Cropping Systems in South Dakota
A 2015 Inventory and Review

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South Dakota
Who are we? Introduction of NRCS – or our predecessor, the Soil Conservation Service. We are an agency of the U.S. Department of Agriculture that works on private lands. We assist private landowners with conservation planning and programs. In most cases, it’s the planning advice, the brainstorming, the sharing of ideas of what other producers are doing, that may be the most valuable service we have to offer.
We focus on ALL natural resources. A while back, our name changed from Soil Conservation Service to Natural Resources Conservation Service, -- a change that is more appropriate and better represents our mission: Helping People Help the Land. All resources are connected – they are related – in the center is the landowner – the person who brings all this together and makes agriculture happen.
Conservation Technical Assistance is...

We do planning with partners on a local level.
Most work is done with local partners

- Conservation Districts
- Agricultural Groups
- Conservation and Wildlife Groups
- State and Local government
- Universities
- many others

Our locally-based NRCS staff works directly with farmers, ranchers, and others, to provide technical and financial conservation assistance.

- Service
- Partnership
- Technical Excellence
Let’s have a discussion!

WE CAN ALL LEARN BEST FROM EACH OTHER
The document was published December 1, 2015. It used to be called the “Tillage Survey” – we changed the name to better reflect the complexity of farming – to be the South Dakota Cropping Systems Inventory. It is an inventory of what is happening across South Dakota. It hadn’t happened since 2004. When Jeff Zimprich came to be State Conservationist, he wanted a better picture of South Dakota cropping systems and conservation progress. In 2013, Jeff first allocated staff and resources to acquire the data.

In 2015, the U. S. Department of Agriculture’s Natural Resources Conservation Service (NRCS) and partners in South Dakota (SD) again conducted a county-level inventory of the types of cropland management systems being used by agricultural producers. The 2015 Cropping Systems Inventory 1) provides information that can be used by individual conservation districts and others in establishing priorities for educational or other programs, 2) evaluates progress achieved in reaching county or statewide goals, and 3) provides data on the adoption of conservation cropping systems across South Dakota. The purpose was to capture a “snapshot in time” of the types of cropping systems being used across South Dakota and to be able to apply current knowledge of how cropping systems relate to soil health, productivity, and sustainability. Conducting this inventory on a biennial basis allows for the identification of short-term fluctuations, in addition to long-term trends. Information was collected for the crop management systems used. Selected counties with large acreages of winter wheat completed the survey for fall seeded crops prior to December 1, 2014. Fall gathered data was combined with the data collected in the spring of 2015. It was done after crop emergence but before the crop canopies closed, and while it was still evident what type of cropping system had been employed to plant the crop. The field observations since the 2013 data was collected indicate that No-till Cropping Systems are still the most predominant cropping system utilized in South Dakota. In 2015, one percent more cropland acres were added to South Dakota annual cropland production compared to 2013. The 2015 data (6,475,903 acres) shows about a 4 percent expansion in total acres farmed under a no-till system since 2013 (6,229,856 acres) and a 36 percent expansion since 2004 (4,873,352 acres).
When we talk about different types of cropping systems, what are we saying? Here are the definitions.

South Dakota NRCS and partners conducted a county-level inventory on cropland management systems (no-till, mulch tillage, reduced tillage or conventional tillage) and the crop types planted.

- **No Tillage (no-till):** the soil is left undisturbed from harvest to planting with greater than 30 percent residue remaining after planting. There are allowances for nutrient injection, etc. but the point is very little disturbance.

- **Mulch Till:** disturbs the entire soil surface and is done prior to and/or during planting with greater than 30 percent residue left after planting. Usually, 1 to 3 tillage trips. Chisel plow, disk, field cultivator and combination tools are used.

- **Reduced Tillage:** disturbs the entire soil surface and is performed prior to and/or during planting with 15-30 percent residue cover remains planting.

- **Conventional Tillage:** soil in the entire field is tilled with one or more tillage trips that disturb the entire soil surface and is performed prior to and/or during planting with less than 15 percent residue cover remaining after planting. Generally involves plowing or intensive (numerous) tillage trips.
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Point – there was a time when we were taught that the best thing for the field was to leave residue at the surface – that is all that was needed. We didn’t understand that we needed to consider what was happening right beneath the soil surface. We have evolved in our thinking – we are now considering what is happening beneath the soil surface and the physical, chemical, and especially, how the biology of that thin layer is affected by what we do on the surface.
The inventory recorded a county-level statistical “snapshot” of the types of cropping systems. The first pie chart on the left is the 2004 date, 2013 in the middle and 2015 on the right.

