Soil health reduces crop insurance liability and creates jobs.

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Outline

• Climate variability impact on food security

• How soil health improves resiliency

• Where are we today

• Soil health impact on economic sustainability
Agricultural Challenges

• American is the Bread Basket of the world.

• We have been able to do this, because many of our soils are incredible rich.

• However, our ability to produce inexpensive high quality food has been challenged by drought, flooding, climate variability, and water quality concerns.
Food security

• It is not uncommon for farmers to be flooded in one year followed by years where yields are reduced by drought.
The failure to manage a variable climate can result in severe consequence.
Soil health

• Research has shown that one approach to improve food security is to enhance the soil health.
A low hanging fruit to reduce the impact of climate variability on food security is to improve soil health. Soil health can be monitored by measuring changes in soil organic carbon or organic matter.
Soil organic matter mitigates adverse impacts

What research shows is that soil organic matter (the dark stuff in soil) or carbon, can be used as a proxy for the soil productivity.
Associated with the loss of soil organic carbon

There was a change in the ability of soil to retain and provide soil nutrients and water to the growing plants.
Soil organic matter also traps soil nutrients

Soil organic matter increases the amount of charges contained in the soil. These changes help the soil retain nutrients.
Soil organic matter improves soil structure and water infiltration.

Soil organic matter helps hold the soil together.
Soil organic matter can be increased by adopting conservation tillage.
Around 1990 no-tillage and conservation tillage adoption increased.

An OSU Extension Survey found that No-till practices were implemented on 28% of Oklahoma Cropland in 2008.
Quiz, How much have we increased soil organic matter across the Midwestern portion of the United States over the last 25 years?

- We have lost SOM
- We have gained 5%
- We have gained 10%
- We have gained 20%
- We have gained over 20%
At the same time that SOC was increasing in South Dakota, erosion losses decreased.

According to USDA-National Resource Conservation Service (USDA-NRCS), from 1982 to 2007, wind erosion decreased 34% and water (sheet and rill) erosion decreased 22%.
Soil test results for Iowa from Midwest Laboratories from 1997 to 2013. In this chart, year 0 is 1997. Data provided in this chart were provided by Midwest Laboratories. These samples, were collected from the production fields similar to Clay et al. (2012).
Minnesota Organic Matter %

25% increase
Midwest labs. Over half a million soil samples collected from farmers fields in Wisconsin that shows that C has been stored in the soil.

84% increase
Nebraska
Why increasing'

- Increasing yields
- Reduced tillage intensity
  - No-tillage and conservation tillage adoption increased from near zero in 1985 to between 40 to 45% in eastern SD
- Better genetics

![Graph showing yield vs. year with data points for different locations and years.](image)
Summary

• Findings from these soil samples represent millions of samples that were collected over many years. These samples were collected from farmers that rely on soil sampling for fertilizer recommendations.

• The samples were collected from fields, where the producers were attempting to optimize yields and minimize fertilizer costs.
Why do we care?

• In 2012, the United States experienced one of the most severe droughts over the last 25 years.
  • Palmer drought index in 1974 was -3.35
  • Palmer drought index in 2012 was -2.18
• The drought reduced yields at numerous locations across the Midwest.
  • The Congressional Budget Office, estimated that the drought in 2012 produced a 14 billion dollar liability to the crop insurance program.
South Dakota yields during similar droughts

<table>
<thead>
<tr>
<th>Crop</th>
<th>1974 (kg/ha)</th>
<th>2012 (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>1230 (18 bu/acre)</td>
<td>3070 (46 bu/acre)</td>
</tr>
<tr>
<td>Soybean</td>
<td>1340 (20 bu/acre)</td>
<td>2012 (30 bu/acre)</td>
</tr>
<tr>
<td>Corn</td>
<td>2060 (33 bu/acre)</td>
<td>6321 (100 bu/acre)</td>
</tr>
</tbody>
</table>

How much of this yield increase was attributed to improved soil health
Based on changes in soil organic carbon, we can estimate changes in plant available water.

1% increase in soil organic matter can increase water storage by 25,000 gallons/a
Management improvements has reduced evaporation and increased soil water storage.

Return in 2012 (compared to 1974) due to increased water

<table>
<thead>
<tr>
<th>Crop</th>
<th>Inches of water</th>
<th>Acres</th>
<th>WUE</th>
<th>Price</th>
<th>Return due to soil health</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>1.61</td>
<td>5.2</td>
<td>8.81</td>
<td>7.25</td>
<td>534</td>
</tr>
<tr>
<td>Soybean</td>
<td>1.61</td>
<td>4.1</td>
<td>3.60</td>
<td>14.25</td>
<td>338</td>
</tr>
<tr>
<td>Wheat</td>
<td>1.61</td>
<td>2.43</td>
<td>5.85</td>
<td>7.83</td>
<td>177</td>
</tr>
<tr>
<td>Total</td>
<td>11.73</td>
<td></td>
<td></td>
<td></td>
<td>1,050</td>
</tr>
</tbody>
</table>

This results in an annual return of $89.6/acre resulting from soil health.
Why do we care: 1974 vs 2012 droughts

• Increased SOC and adoption of conservation practices increased plant available water 1.6 inches in 2012.

• Increased water had a 1 billion dollars impact on SD crop production in 2012.
  • This billion dollars did not need to be replaced by crop insurance
  • This billion dollars supported local schools, hospitals, governments, jobs, and small businesses.

• It is likely that similar responses occurred across the region
We care about soil organic matter because

- We like to eat.
- Increasing carbon reduces the impact of agriculture on the environment.
- Creates wealth and jobs.
- Reduces crop insurance liability.
Summary

This did not happen by magic, but required investments by farmers, industry, and the local, state, and federal governments.

Success required collaboration across the industry, local, state, and federal partners.

We can do much better, there are many fields where minimal benefits have been observed. Success is dependent on matching problems to local conditions.

We can use precision conservation/tillage and create the mathematics that to target resource allocation.
How much have we increased soil organic matter over the last 25 years?

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Thank you and I would be willing to answer any questions.