

**Project Title:** Soil Health/Soil Biology Training for the Northern Plains

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**Legal Name of Organization to which Award was made:**

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**Primary Grantee's Tax Identification Number EIN#:** 45-6002439

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**Partner Organizations:** None

**Project Start Date:** 10/1/2012

**Project Duration:** 6 months (3/31/13 end date)

**Total Budget Requested from NC-SARE:** \$49,000

## **Summary**

Funds from NC-SARE were used to increase the knowledge of county agents, NRCS personnel, conservation district folks and producers in the area of soil health. The education series was initiated with a field tour addressing crop rotations, reduced tillage, soil biology and salt-affected soils. Followed by six workshops offering training on salinity, land reclamation, setting up on-farm trials to improve soil health, and crop and rangeland soil health. Overall, 45 hours of face-to-face training were offered to a total of 500 attendees in a period of five months.

## **Introduction**

Progressive producers in the Dakotas are experimenting with diverse cover crops in their cropping systems to determine if they would be helpful in increasing the efficiency of nutrient inputs, decreasing the need for herbicide applications and increasing soil health characteristics, which would enhance productivity for grain production and grazing. Improved soil health due to increased microbiological activity is promoted as a reason for the use of cover crops, yet soil biology is not well understood by most agricultural professionals. This project we trained NRCS district conservationists, soil conservations, Extension educators, Soil Conservation District supervisors, technicians and watershed coordinators, two and four-year agriculture college instructors, and high school Vo-Ag teachers in advanced principles of soil health in both classroom and in field exercises. Outcomes from these trainings included:

1. Increased awareness of soil health and soil biological roles in improved agricultural sustainability.
2. Increased understanding of soil health principles for their improvement.
3. Synthesis in understanding cropping as a system that includes natural cycles for improvement of crop input efficiencies and reduced reliance on fertilizers and pesticides.
4. Instructional components that can be taken and used by the attendees to incorporate and use in their educational programs to farm producers and the public.

## **Objectives/Performance Targets**

The first training sessions for the Soil Health/Soil Biology Training for the Northern Plains were well-received by the attendees as indicated in their responses to the post-meeting surveys and shared in the 2011 report of activities. There are several items,

however, that were indicated in the surveys as still being weakly understood. These less understood items were:

1. Cover crop species characteristics that might make them more or less favorable for a particular farm.
2. Deeper understanding of soil biology and the roles that different types of organisms contribute to soil health characteristics.
3. Cover-crop grazing and its contribution to soil health characteristics.
4. Deeper understanding of nutrient cycling by residues, organic matter and cover crops.
5. Including economics in discussion of soil health.
6. In-field exercises to increase the understanding of soils and soil health characteristics.
7. Packaging of exercises and training so that attendees could more easily share the concepts with their audiences of generally lower soils education level.

Each of these items was addressed in workshops held in North Dakota.

## **Materials and Methods**

A diverse group of soil scientists and practitioners from NDSU campus, NDSU Minot North Central R&E Center, NDSU Langdon R&E Center, NDSU Carrington R&E center, Hettinger R&E Center, USDA-ARS at Mandan, USDA-NRCS, the North Dakota state conservation districts and area consultants conducted the trainings. Where available, producers were included in the trainings to provide field sites and local experiences using soil health improving management techniques. NDSU Extension provided the organizational expertise for coordinating training in North Dakota. The partnerships fostered by these trainings will likely lead to additional research and educational projects in future years.

Training sessions lasted from 1-2 days, depending on the nature of the training. Training sessions were developed around the curriculum topics outlined in the Environment and Audience section previously listed (for outline of workshops, see below) as well as issues of regional interest. The short-term outcome of these workshops was a deeper understanding of soil health, implications of cropping systems and tillage practices, nutrient cycling/fertility, techniques to demonstrate soil health and economics of improved soil health (see results). The following is a list of training opportunities and topics offered:

**October 31, 8:00 – 3:00:** Soil Health Tour, CCSP Farm, Forman, ND. Topics covered: reduced tillage, salinity, rooting depth, cover crops, tile drainage, soil biology and structure, water movement. Tour of highlights of the CCSP farm south of Forman, including soil pits and use of cover crops; two fields on the Joe Breker farm near Rutland, including use of fall cover crops in a strip-till system were visited with in-door afternoon program presentations provided.

