FOTC 2015 Fertilizer Outlook & Technology Conference

Bianca Moebius-Clune

Director
NRCS Soil Health Division

Bringing Science, Production, and Conservation Together

The Fertilizer Institute
Nourish, Replenish, Grow

Fertilizer Industry Round Table

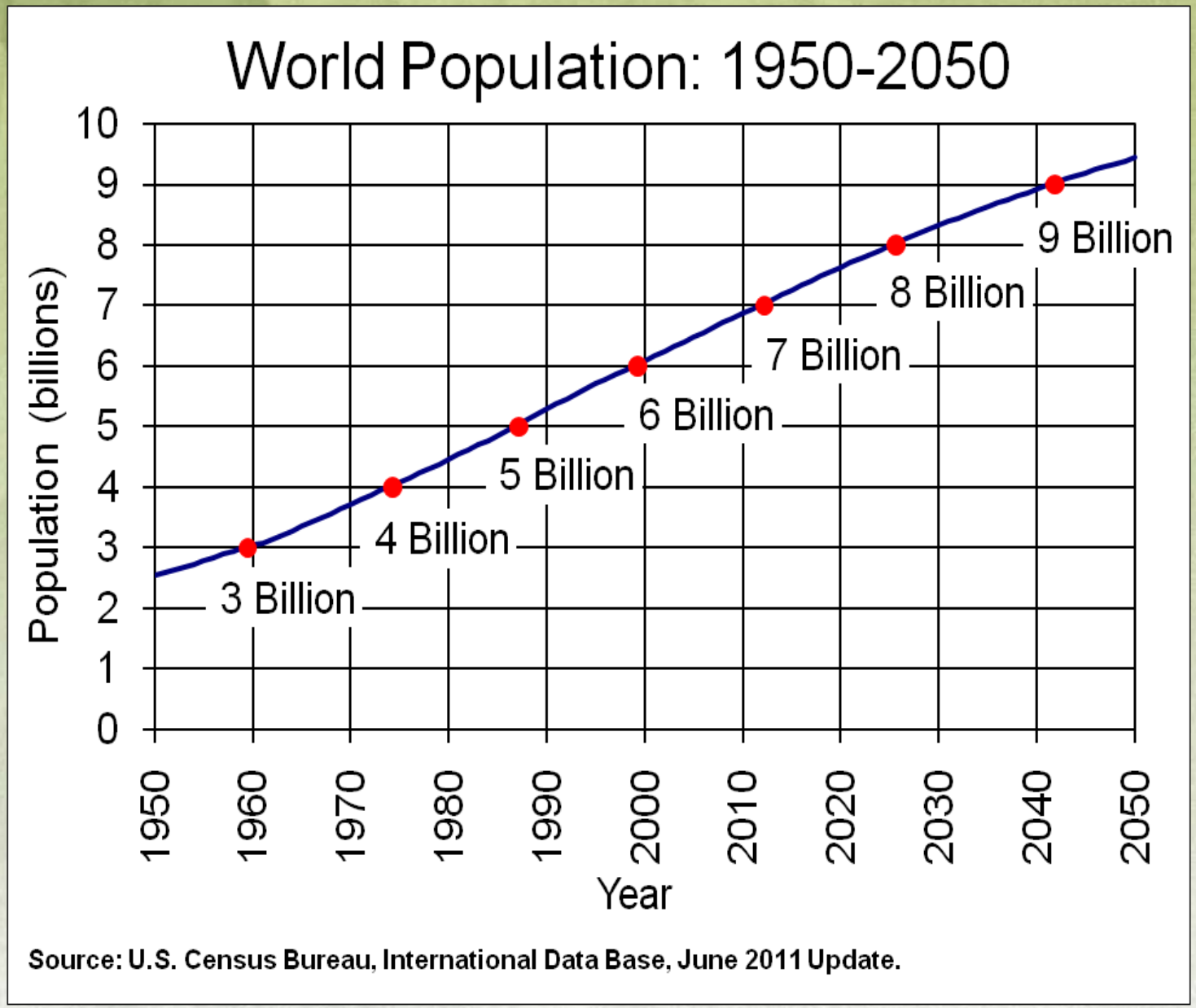
Bringing Science, Production, and Conservation Together for Better Soil Health