Use of a no-till cropping system was found to be the predominant cropping system with 46 percent of South Dakota cropland (6.4 million acres). A cropping system that leaves more than 30 percent residue cover on the soil surface after planting (including no-till and mulch-till) was used on more than 68 percent of the state’s cropland. The percentage of acres under conventional tillage systems decreased from 2013 to 2015. Use of conventional tillage is seen most often in eastern South Dakota counties.
The picture of cropping systems has changed. Here is one of our South Dakota Voices for Soil Health: Robert Nehl, who farms in Corson County, SD.

ROBERT NEHL - In 2013, nearly 100 years after his great-grandfather first put a plow to the ground, Corson County farmer Robert Nehl decided it was time for a big change. With help from NRCS, Robert planned and implemented a new no-till cropping system that integrated cover crops for grazing with his crop rotation. “The wheat in 2014 was the best I ever had where there had been cover crops,” says Nehl. His cattle grazed 3 1/2 weeks before until bad weather set in. Spring soil tests showed available nitrogen was tripled where the cattle grazed. The cover crop mixture was turnips, radishes, lentils, winter peas, sweet clover, oil sunflowers, sorghum, sudan grass, and forage oats. Nehl’s records showed up to a 57% increase in gross return in one year.

Use of Conventional Tillage Drops in 20 Counties - Although use of conventional tillage systems continues, in the last decade a significant drop (greater than 10 percent of the county acres) has been seen across South Dakota counties. Since 2004, producers in 20 counties have significantly decreased their use of conventional tillage systems. This conversion from tillage to a higher residue management system was observed in counties statewide. Soils with improved soil structure can better carry farm equipment (trafficability) in changing weather conditions. **Counties with Greater than 10 Percent Drop in use of tillage:** Bennett, Brookings, Butte, Corson, Dewey, Gregory, Haakon, Hand, Harding, Hughes, Hyde, Jones, Lyman, Meade, Miner, Pennington, Shannon, Stanley, Todd, and Ziebach.
There are positive trends across South Dakota – changes are being made across the state. When you look from 1985 to 2015, the use of no-till is steadily increasing. This is a positive trend for South Dakota and it’s agriculture industry.

Tillage is down and **30-Year Trend Shows Increase in No-Till Systems**
Over the last the 30 years, use of a no-till cropping system on South Dakota planted cropland acres is at an all-time high (46 percent of all acres planted).
On the map, the darkest green are the counties with more than 76 percent of their cropland fields under a no-till cropping system. The, next two shades reflect the mulch till and reduced tillage while the lightest color shows the counties with less than 25 percent of their cropland acres under no-till. Basically, the dark is the more advanced no-till systems and the lighter counties have tillage. Check out the trends in those counties since 2004.

The 2015 inventory found use of no-till cropping systems to be predominant on 46 percent of South Dakota cropland (6.475 million acres). A cropping system that leaves more than 30 percent residue cover on the soil surface after planting (including no-till) was used on more than 68 percent of the state’s cropland.

The number of counties with more than 75 percent of their cropland acres under a no-till system increased from 4 counties in 2004, to 14 counties in 2013, to 17 in 2015. While the overall acres under no-till increased between 2013 and 2015, two counties, Charles Mix, and McPherson, dropped two classes with a dramatic decline in acres of cropland under a no-till system.

The counties listed below represent locations where the cropland acres with no-till systems shifted from the no-till category to another category.

**8 Counties that had a Significant Loss in No-till Systems Acres since 2013:**
Bennett, Charles Mix, Hand, Hanson, McPherson, Oglala Lakota (formerly Shannon), Spink, and Ziebach

**13 Counties that had a Significant Gain in No-till Systems Acres Since 2013:**
Bon Homme, Brown, Buffalo, Butte, Clark, Corson, Codington, Grant, Haakon, Hamlin, Jerauld, Marshall, Meade, and Moody.

The greatest increase in the use of a no-till systems occurs in central South Dakota.
Let’s talk about the county status. It’s important to highlight the farming operations in those lighter counties who are doing the more advanced systems and are productive and profitable.