**December 6, 9:45 – 3:00:** Soil Health In Service Workshop, Langdon Research Extension Center, Langdon, ND. Topics covered: salinity, sodicity, soil sampling strategies, cover crops, suitability of soils for tiling, water control using tile drainage.

**January 29, 9:45 – 3:00:** Soil Health in North Central ND, North Central Research Extension Center, Minot, ND. Topics covered: holistic understanding of soil health, interpreting a soil test, salinity management, prairie pothole region soil dynamics, oil development impacts on soil health, coal mine reclamation and soil health.

**February 12, 10:00 – 3:30:** Soil Health Concepts and Success Stories, Carrington Research Extension Center, Carrington, ND. Topics covered: soil health, long-term management, demonstrations you can use for soil health, using a soil pit to tell a story, hosting successful field tours and workshops for soil health, obtaining funding through SARE, building relationships, addressing soil health using in-field trials.

**February 26, 8:15 – 4:45:** Reclamation – Bringing Ideas Together, Biesiot Activity Center at Dickinson State University, Dickinson, ND. Topics covered: soil formation and health, seed mixes, cover crops, restoration of pipeline projects, weeds, topsoil replacement depths.

**March 12, 9:30 – 3:30:** Whole-Systems Approach to Management, Carrington Research Extension Center, Carrington, ND. Topics covered: the basics on soil testing, analyzing and interpreting results, designing trials for cropping systems, weed and pest pressures, soil fertility and biology.

**March 19-20, starting at 1:00 on the 19th:** Soil Health and Land Management in SW ND, Hettinger Research Extension Center, Hettinger, ND. Topics covered: soil health, salinity and sodicity, cropping systems, rangeland systems, multiple land use, history of fire, integrated management systems.

Intermediate outcomes to be evaluated in Fall 2013 are that the target audience will incorporate soil health principles into their educational programming. This outcome will be enhanced by providing packaged curriculum of some of the concepts for use by attendees. Educators will begin to incorporate their newly gained knowledge of soil health principles into their recommendations and educational programs that are delivered to growers and the public. They will see that soil is a system that includes a major biological component and the healthiest crop/grazing systems are those that address the biological status of the soil as well as inputs for the sustainability of a profitable farming operation.

Long-term outcomes will be to have producers use long-term management to increase the efficiency of inputs by addressing soil health principles of increased crop diversity, soil biological diversity and more continual vegetative cover. In doing so, the producers ensure that the public will have a sustainable and healthy food supply for future generations to enjoy.

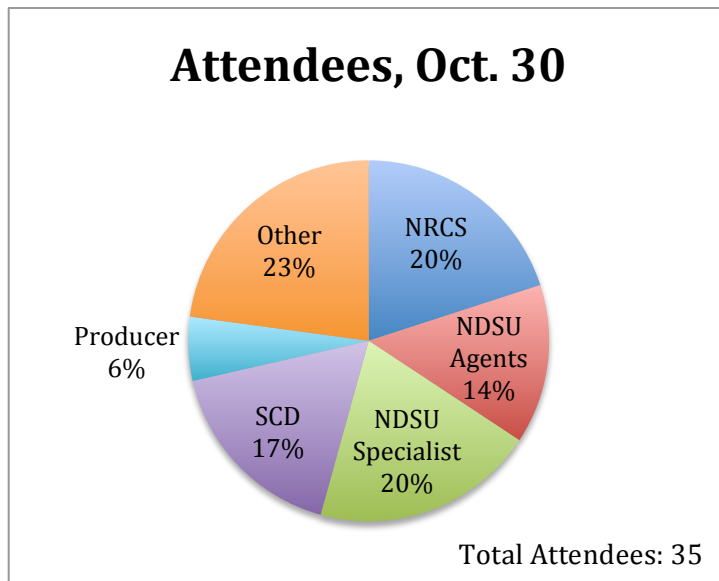
An evaluation specialist at NDSU, Myron Eighmy, was utilized to devise training assessments to use both during the educational programs and a post-training follow-up. These evaluation tools have been constructed to address the needs of past attendees as listed in Logic Model number 1 shown previously.