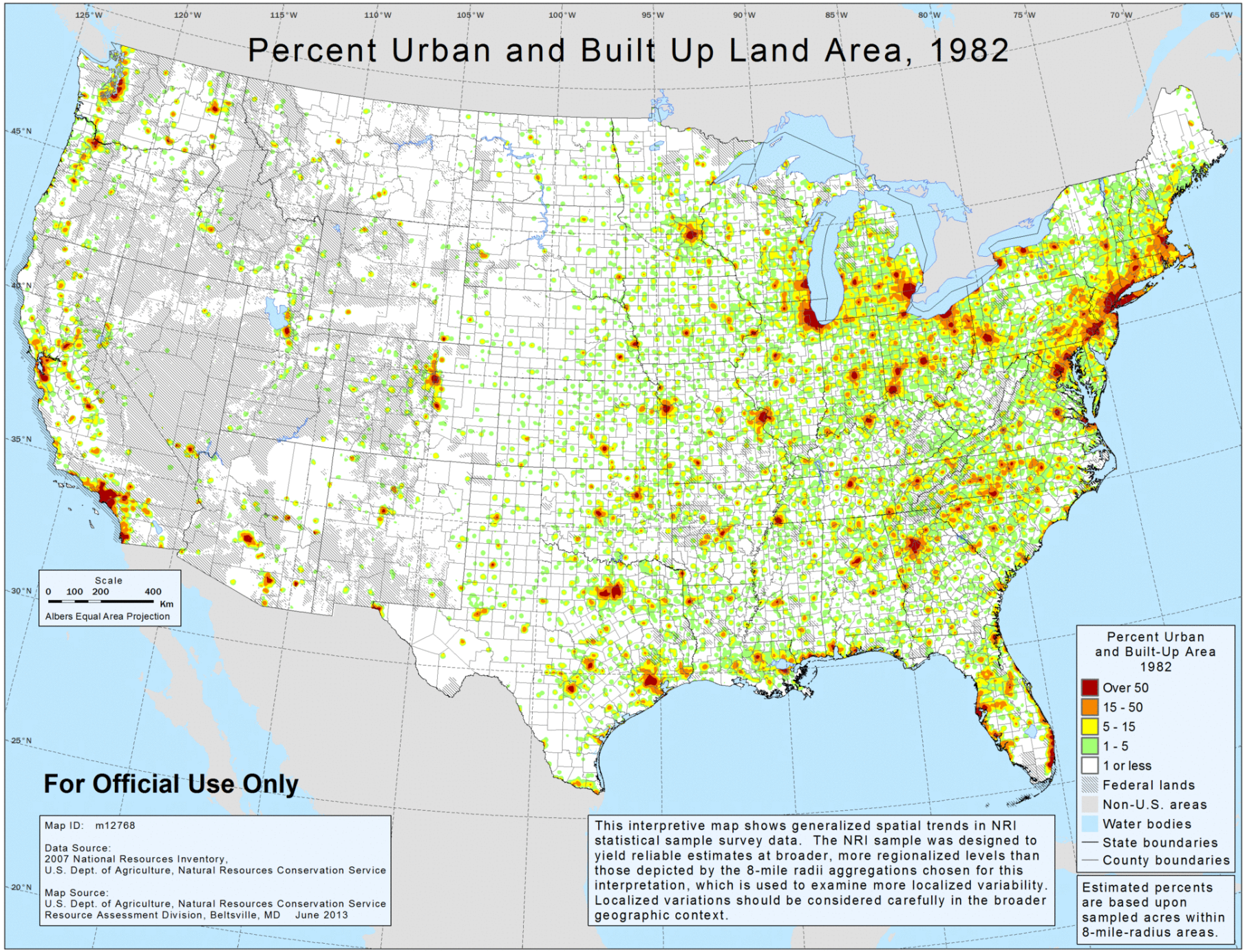
Bianca Moebius-Clune, Ph.D.
Director, Soil Health Division
USDA-NRCS
Washington, DC

