United States Department of Agriculture

Marlon Winger,
NRCS, Soil Health Division

CEMA 204: Adaptive Management for Soil Health

Citizen science for soil health management systems

Natural Resources Conservation Service

nrcs.usda.gov

USDA United States Department of Agriculture

Adaptive Management for Soil Health

- Adaptive management is a process to collect, monitor, analyze, learn from results, and adjust the application of conservation practice over multiple seasons.
- The goal of the adaptive management approach is to test and evaluate how a practice can best be applied on a given farming operation or site condition.
- Land uses: Crop, Forest, Pasture, Range
- Replicated plots with T test or ANOVA statists
  - Applicable to a producer that is already using a given practice but may be looking to improve the effectiveness of the practice.
  - Applicable to a producer using a practice for the first time to learn how best to apply that practice on their own unique landscape and their management style.

Photo courtesy of Nathan Hicklin, TN

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Adaptive Management for Soil Health

- Agronomy Technical Note No. 10
- Direction is to coordinate w/ state technical specialist to collaborate on proposed projects.
- Implement conservation practices according state's practice standard(s), Implementation Worksheet(s), etc.


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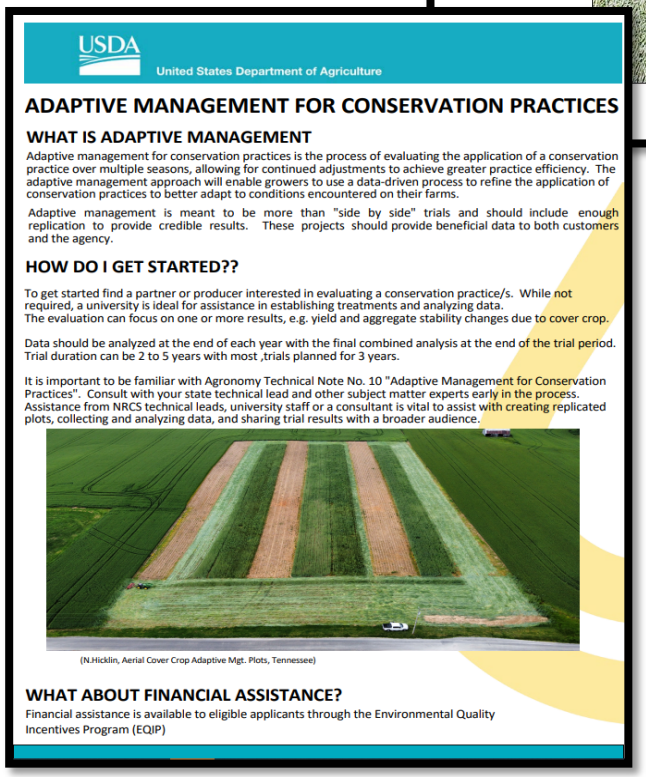
July 2014

Agronomy Technical Note No. 10

Adaptive Management for Conservation Practices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ADAPTIVE MANAGEMENT FOR CONSERVATION PRACTICES

WHAT IS ADAPTIVE MANAGEMENT

Adaptive management for conservation practices is the process of evaluating the application of a conservation practice over multiple seasons, allowing for continued adjustments to achieve greater practice efficiency. The adaptive management approach will enable growers to use a data-driven process to refine the application of conservation practices to better adapt to conditions encountered on their farms.

Adaptive management is meant to be more than "side by side" trials and should include enough replication to provide credible results. These projects should provide beneficial data to both customers and the agency.

HOW DO I GET STARTED??

To get started find a partner or producer interested in evaluating a conservation practice/s. While not required, a university is ideal for assistance in establishing treatments and analyzing data.
The evaluation can focus on one or more results, e.g. yield and aggregate stability changes due to cover crop.

Data should be analyzed at the end of each year with the final combined analysis at the end of the trial period. Trial duration can be 2 to 5 years with most ,trials planned for 3 years.

It is important to be familiar with Agronomy Technical Note No. 10 "Adaptive Management for Conservation Practices". Consult with your state technical lead and other subject matter experts early in the process. Assistance from NRCS technical leads, university staff or a consultant is vital to assist with creating replicated plots, collecting and analyzing data, and sharing trial results with a broader audience.

(N.Hicklin, Aerial Cover Crop Adaptive Mgt. Plots, Tennessee)

WHAT ABOUT FINANCIAL ASSISTANCE?