The Leitheiser Family, McCook County, SD farms in one of those counties that is less than 25 percent no-till. George Leitheiser says he has heard arguments that no-till won’t work. He looks at things differently. “Mother Nature does not till and things seem to grow,” says George, who chairs the McCook County Conservation District. “We are not doing anything that anybody else can not do,” he says. “It doesn’t matter how many times you succeed, it is a challenge to repeat it. There will be both dry spells and wet spells.” No-tilling helps the Leitheisers deal with wild swings in the weather. “When we dried out in 2012, our no-tilled corn was not as terrible compared to conventionally tilled corn-on-corn in a nearby field. We had an 80-acre field of no-tilled corn that yielded 80 bushel, while a nearby field of corn-on-corn where they had done a lot of tillage, got cut for silage.”
DIVERSIFICATION –
Across South Dakota, we know our soils are different and we recognize that. We have examples through our Voices of people who say that no-till does work on my operation. In Kingsbury County, another with 0-25 percent use of a no-till system. The Weerts Family Farm in Kingsbury County, SD, says “Since we began leaving crop residue in the field and following our wheat with cover crops, we have seen increased organic matter and improved water infiltration,” Steve says. “We’re now working on managing excess water in some of our fields and finding ways to reduce compaction without using tillage.”

Again, with the use of no-till and cover crops, producers are thinking of how they can work WITH Mother Nature.
Joel and Karen Erickson, Marshall County, SD, farmers use a no-till cropping system with diversified crop rotation. Crops include corn, soybeans, wheat, and alfalfa, and the use of cover crops. Joel says that no-tilling saves time, money, fuel, and machinery wear and tear. “All of these financial benefits make a huge difference when the bottom line on crops prices is much lower now. We watched our costs when corn was $7, but you sure need to be even more diligent watching your costs now.”
RESILIENCY – Al Miron, Crooks, SD, is a 25-year no-till farmer operating 1,400 acres in Minnehaha County, SD. Pictured is a cropland field under his management on which he implemented a no-till cropping system eight years ago. Soil tests have shown the soil organic matter in his fields has risen from 2.4 % in 1994 to 4.7 % in 2014. Al has also been conducting infiltration tests and tracking rates.

Prior to advancements in conservation farming technology, many producers had used tillage to prepare seed beds and for weed control. In wetter areas, tillage caused soil compaction.

Now, no-till systems that use diverse crop rotations have become critical for drier areas of South Dakota because of the moisture savings that allows introduction of alternative crops types in the rotation.

Using cropping systems that don’t disturb the soil, that keep the soil covered, that keep roots growing year-round and that use diverse cover crop mixes and crop rotations are the tools that enable our farmers to improve soil health.

Producers across South Dakota are making advanced cropping systems with no-till work, like Bill Nelson who farms in Lake County, Jorgensen Farms in Tripp County and Al Miron in Minnehaha County are demonstrating long-term success and profitability with cropping systems that focus on healthy soil.
RESILIENCE - ECONOMICS – YIELDS
Soil samples in Bill Nelson’s fields in Lake County, SD, show a rich, dark soil with high organic matter (averaging 5- to 6.1 percent). For more than 30 years, the fields have been under no-till with a diversified crop rotation including corn, soybeans, alfalfa, oats, spring wheat, winter wheat, rye, and cover crops.

Nelson adjusts the rotation based on what he feels the soil needs based on visual and soil test results. He believes that the use of a cover crops mixture and small grains has been the key factor why he has fewer weed, disease and insect problems because they build the soil.

For example, 2009-2011 were above average precipitation years in eastern South Dakota. “Like everyone, I was worried about getting in to plant. By waiting, I allowed the soil to function (let the macro pores move the extra precipitation into the soil profile) rather than using tillage to dry the surface. I was surprised when my soil performed well under the planting equipment.” Nelson says, “That’s a good cropping system!”

“We had that big rain on May 5 and I had no erosion and no run-off. Not one field had a problem because the organic matter and good soil structure put that water into the profile.” That sub soil moisture was useful in August. “The no-till cropping system works and I’m happy with the yield results,” he says. “For me, it is my choice and a personal challenge to continue to decrease chemical inputs while getting respectable return. I am seeing better soil structure, better infiltration, an increase in the biological activity in the soil, and more beneficial insects around my fields.”

Let’s build systems that have resilience.
Let’s look at fence line contrasts. Unedited photos from adjacent cropland fields in eastern Brookings County, SD, taken June 19, 2014, after several heavy rain events. Hours before the photos, a thunderstorm left .80 rain on the no-till system (left) and the conventional tillage system (right). The protected field had good soil structure which allowed infiltration while the macro pores in the tilled field were destroyed through tillage leading to major runoff and erosion. Let’s look at HOW we are farming these fields. Is it based on old knowledge, on what we thought was working? The challenge today is to really look at the soils and what is happening – what we are doing to the health of the soil.