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

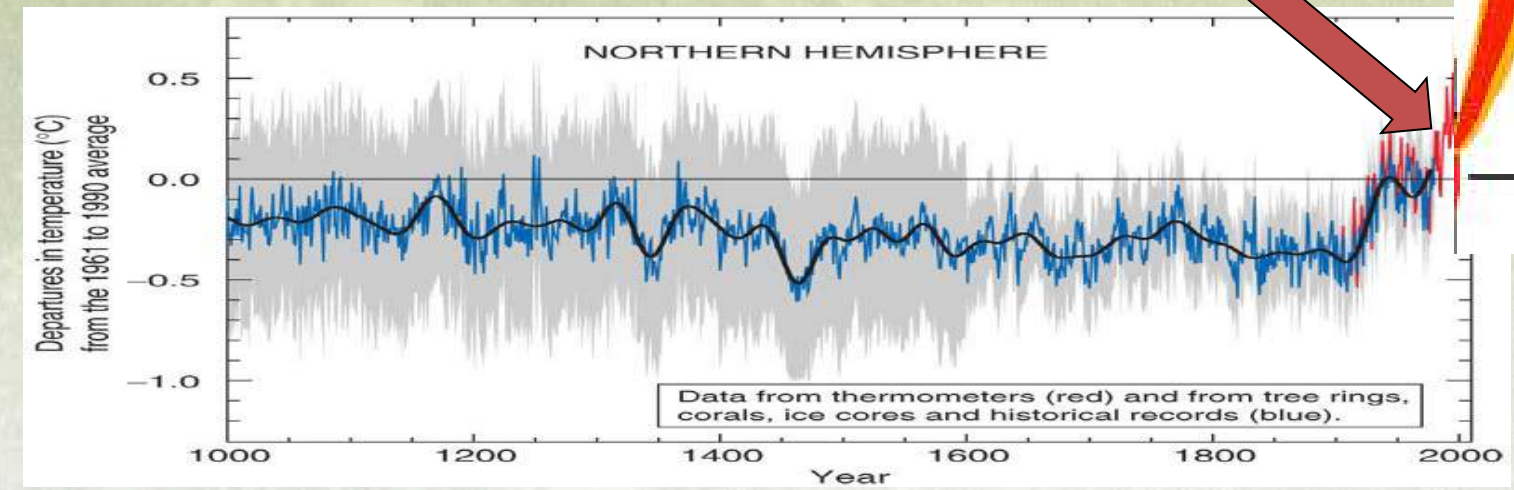
Our Challenges

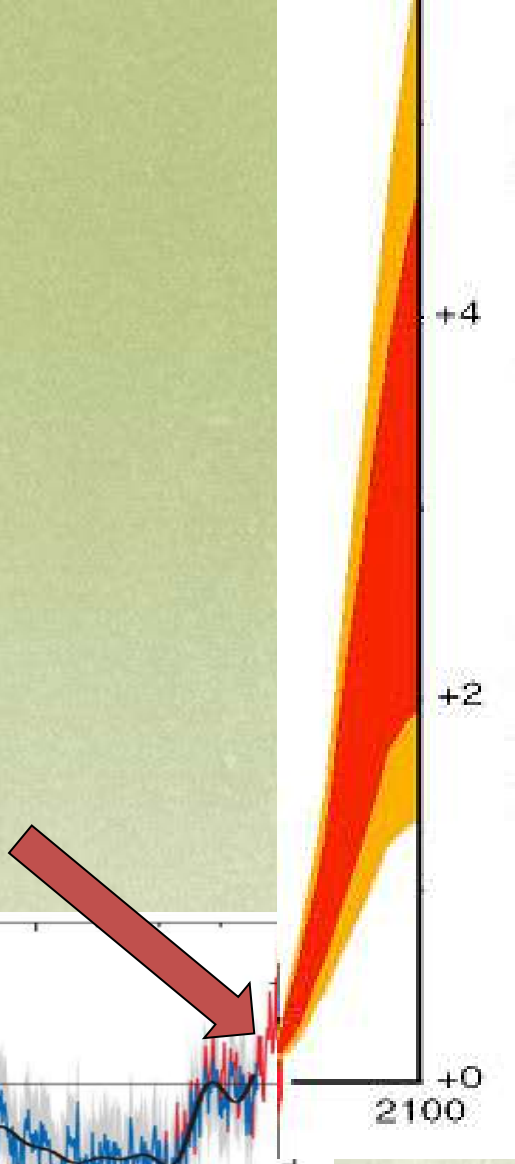
Feeding the population on a shrinking available land base