Financial assistance is available to eligible applicants through the Environmental Quality Incentives Program (EQIP)

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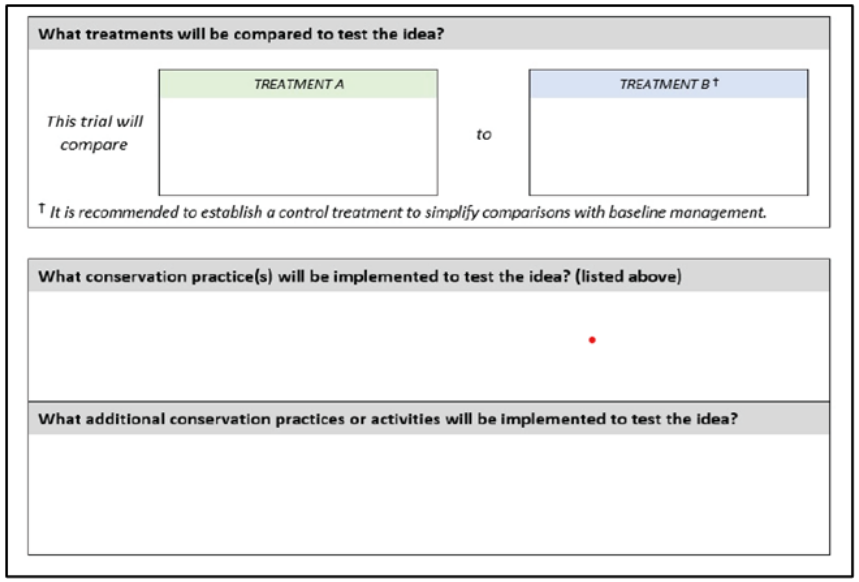
Adaptive Management for Soil Health Proposed Practices:

- Conservation practices that impact soil health.
- Minimum 3-years participation
- Monitoring throughout season

311 Ally Cropping	345 Residue and Tillage Management, Reduced Till
314 Brush Management	379 Forest Farming
315 Herbaceous Weed Treatment	381 Silvopasture
328 Conservation Crop Rotation	420 Wildlife Habitat Planting
329 Residue and Tillage Management, No Till	484 Mulching
336 Soil Carbon Amendment	528 Prescribed Grazing
338 Prescribed Burning	550 Range Planting
340 Cover Crop	590 Nutrient Management

CEMA 204 Supportive Documents

- T Test Statistical Tool
- Design Sheet for Planning
  - Documents Hypothesis, Planning of project
  - Developed by Chad Cochrane, NH
- FAQ document for planners
  - Reviews basic planner questions



What treatments will be compared to test the idea?

This trial will compare	TREATMENT A	to	TREATMENT B†

† *It is recommended to establish a control treatment to simplify comparisons with baseline management.*

What conservation practice(s) will be implemented to test the idea? (listed above)

What additional conservation practices or activities will be implemented to test the idea?

Frequently Asked Questions

CEMA 204 Adaptive Management for Soil Health

How do you define CEMA 204 and what land uses are applicable?

The Evaluation and monitoring of soil health management strategies to inform conservation planning. Land uses include Crop, Forest, Pasture and Range lands.

When would a producer consider implementing CEMA 204 on their operation?

The soil health adaptive management concept is applicable to growers that are already using a given practice but may be looking to improve the effectiveness of the practice or can be useful for a producer using a practice for the first time to learn how best to apply that practice on their own unique landscape and their management style.

What is a strength or positive outcome of an Adaptive Management for soil health?

Producers don't have to totally rely on an offsite Meta analysis of data to determine on farm comparative research, they can utilize the context of their own operation to help make farm decisions. Adaptive management using the on-farm field trials protocol enables growers to make well-informed and documented decisions on how to adjust their management to be more profitable and sustainable. The protocol helps the grower establish and test a hypothesis in consideration of the biological processes taking place in their fields. The process provides an analytical method for determining if a significant difference occurred between the existing and proposed treatments.

What or who is a qualified Individual for this CEMA?

A QI for Adaptive Management for Soil Health CEMA 204 is one of the following:

T-test used to compare two treatments and determine if the means are significantly different from each other

- **Identify the Significance level (Alpha) 0.05, 0.1, 0.3**
  - 0.05 is 95% confidence level that there is a statistical difference
- **Stats tool will calculate Least Significant Difference (LSD)**
- **Use Analysis of Variance (ANOVA) if comparing more than two treatments**

Document each treatment in the sections below.

TREATMENT A	*TREATMENT B*

Variable Measured: _____

Unit of Measurement: _____

Significance Level (Alpha)

The alpha indicates the level of confidence that the data are significant and not due to chance.

