher yields than our N recommendation formulas indicate, our data show that greater N release from the soil will support these higher yields without requiring additional supplemental N fertilizer.

Nitrogen

Nitrogen (N) recommendations for most crops except some legumes are based on the amount of nitrate-N ($\text{NO}_3\text{-N}$) in the top 2 feet of soil and the yield potential. Nitrogen fertilizer recommendations are not adjusted based on method of placement, but they are adjusted for previous crop and depth of sampling. To determine the amount of recommended fertilizer N, subtract the amount of $\text{NO}_3\text{-N}$ in the soil as determined by soil test and N-credit from the previous crop, if applicable, from the total amount of available N needed for a particular yield goal and crop. Spring wheat and durum recommendations include economic components.

For example:

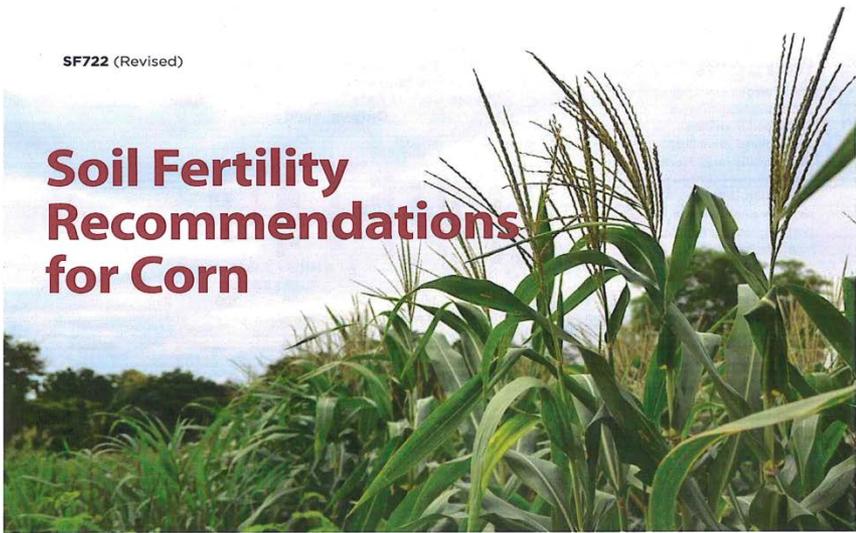
Your NDSU soil test shows 55 pounds of $\text{NO}_3\text{-N}$ are present in the soil to 2 feet. Your yield history is about 40 bushels per acre (bu/A) of spring wheat. The amount of nitrogen recommended to support a 40-bushel yield is 100 pounds of nitrogen per acre (N/A). The difference between 100 pounds and 55 pounds (the soil test) is 45 pounds of N. Therefore, the N recommendation is 45 lb N/acre.

- "If the field has been in no-till five or more continuous years, subtract 50 lbs N/acre."

NDSU
Extension Service
North Dakota State University
Fargo, North Dakota 58108
January 2010

NDSU Corn Fertilizer Recommendations - July 2014

SF722 (Revised)



Soil Fertility Recommendations for Corn

Corn has been a crop in North Dakota for at least 100 years. However, the acres under corn grain production have been relatively small, compared with small-grain crops, until about 20 years ago. Today, corn consistently is planted on more than 3 million acres each year, with most North Dakota counties having significant acreage.

The surge in acreage has been the result of improved corn genetics supported by NDSU corn inbred research, combined with greater rainfall and the increase of long-term no-till acreage in western North Dakota.

Fertilizer recommendations for corn used until recently were published about 40 years ago and have been changed little since then. However, in the past 40 years, yield expectations have at least doubled from about 80 to more than 200 bushels per acre in many fields. Tillage practices and the hybrids planted have changed as well.

The changes from previous corn fertility recommendations in this publication are primarily the result of recent assessments of corn yield responses to nitrogen (N) through field experiments using modern hybrids and conditions.

D.W. Franzen
Extension
Soil Science Specialist

NDSU EXTENSION SERVICE
July 2014

- “the difference in N recommendations between long-term no-till and conventional-till soils was between 40 and 50 pounds less N per acre for long term no-till soils”

North Dakota Declares Soil Health Week



State of
North Dakota
Office of the Governor
Jack Dalrymple
Governor

PROCLAMATION
SOIL HEALTH WEEK
JANUARY 6-12, 2013

WHEREAS, soil health and function is of vital importance to the health, well-being and sustainability of the people of North Dakota and their quality of life; and

WHEREAS, it is important for the citizens and civic leaders of this state to gain knowledge of and to maintain a progressive interest in the valuable role that soil health plays in plant and animal health and therefore food quality; and

WHEREAS, farmers, ranchers, land managers, conservationists and supporting organizations are responsible for studying, managing, protecting and regenerating our soil resources to ensure that future generations have the same opportunities essential for communities and landscapes across the state; and

WHEREAS, North Dakota's farmers, ranchers, land managers, conservationists and supporting organizations should be recognized for their dedication and contributions to the growth, development and knowledge of our state's foundational resource.

NOW, THEREFORE, as Governor of the State of North Dakota, I do hereby proclaim January 6-12, 2013, **SOIL HEALTH WEEK** in the state of North Dakota.


Jack Dalrymple
Governor

ATTEST:


Alvin A. Jaeger
Secretary of State

- Governor Jack Dalrymple signs a proclamation declaring January 6-12, 2013 as Soil Health Week.

New Soil Health positions for ND



- NDSU added 5 new Soil Health positions on April - 2012.
- NRCS added a new Soil Health position on August - 2014.

Burleigh County Today

November 19, 2014



- 10% Never Changed
- 70% No-till Systems
Increased SOM a minimum of 1%.
- 60% Grazing Systems
Leave more grass at the end of the year than they used to produce.
- 25% Use Cover Crops
As a bridge to connect the cropping and grazing system together with livestock.



Thank You
Jay.fuhrer@nd.usda.gov