Short-term outcomes were assessed at the meeting and we achieved our goal of having 90% of the participants leave with a greater understanding of the principles than they did coming to the event. Our goal for intermediate level evaluation would be to have at least one-half of the participants incorporate some portions of the programs into their educational programs. Long-Term Evaluation was not possible during the length of the proposal.

## Results and Discussion/Milestones

### October 30, 2012 Field Tour Results:

At this field tour, we had a good distribution of educators in attendance and the tour was generally well received. We were able to touch on a variety of topics from management approaches (reduced tillage, soil amendments and cover crops) to the basics of soil health (salinity/sodicity, water movement, organic matter, aggregation and soil biology). We received excellent questions related to using manure applications to build aggregation and available organic matter pools as well as identifying the difference between saline and sodic soil conditions in a tile drained field.



#### **Comments:**

“Today was well worth the drive and time. I especially enjoyed seeing Joe Brecker’s farm and talking to him about what he had done with cover crops. Great job putting everything together” – Tim Dritz, Producer

“We really enjoyed the tour” – Renee Schlosser, SCD

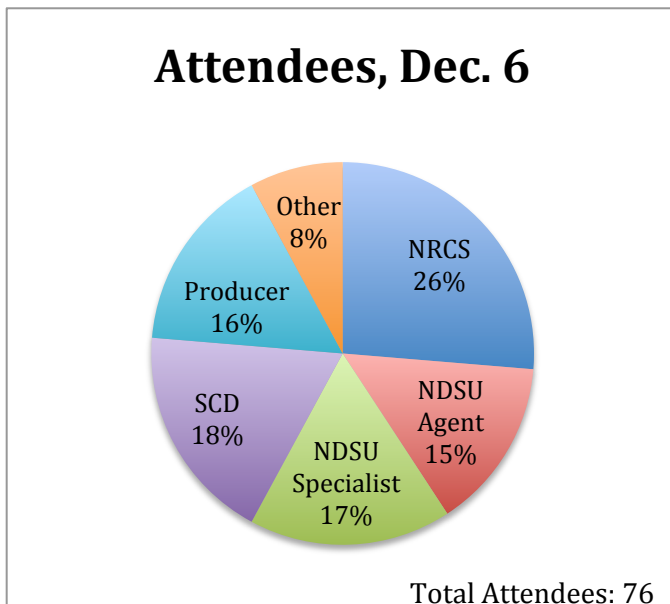
“I very much enjoyed the health tour in Sargent County” – Jason Goltz, County Agent

<i>Question</i>	<i>Average Score (scale 1-10)</i>
Please Circle the number that best represents your perception of knowledge regarding <i>SOIL HEALTH BEFORE</i> attending todays Soil Health Tour on a scale of 1 to 10. A rating of 1 means little or no knowledge while 10 means you could probably teach the course.	6.14
Please Circle the number that best represents your perception of knowledge regarding <i>SOIL HEALTH AFTER</i> attending todays Soil Health Tour on a scale of 1 to 10. A rating of 1 means little or no knowledge while 10 means you could probably teach the course.	7.43
Please Circle the number that best represents your perception of knowledge regarding <i>Soil Salinity/Sodicity BEFORE</i> attending todays Soil Health Tour on a scale of 1 to 10. A rating of 1 means little or no knowledge while a 10 means you could probably teach the course.	5.71
Please Circle the number that best represents your perception of knowledge regarding <i>Soil Salinity/Sodicity AFTER</i> attending todays Soil Health Tour on a scale of 1 to 10. A rating of 1 means little or no knowledge while a 10 means you could probably teach the course.	7.14

**December 6, 2012 Workshop Results:**

This workshop was also well received and attended by a variety of educators and producers. Because of the location, we were able to include experts from Manitoba in the lineup of speakers as well as several specialists from NDSU Main Campus. We addressed topics ranging from tile drainage to other management approaches for building soil health and managing water (cover crops). A video review of this workshop as well as presentations can be viewed at the following website:

<http://www.ag.ndsu.edu/langdonrec/soil-health/in-service-soil-health-workshop-2012>



**Comments:**

“Excellent information” –producer

“How are agronomic employees being trained in soil sampling strategies?” – NRCS

“Need more info on grazing cover crops” – SCD

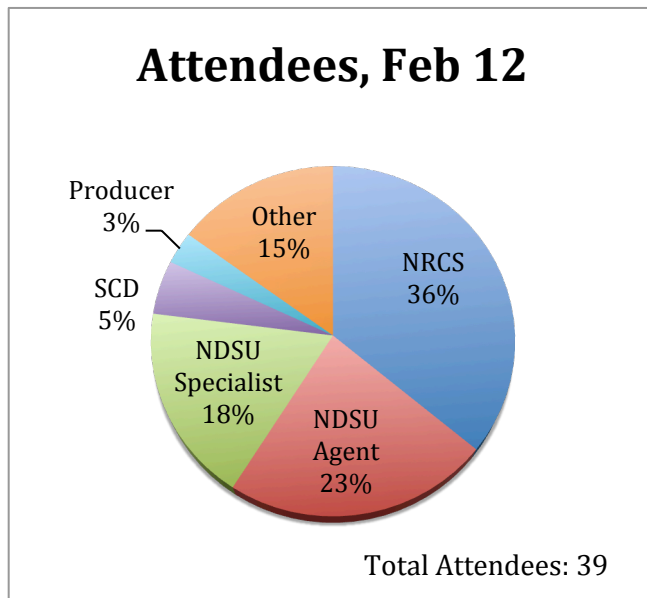
“Don’t agree with tiling, but appreciate the sodic soil topic. People never hear about this part”

### **January 29, 2013 Workshop Results:**

Though the evaluation data and attendee distribution are not shown, we again had an excellent turnout for this workshop (50 attendees) despite the poor weather conditions. We were able to touch upon a range of topics of regional interest and provide basic information on interpretation of soil tests. Getting the most out of a soil test and proper interpretation of the results is an area that we have identified as a weakness of most educators and producers. We hope to build upon this area with circulars and videos to encourage adequate and meaningful zone soil sampling followed by appropriate analyses to answer important management questions.

### **February 12 Workshop Results:**

We took the approach of providing the necessary tools for educators to start the discussion of soil health with producers. This workshop was very interactive! Attendees walked away from this workshop with tools that could be implemented in programs and ideas about where to get funding to support demonstrations in their areas or counties. Specifically, we had Bill Hodous (County agent, Ramsey County, Devils Lake) talk about opportunities for funding through ND SARE programs. We hope to evaluate how these tools were used in summer programs with a level 2/3 survey this fall. On a personal note, I can already see NDSU Extension county agents who attended that workshop utilizing the salinity demos we showed and have asked for “soil health demo boxes” to be distributed to their district offices for their use in programs. They have also been enthusiastic about initiating demonstration sites related to salinity in their counties, creating a network of sites with a consistent soil health message across 10 counties.



#### **Comments:**

“Creative”

“Very usable to agents”

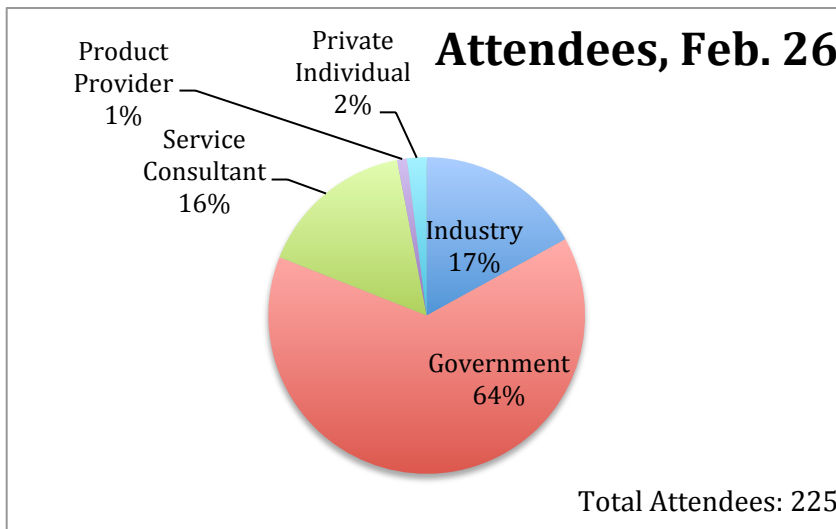
“Consider getting programs approved for CCA credits”