Significance Level (Alpha): 0.05 **95% Confidence Level**

***t*-Test Data Entry** Clear Data Table

Replication No.	*TREATMENT A*	*TREATMENT B*	Difference (C)	Deviation (D)	Deviation²
1	24	36	-12.00	-4.75	22.56
2	25	32	-7.00	0.25	0.06
3	29	34	-5.00	2.25	5.06
4	25	30	-5.00	2.25	5.06
5					
6					
7					
8					
9					
10					
Averages	25.75	33.00	-7.25	**LSD:**	5.25

Results

The data indicate the differences between the treatments are: **SIGNIFICANT**

This analysis is based on a 95% Confidence Level

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Adaptive Management for Soil Health

Principles of Soil Health: minimize soil disturbance, maximize soil cover, biodiversity, and presence of living roots

Focus is on soil health indicators:

Biological: respiration, enzymes

Chemical: organic C, pH, WEOC, WEON, POXC

Physical: aggregate stability, available water holding capacity, infiltration

Minimum, measure/analyze soil organic carbon by dry combustion, pH, and wet macro-aggregate stability in addition to characteristics identified in the purpose of the conservation practice being evaluated

Photo: Nathan Hicklin, TN

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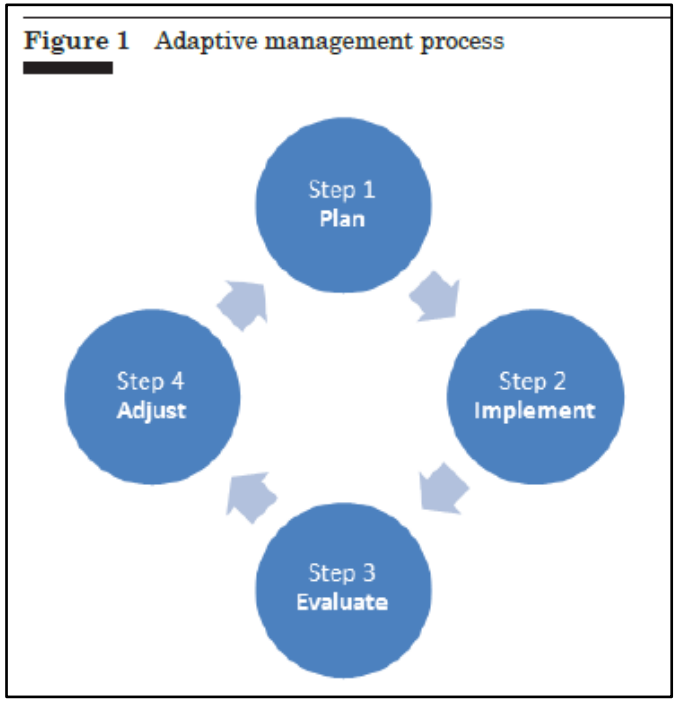
Qualified Individual for CEMA 204

- **Certified Crop Advisor (CCA) or Certified Professional Agronomist (CPAg) through the American Society of Agronomy.**
- **A Certified Professional Soil Scientist (CPSS) or Associate Professional Soil Scientist (APSS) through the Soil Science Society of America.**
- **An Extension Specialist from the Land Grant University or is affiliated with an institution of higher learning with a focus on agriculture, range, or soil science.**
- **Holds a bachelor's degree or higher in an agricultural, range, forestry, or soil science field with at least 2 years of experience using the scientific process to answer questions. This includes experimental design, data collection, and analysis.**

Starting the Adaptive mgt Process

1. Start with an idea (hypothesis) and make it a statement:
   - *No-till planting will improve soil organic matter and aggregate stability and reduce fuel consumption.*
2. Design the experiment – replicated plots, resources needed, data to be collected
3. Collect data to evaluate hypothesis
4. Evaluate and 'learn' from the results
5. Adjust management based on results



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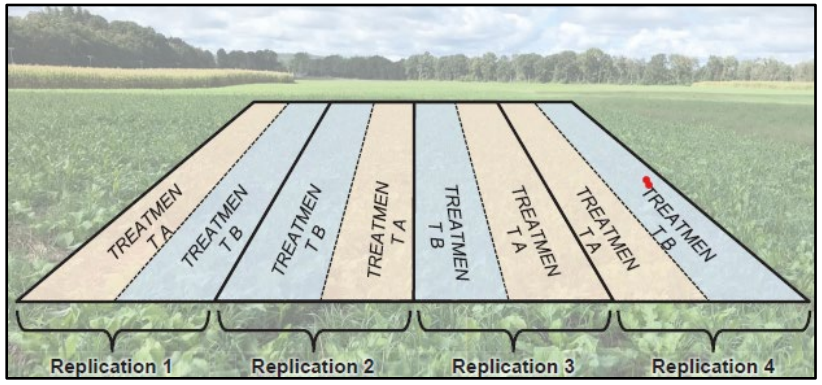
Replication of Plots

- **Select locations that are uniform (soils, mgt history)**
- **Minimum of 3 replications of each treatment**
  - Randomized plots
  - Two treatments = 6 plots
  - 4 replications suggested, 3 is adequate
  - Consider size of planting / harvesting equipment
  - Size ranges from 5 to 15 acres, but opportunity is size neutral
  - Not paid by replication but by the comparison type project