Percent Urban and Built Up Land Area, 1982
125°W
120°W
115°W
110°W
105°W
100°W
95°W
90°W
85°W
80°W
75°W
70°W
65°W
45°N
40°N
35°N
30°N
25°N
20°N
Scale
0 100 200 400
Km
Albers Equal Area Projection
Percent Urban and Built-Up Area 1982
Over 50
15 - 50
5 - 15
1 - 5
1 or less
Federal lands
Non-U.S. areas
Water bodies
State boundaries
County boundaries
Estimated percents are based upon sampled acres within 8-mile-radius areas.
For Official Use Only
Map ID: m12768
Data Source:
2007 National Resources Inventory,
U.S. Dept. of Agriculture, Natural Resources Conservation Service
Map Source:
U.S. Dept. of Agriculture, Natural Resources Conservation Service
Resource Assessment Division, Beltsville, MD June 2013
This interpretive map shows generalized spatial trends in NRI statistical sample survey data. The NRI sample was designed to yield reliable estimates at broader, more regionalized levels than those depicted by the 8-mile radii aggregations chosen for this interpretation, which is used to examine more localized variability. Localized variations should be considered carefully in the broader geographic context.

Increasing Temperature

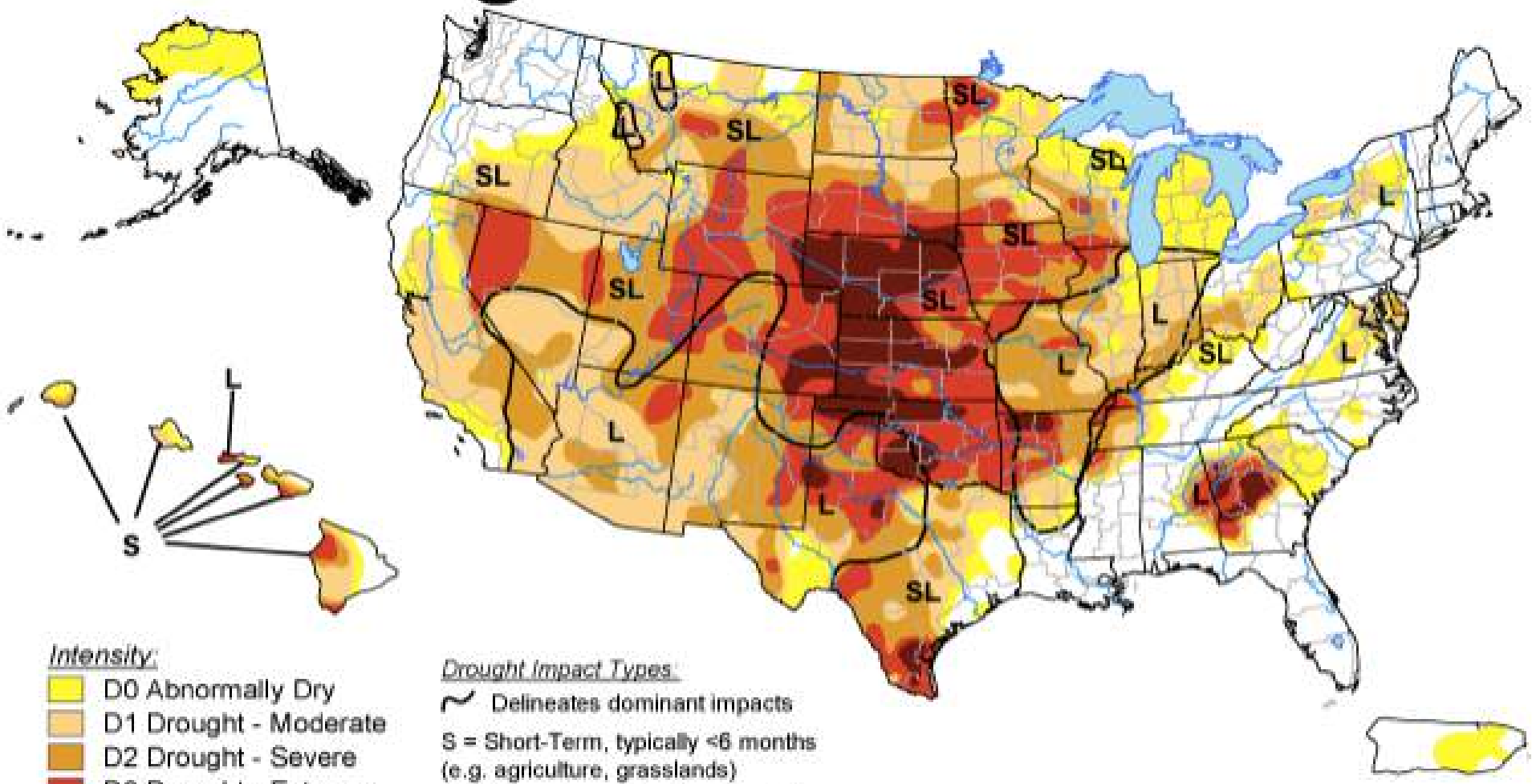




Adapted from Hayhoe 2011

U.S. Drought Monitor

September 25, 2012
Valid 7 a.m. EDT



Intensity:
- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

Drought Impact Types:

~ Delineates dominant impacts

S = Short-Term, typically <6 months (e.g. agriculture, grasslands)

L = Long-Term, typically >6 months (e.g. hydrology, ecology)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://droughtmonitor.unl.edu/

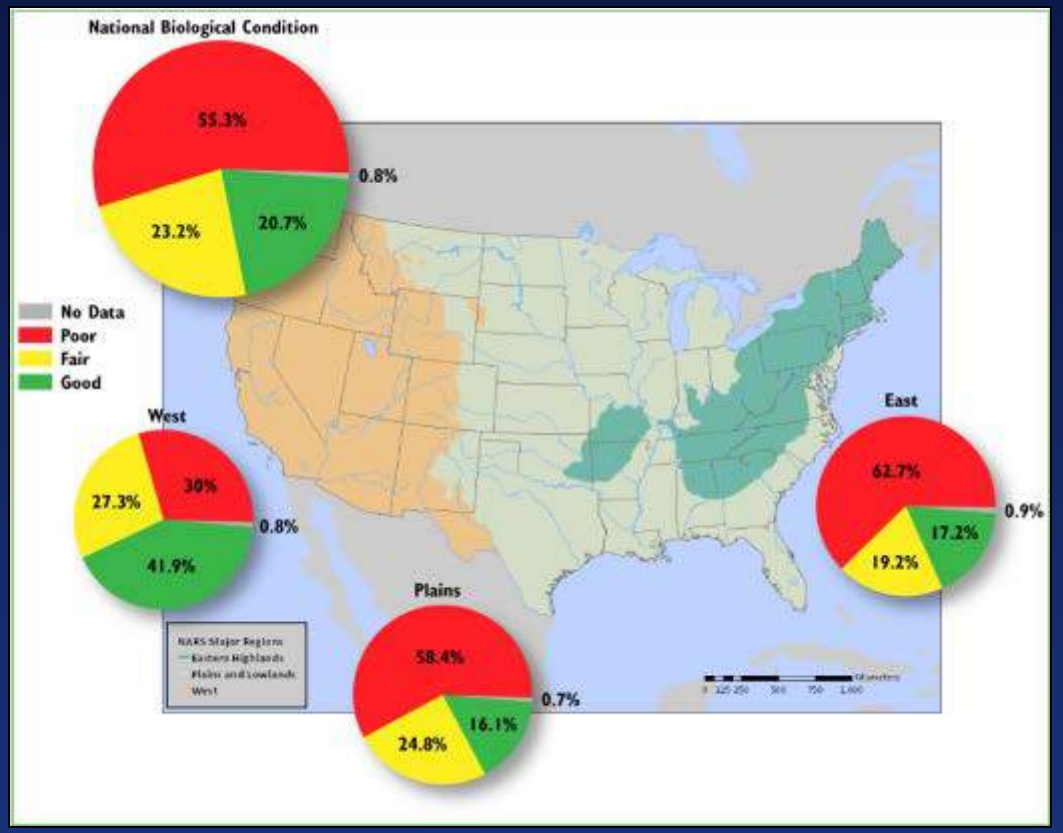
Released Thursday, September 27, 2012

Author: Anthony Artusa, NOAA/NWS/NCEP/CPC

unlock the SECRETS IN THE SOIL

National Water Quality Challenges

- Biological conditions of nation's rivers and streams
  - Poor - 55.3%
  - Fair – 23.3%
  - Good – 20.7%
  - Unknown – 0.8%
- Greatest stressors:
  - Phosphorus
  - Nitrogen
  - Riparian cover and disturbance
  - Streambed sediment
  - Enterococci



Biological condition of the nation's rivers and streams, based on the Macroinvertebrate Multimetric Index. From National Rivers and Streams Assessment (2008–2009) (EPA, 2013.)

Our Win-Win Opportunities

Feed ourselves, improve profits,
AND improve the environment!