**Topics covered in the workshop are expressed in the evaluation below:**

<i>Question</i>	<i>Average Rating (scale 1-5)</i>
How would you rate your understanding of soil health <i>prior</i> to the start of this workshop?	2.7
How would you rate your understanding of soil health <i>after</i> to the start of this workshop?	3.7
How comfortable do you feel hosting a soil health workshop or field tour <i>prior</i> to this workshop?	2.2
How comfortable do you feel hosting a soil health workshop or field tour <i>after</i> to this workshop?	3.5
How would you rank your ability to use demonstrations related to soil health <i>prior</i> to this workshop?	2.0
How would you rank your ability to use demonstrations related to soil health <i>after</i> to this workshop?	3.3
How would you rank your ability to interact with producers concerning soil health <i>prior</i> to this workshop?	2.4
How would you rank your ability to interact with producers concerning soil health <i>after</i> to this workshop?	3.3
How likely are you to attend another soil health workshop?	4.7

**February 26, 2013 Workshop Results:**

This workshop took a different approach to educate on reclamation approaches to a booming industry in North Dakota (oil). Soil health was a major component of this workshop, where we included presentations titled “It starts with soils” and “Achieving soil health with reclamation”. This workshop will be an annual event, hosted the last week in February. We are in the planning process for the 2014 meeting where additional soil topics will be discussed from regulatory, science and practical application points of view. We anticipate another great turnout in 2014 (in excess of 250).



Comments:

“The sky is the limit! There is much to talk about and it’s hard to go wrong in terms of topics that get discussed”

“Provide examples of what has and hasn’t worked in ND”

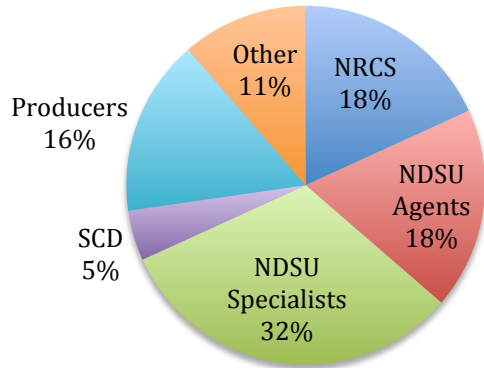


<i>Topic</i>	<i>Average Rating (Scale 1-10)</i>
Soils	
pre-workshop	6.45
post-workshop	7.39
Seed Mixes	
Pre-	6.39
Post-	7.45
Weeds	
Pre-	6.84
Post-	7.61
Reclamation in general	
Pre-	6.5
Post-	7.63

### **March 12, 2013 Workshop Results:**

This workshop was developed around the idea of setting up meaningful on-farm trials to evaluate “whole systems”. We discussed not only soil health, but also statistics disguised as an “M&M” experiment where we assigned meaning to the colors found in each bag of M&M candy. This was well received and some people made the comment that this was the first time that they understood replication and statistical significance in studies. We also discussed whole system approaches to management, variability in soil biology, soil fertility recommendations, agronomy trials, adjuvant screening for herbicide applications, and rangeland evaluations. This workshop was also well attended considering icy road conditions. We are using a similar approach in topics for a field tour we will be hosting on August 22, 2013, where a suite of specialists (soil scientists, entomologists, plant pathologists, weed scientists, economists, agronomists) will address topics related to primary soil health issues of salinity and sodicity.