Other Considerations
Payment Schedules

Utah	Utah EQIP-1	204	Adaptive Management for Soil Health	Basic with Soil Health Test	No	$3,057.58
Utah	Utah EQIP-1	204	Adaptive Management for Soil Health	HU-Basic with Soil Health Test	No	$3,669.10

Adaptive Management for Soil Health Team

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- Willie Durham, SHD Regional SH Specialist
- Joe Williams, SHD West Team Leader
- Candis Williams, SHD National Specialist
- Betsy Dierberger, National Agronomist (ESD)
- Laurie Schoonhoven, National Forester (ESD)
- Nathan Hicklin, District Conservationist – Tennessee
- Aaron Hird, State Soil Health Specialist – Nebraska (previously)
- Kate Parson, Resource Conservationist – Massachusetts
- Christine Newton, State Agronomist – Colorado
- Keela Deaton, District Conservationist – Wyoming
- Chad Cochrane, District Conservationist – New Hampshire

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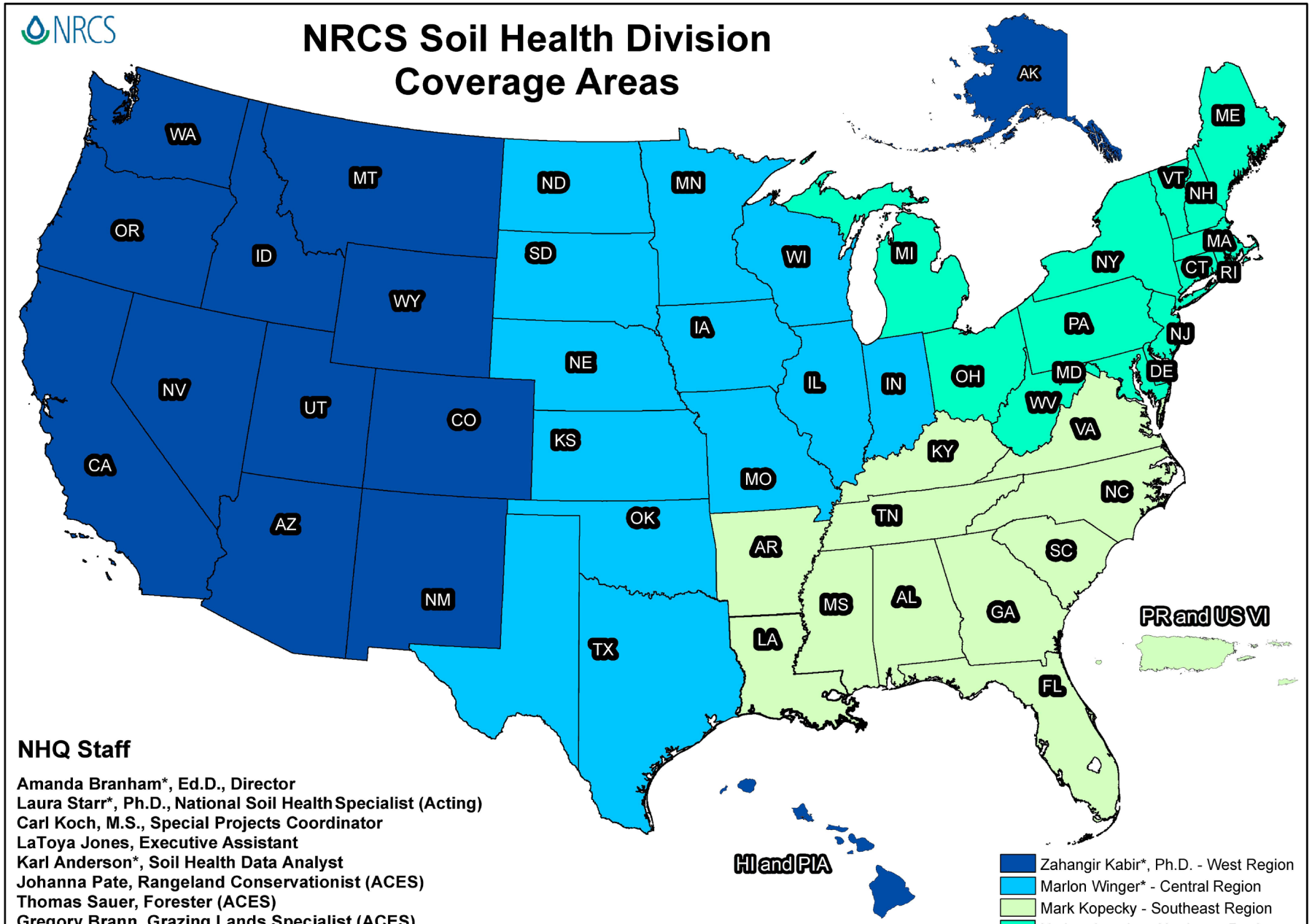
NRCS Soil Health Division Coverage Areas



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