Cropping systems impact the health and productivity of soil. Reducing or eliminating tillage not only improves soil health, but can increase fertility, lower long term fertilizer inputs, and save fuel costs. A 50-percent reduction in fuel costs at $2.50/gallon would come to a $8,000 annual savings on the average 1,200-acre farm. Farmers are encouraged to estimate their own fuel savings by using the Energy Tools located at http://energytools.sc.egov.usda.gov. No-till cropping systems can be part of an advanced Soil Health Management System that includes conservation practices such as residue management (no-till), diverse cropping rotations, and cover crops. These practices result in higher levels of soil organic matter and improved microbial activity. Healthy soils are high-performing, productive soils with increased levels of organic matter. Research shows that organic matter builds when tillage declines and plants and residues cover the soil.

Organic matter plays a big role in soil/water interaction. One percent of organic matter in the top six inches of soil holds approximately 16,500 gallons of water per acre. The rate water infiltrates a soil and the amount of water that a soil can hold is higher with increased organic matter. Higher organic matter means less run-off and erosion. It means more plant available water held in the root-zone, and that means more of the crop inputs (fertilizer, etc.) remain with the soil and plants. The adoption of increased residue management practices or no-till systems on additional acres could make a substantial increase in crop resilience due to large swings in seasonal precipitation. Most farmers can improve soil health indicators by keeping the soil covered as much as possible, minimizing soil disturbance, using diverse crop rotations, and cover crops to maximize the time living roots can feed the soil.
Infiltration tests on Enet Soil – under two different cropping systems.

If that inch of moisture falls over extended time, ok, but if that inch falls quickly, then it is likely to be lost in the form of runoff. And, maybe it will cause erosion issues in other areas of the field or the ditch. More importantly, you’ve lost the opportunity to use that moisture to raise a crop.
A landscape example...
By increasing the water absorption of all the cropland in the Mississippi River Basin by just one-half inch (through improved soil quality), that water retention would be the equivalent of...
The amount of water that flows over Niagara Falls in 83 days.

Things that can improve your farm can also impact the watershed – they can have huge impacts on a landscape scale.
Advanced cropping systems include conservation practices such as no‐till, diversified cropping rotations and cover crops.

Cropping systems impact the health and productivity of soil.

This is why NRCS is focusing on helping farmers and ranchers improve the health of their resources.

The health of Soil matters. Healthy soil is the key to the sustainability of our soil and water resources; it’s the key to the productivity, profitability and resiliency of our farms and ranches; and it’s the key to reducing or eliminating any off-site water or air quality impacts of agricultural production.”
Diversified Crop Rotations – photo shows residue in a “biologically active” no-till system with a diversified crop rotation and cover crops seedlings. Good photos of biologically active soil showing residue on the surface as it is decomposing are challenging because people can see it easier than residue that has already been broken down. Our challenge is to develop economical as well as agronomically-sound rotations.
No-till cropping systems appear to go hand-in-hand with diverse crop rotations.

Areas with less diversity in their crop rotation were also the areas with the greatest soil disturbance, i.e., conventional tillage. Areas with the greatest amount of acres under a no-till cropping system also had the greatest diversity in crops grown.
This year, we took a look at diversified crop rotations and the correlation to the cropping systems on a county level. The crops categorized as cool season broadleaf and grasses, and warm season broadleaf and grasses. The Crop rotation diversity on the map is indicated in those counties with three or more crop types relatively equal in percentage.

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More complex rotations mimic nature and reduce development of potential niches for pests and increase soil health. Think back to the map of the cropping systems – see the split of cropping systems and the diversified rotations. On the eastern side of the state, the operations are lacking the diversity. And the west also lacks diversity. How can we raise the same crops in our state but get diversity into those systems.
There is a lot of talk about diversity in cropping systems. This study talks about how U.S. farms are losing diversity. https://www.ksre.k-state.edu/news/news-stories/2015-news-releases/september/crop-diversity091415.html

It’s a challenge for farmers and ranchers, NRCS and our partners to solve.
Here’s an example at the County level in South Dakota. The bar chart shows crop diversity trend for Beadle County, SD. The left is 1985 while the right is 2015. The colors represent crops. When you look at the chart, there was a lot more diversity in 1985 in Beadle County than 2015.
Diversity in Crop Rotations, ...the lost art?
We know there are challenges. We know that cover crops build soil. Research shows that soil managed with the highest diversity of crops in the rotation is also healthier soil.
The distribution of cropping systems across South Dakota, in part, reflects the variation in soils and climate and the crops that are well-adapted to those conditions.