## Attendees, March 12



Total Attendees: 44

### Comments:

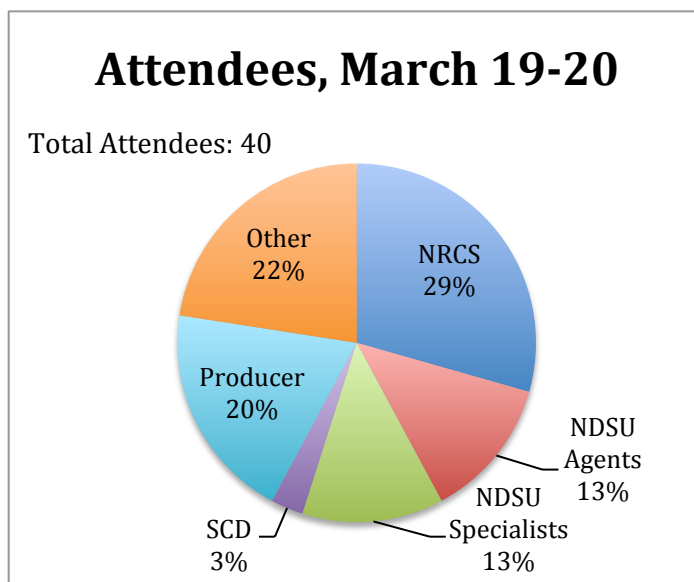
“This was good because it was something different”

**Topics covered in the workshop are expressed in the evaluation below:**

Evaluation	Average
How would you rank your understanding of variability in agricultural systems <b>prior</b> to the start of this workshop?	3.4
How would you rank your understanding of variability in agricultural systems <b>after</b> attending this workshop?	4.2
How would you rank your understanding of important linkages in agricultural systems <b>prior</b> to the start of this workshop?	3.2
How would you rank your understanding of important linkages in agricultural systems <b>after</b> this workshop?	4
How would you rank your understanding of the following <b>prior</b> to the start of this workshop?	
<i>biological variability</i>	3.2
<i>fertility trials</i>	3.2
<i>herbicide trials</i>	3
<i>cropping system trials</i>	3.2
<i>livestock-crop evaluation</i>	3
How would you rank your understanding of the following <b>after</b> attending this workshop?	
<i>biological variability</i>	3.9
<i>fertility trials</i>	3.8
<i>herbicide trials</i>	4
<i>cropping system trials</i>	4
<i>livestock-crop evaluation</i>	4.1

### March 19-20, 2013 Workshop Results:

We held a two-day workshop to address soil health topics in crop and rangelands in southwest ND. Most of the people attending the first day of the workshop returned for the second day of the workshop. We also had several producers that attended, which added value to the workshop through questions asked and their perspective on issues. This workshop was very interactive with a lot of discussion and questions. We hosted a dinner on day one of this workshop, which allowed for time to interact. In the future, we would try to have the presenters stay for this dinner to allow for more one-on-one conversations (which was a comment we received). This is another workshop that we plan to hold in 2014 because of the turnout and interest in the topics presented.



### Comments:

“Good selection of speakers – good info”

“I really enjoyed the talks on soil health”

“Have presenters stay longer for more one-on-one conversations”

“I would like to see some cover crop work (with statistics). I have heard lots about how good cover crops are, but have seen very little actual scientific data on the topic”

