MOVING TOWARD SUSTAINABLE CROPPING AND GRAZING SYSTEMS

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ABSTRACT

During the 1980's Burleigh County, North Dakota farmers and ranchers historically managed their operations in a traditional manner of tillage dependent cropping systems with simplified rotations, no cover crops, high input costs, and season long grazing. In the early 1990s, the Burleigh County Soil Conservation District Supervisors formed a team and began implementing no-till cropping systems with some crop diversification and simple cover crop mixtures. Native Rangeland was established as their Soil Health template for cropping and grazing systems. Since native rangeland in the northern Great Plains is a sustainable ecosystem with hundreds of species, it made sense to increase their annual crop diversity by using all four major crop types (warm season grass, warm season broadleaf, cool season grass, and cool season broadleaf) and to eventually add high diversity cover crop combinations. In addition, they began cross fencing their pastures and rotating their livestock through several pastures; mimicking the bison grazing characteristics. Additional grazing tools included winter grazing and mob grazing.

Since 2000, through education, observation, trial and error, and sharing information with other farmers and ranchers, the team increasingly recognized the impact their management changes were having on the soil resource and how improved soil health is the key to a successful management strategy. They have continued to build on this foundation of soil health by further intensifying their cropland and grazing management. No-till cropping rotations have been expanded and diversified as a result of inclusion of highly diversified cover crop mixtures, which started in 2006. Additional cross fencing has allowed for better control of time, extended recovery periods and facilitated livestock movements which are closely tied to plant growth/regrowth rates.

INTRODUCTION

The seeds of Burleigh County's soil health transformation were sown in the early 1990s, when a soil health team was formed. The idea really took root, when all five of the soil conservation district supervisors converted to no-till crop production on their operations. Then, in 2006, the stage was set for great gains with the introduction of "cocktail" combination cover crops, the switch from 3-4 pasture rotation systems to 25-30 pasture systems, and the integration of livestock into cropping and cover crop systems.

The team decided 20 years ago they needed a change. The all agreed they could no longer accept a degraded soil resource. The team wanted their soil to do much more than simply hold up a growing plant. They came together and began educating themselves on soil health, one natural resource concern at a time. They looked at how to build organic matter, then how to

reduce soil compaction and how to get the soil to hold more water. No-till expert Dr. Dwayne Beck and soil biology expert Dr. Kris Nichols are also on the team, along with others.

METHODS

Adding annual crop diversity, cover crops, and rotationally grazed livestock to our cropping and grazing systems resulted in changes to our soils. Different methods of measuring progress have been used over the years. Tracking soil organic matter improvements from individual farmer's yearly soil test results has been one of the more common methods, along with increased rangeland carrying capacity. Tracking changes in this manner has worked out well for conservation planning needs. In addition, three methods with more field specific information were also used in this soil health overview:

First – Bulk Density, which is an indicator of soil compaction. It is calculated as the dry weight of soil divided by its volume; which includes the volume of soil particles and the volume of pores among soil particles. Bulk density is typically expressed in g/cm3. All bulk density results were completed by North Dakota Natural Resources Conservation Service.

Second – Solvita, which is a measurement of the carbon dioxide emissions from the soil, and are primarily due to microbial respiration. Higher levels of carbon dioxide indicate healthier and more fertile soils, than lower level emissions. All Solvita tests were completed by Ward Labs, Kearney, Nebraska.

Third – Haney Soil Tests, which in addition to the standard inorganic soil test information, also offers the organic nutrient data. This test is especially important for nutrient management and water quality resource concerns. All Haney Soil Tests were completed by Ward Labs, Kearney, Nebraska.

RESULTS AND DISCUSSION

Direct Impacts

70% of the Burleigh County farmers have transitioned from mechanical tillage and summer fallow to a successful no-till cropping system based on soil health. All achieved an increase in soil organic matter over a 12 year period.

25% of the farmers and ranchers use cover crops to connect the cropping and grazing systems together with livestock.

60% of the ranchers use a rotational grazing system.

10% of the county operators never changed.

Indirect Impacts

Reduced fertility rates for both corn and wheat regarding long term no-till, was brought forward by North Dakota State University.

Additional Soil Health positions have been added by both North Dakota State University and the Natural Resources Conservation Service.

Additional Discussion:

Minimizing soil disturbance allows us the opportunity to sequester more carbon, which in turn builds pore spaces and soil aggregates, which allow us to hold more water and nutrient in our soils. Recognizing that tillage and erosion have degraded our soils, and ultimately this is our opportunity to build back our soil aggregates (the pore space we are missing). Further allowing

our soils to function in their full capacity, by once again being better able to exchange gas, hold water and nutrient, and allow the soil biology to travel in their environment.

We can start by leaving residue (soil armor) on the soil surface on farms where it is not the tradition or custom, allowing us to reduce wind and water erosion. Expanding diversity will allow us to decrease our pesticide use (herbicides, insecticides, and fungicides). Lowering our commercial fertilizer use by moving from monoculture cropping (i.e. continuous corn) to crop rotations with all four crop types, will result in more balance in our soils and our diets.

How do we integrate cover crops and livestock into our cropping plans? Livestock are a tool to manage crop residue and increase plant carbon dioxide intake, we must come to the understanding that livestock can harvest a portion (usually about half) of the cover crop and/or the annual crop residue, but the other portion is the soils armor and a food source for the soil biology. The cover crops provide a continuous live root, providing a preferred food source for the soil biology and mimicking our native grazing lands. Moving livestock from the feedlot to a more grass finished environment will allow for lower energy equivalents per pound of beef and the slaughter of a healthier critter.

SUMMARY

Moving Toward Sustainable Cropping and Grazing Systems, illustrates one counties soil health journey from a simplistic landscape to a more complex landscape.

As we move toward landscape simplicity our soils degrade and require more disturbance and fossil fuel inputs. Such as: tillage, season long grazing, cropping systems with only one or two crop types, and no use of cover crops or livestock integration. This simplicity results in soil degradation. Such as: soil compaction which does not allow rainfall to be completely absorbed by the soil profile, thereby producing runoff containing topsoil and nutrients; excessive use of fossil fuel inputs resulting in soil acidification and offsite chemical loss, and questionable nutrient density in our food; and of course, a reduction in soil organic matter. Water quality issues and erosion are well documented in our nation's rivers, lakes, and even our drinking water.

As we move toward complexity we can build soils in our cropping systems, grazing systems, and gardens by minimizing soil disturbance, providing armor (litter), using all four crop types and cover crops, and integrating livestock diversity (cattle, sheep, hogs, poultry, etc). We need to build soils based on soil health foundation principles, which will result in improved levels of carbon in our soils.

Recognizing the significance of soil health resulted in a fundamental change in the team's management philosophy. They base their management decisions on improving soil health by managing the cropping enterprises, livestock, and grazing, so each compliments and enhances the other. The link in this integration of a diversified no-till cropping system with intensively managed grazing has been the addition of highly diverse cover crop mixtures. The farmers and ranchers incorporated the cover crop mixtures into their no-till systems to enhance the soil health foundation consisting of: soil aggregates, crop diversity, soil organic matter, nutrient cycling, surface litter, moisture management, pest management, water quality, wildlife, and livestock forage. These diverse cover crop mixes serve as a bridge between the livestock and cropping enterprises, resulting in improved soil health which has reduced input costs and enhanced economic returns.

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