The greatest density in increased use of no-till systems occurred in central South Dakota’s transition zone between the drier western and the more moist eastern areas. This area’s cropping systems are built around a diverse crop rotation of row crops and small grains.

Nature has diversity...
Think how Nature uses plants to capture sunlight and store it in the soil. Residue and cover crops help build soil. We need to capture sunlight every chance we can. There are over 650 different soils across South Dakota and other environmental differences. The important point is that healthy soil looks dark, like moist chocolate cake or black cottage cheese. There is a lot of potential for South Dakota soils to get back to how Nature intended them.
Find Paul Hetland’s profile at www.sd.nrcs.usda.gov, click on the South Dakota Soil Health link.

*Note: All of the South Dakota profiles can be found at that same web page.*
Advanced cropping systems include conservation practices such as no-till, diversified cropping rotations and cover crops.

Another item needs to be added to the list... how can we integrate livestock back to the system?

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Jorgensen Farms manage 16,500 acres in south central South Dakota near Ideal. Their no-till farming system has a diversified cropping rotation with cover crops and livestock. Their crop rotation includes: corn, cane, milo, oats, soybeans, winter wheat and alfalfa with use of cover crops. In the 1990s, Bryan Jorgensen channeled his energy and interest in healthier soil toward a complete overhaul of their operation. “Frankly, our soils are now much more robust and healthy for the direction we’ve taken. Our fields have about 4 percent organic matter and the microbial growth in the soil has increased significantly over the past three decades.” Jorgensen’s nutrient management plan approach has shifted from relying solely on soil test chemical results to now evaluating a combination of soil chemical and biological processes to achieve his yield goals with less inputs. Yield is the proof, but the success of his decisions, he says, lies in the soil.

In 2015, the Jorgensens installed more than 20 miles of new fence on their cropland acres so they could integrate livestock through the use of cover crops.
Soil health concepts work on grazing lands as well as cropland acres.
This is a soil properties study conducted in 2009 on a Barnes soil in Duel County. Note: the overgrazed (invaded with introduced grass species) pasture on the left of the fence and the well managed native grass community on the right. Also very noticeably there is a substantial difference in the soil profile where the native sample has more organic matter deeper in the soil profile.
Pasture management does have a substantial impact on species composition but also soil infiltration rates (5 times faster for the native species) and intern long term productivity was substantially decreased.
What does better rainfall infiltration mean on a landscape scale?

In 2013, NRCS helped Ranchers apply over 80,000 acres of improved prescribed grazing through EQIP.

• It is very reasonable to assume that we will infiltrated 1 additional inch of rainfall with that improved management and the improved soil health that results.

• That amount of water, over 80,000 acres, would fill 264,000 tanker trucks. They would stretch 3,500 miles. It is only 2,800 miles for Los Angeles to New York City.
Integrating livestock to croplands will reduce the pressure on grasslands and help the soil to be more healthy.
We still have a lot of learning to do. Walworth County, 1960s – Don’t lose your Reins (rains). Proper grazing use means more grass – more beef – and less sediment pollution. Pastures are the same slope, soil, rainfall and taxes. Over grazing never pays. This rain was 1.81 inches. On the left, the moisture depth in the hole was 6 inches. On the right, went down 17 inches. If you were going to rent that pasture, which side would you want?
After all this time, we must have all the answers?
A well-designed no-till cropping system with a diversified crop rotation, including cover crops or perennial crops to use the extra water in the soil profile, will also reduce compaction and address salinity issues.

The bigger benefit is that using a diversified crop rotation with cover crops equates to more diversity below the soil’s surface also promoting better soil biological health and productivity.

Agriculture is South Dakota’s #1 Industry. Conservation builds better soil which is the foundation of agriculture and the key to economic growth and potential.
What gives much optimism are the producers who are figuring this out – the Voices for Soil Health are willing to step up with sharing their story. We are learning from them. What would Mother Nature do? There is a lot out there, let’s talk about it.
NRCS is committed to helping you with your operation to make things better, in all aspects. Think long-term.
For more information, contact your local
Natural Resources Conservation Service

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