<b><i>Day 1 Questions, SW North Dakota workshop:</i></b>	<b><i>Average</i></b>
How would you rank your knowledge of the following general soil health topics <b>prior</b> to attending this workshop?	
<i>general soil health</i>	3.2
<i>salinity and sodicity</i>	2.6
How would you rank your knowledge of the following general soil health topics <b>after</b> attending the workshop?	
<i>general soil health</i>	4
<i>salinity and sodicity</i>	3.6
How would you rank your knowledge of the following cropping systems topics <b>prior</b> to attending this workshop?	
<i>soil biology/cover</i>	3.2
<i>soil moisture/crop water use</i>	2.9
<i>weed pressures</i>	2.9
How would you rank your knowledge of the following cropping systems topics <b>after</b> attending the workshop?	
<i>soil biology/cover</i>	3.9
<i>soil moisture/crop water use</i>	3.7
<i>weed pressures</i>	3.8
<b><i>Day 2 Questions:</i></b>	<b><i>Average</i></b>
How would you rank your knowledge of the following land management topics <b>prior</b> to attending this workshop?	
<i>public grazing</i>	2.6
<i>oil development reclamation</i>	2.4
How would you rank your knowledge of the following cropping systems topics <b>after</b> attending the workshop?	
<i>public grazing</i>	3.4
<i>oil development reclamation</i>	2.8
How would you rank your knowledge of the following rangeland topics <b>prior</b> to attending this workshop?	
<i>wildlife habitat</i>	3.1
<i>grazing management in drought</i>	2.8
<i>rangeland dynamics</i>	3.1
How would you rank your knowledge of the following rangeland topics <b>after</b> attending the workshop?	
<i>wildlife habitat</i>	3.5
<i>grazing management in drought</i>	3.4
<i>rangeland dynamics</i>	3.6

## **Impact of the Results/Outcomes**

We will evaluate how the information is used in programs and practices in the fall of 2014 due to the short duration of the grant. Evaluation will be made with funds from a USPA-319 grant supporting Soil Health education and demonstration activities. We are confident that information presented in these workshops was valuable to the attendees based on the turnout we had for each workshop, even during inclement weather and poor road conditions. For example, we had a producer travel 600 miles round trip to attend a workshop and it was fairly common to have attendees drive in excess of 200 miles round trip to attend workshops. We were clearly attracting more than just regional people to our workshops, which indicates both the need for and the interest in topics presented at the soil health workshops. We plan to expand upon these trainings with thoughtful and timely topics to build the soil health knowledge base of educators in the state.

## **Economic Analysis**

N/A

## **Publications/Outreach**

We developed and published a technical brochure intended to assist educators convey the meaning and significance of salinity and sodicity using funds from this grant. A website has also been developed, where this brochure can be accessed and which will be the platform for posting videos relating to salinity, sodicity and its prevention and remediation. Using feedback from the survey and evaluations of these workshops, we also intend to write an extension-related manuscript for publication to a wider audience in the next year. We are also using the questions that were asked during the trainings to guide the materials we produce for extension publications. The website address is:

<http://ndsusoilhealth.com/>

## **Farmer Adoption**

As a result of our efforts from October to March, we have seen an increase in awareness of salt-affected areas and soil health topics across the state. Some producers are following our guidance on avoided tilling of saline areas in a field to reduce evaporation and transport of salts to the surface (October 30 Field Tour, December 6 workshop). Additionally, I know of some producers and extension agents who are experimenting on-farm in a more meaningful way with practices that build soil health (March 12 workshop). Because it is difficult to measure change in producer practices and knowledge, we are in the process of designing a “baseline” survey for management practices and soil health knowledge in the state. We will use this survey to measure our success in the transfer of information and trainings throughout the state in subsequent

years (i.e. year five, ten and fifteen after the ND Soil Health Initiative was put in place in 2012).

Recommendations to producers for building soil health (biology) are generally the following: reduce disturbance and increase crop diversity. We have shown this approach during our field day in October (which was well attended by both educators and producers) by visiting the CCSP No-till demonstration farm in Forman and a producer field where cover crops and no-till are utilized.

Recommendations to producers related to management for salinity and sodicity include water management (via crop water use, reduced tillage and drainage options), zone management (growing salt-tolerant crops such as wheat and sunflower in salt-affected areas and nutrient management for saline areas), and use of tools such as the web soil survey to better develop management strategies based on soil type.

## **Areas Needing Additional Study**

We need to continue our efforts training educators in North Dakota on soil health issues. County agents, area specialists and other educators are interested in soil health issues and want to be able to provide the needed support to guide producers in effective land management strategies. The background of a typical county agent in North Dakota is in animal sciences or agronomy with a limited understanding of soil related topics. Providing continued education on soil health is essential to the development of county level staff and ultimately reaching producers in the most effective way. Continued education could focus on topics such as soil salinity and sodicity as well as soil biology with an integrated approach to whole systems management for these soil properties.