Soil Health: the continued capacity of the soil to function

as a vital living ecosystem that sustains plants, animals, and humans

Infiltration - Brookings County, SD


No Cover
With Cover Crop

2011: Resilience to extreme weather

unlock the SECRETS IN THE SOIL

After Hurricane Irene

Cornell Willsboro Research Farm, NY

NT NT NT NT NT NT NT NT

Photos: Daniel Moebius-Clune, Sep-Oct '11

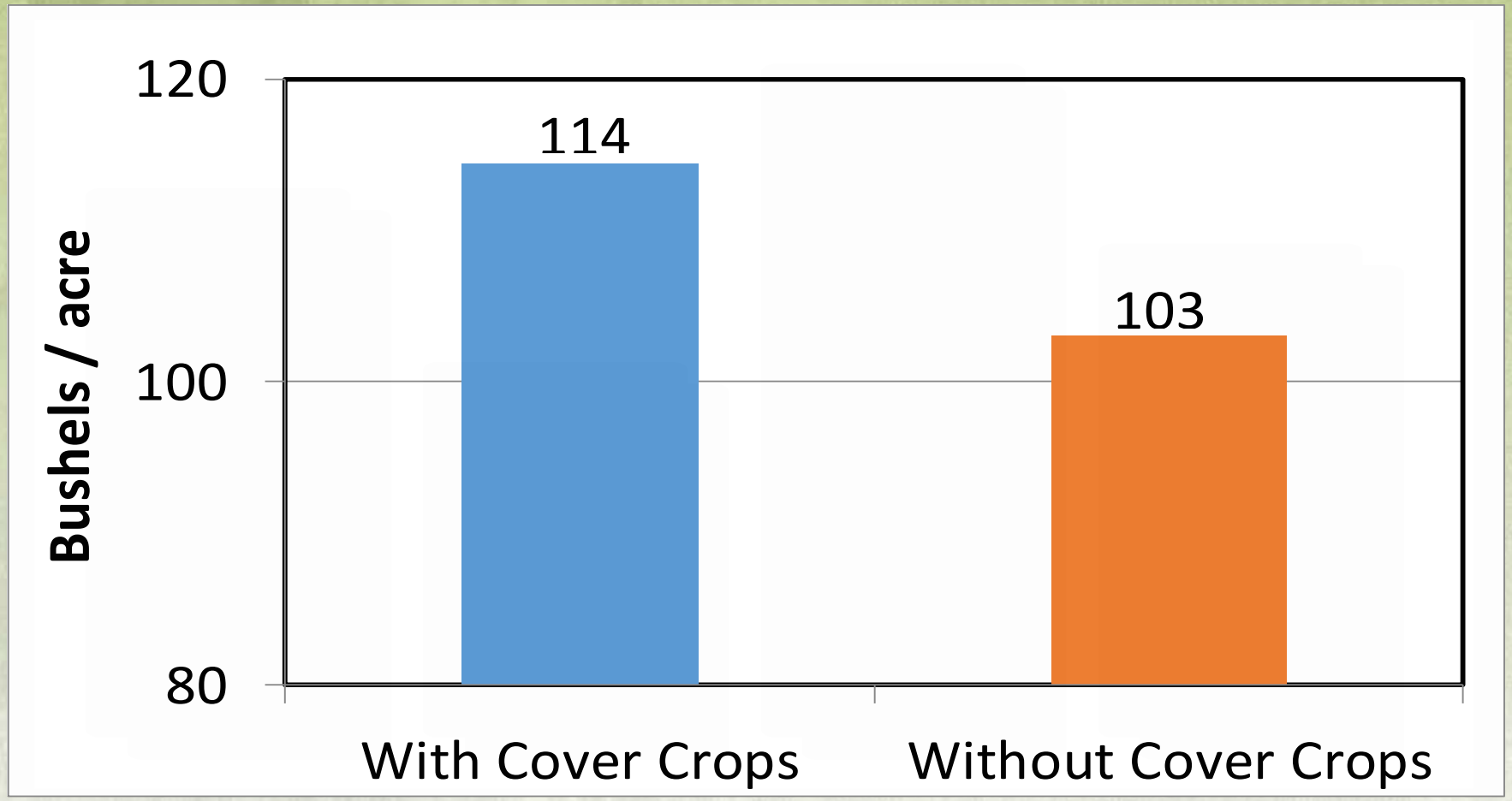
Conventional
Potato System

Soil Improving
Potato System

Honeycutt et al., 2007; Maine ARS

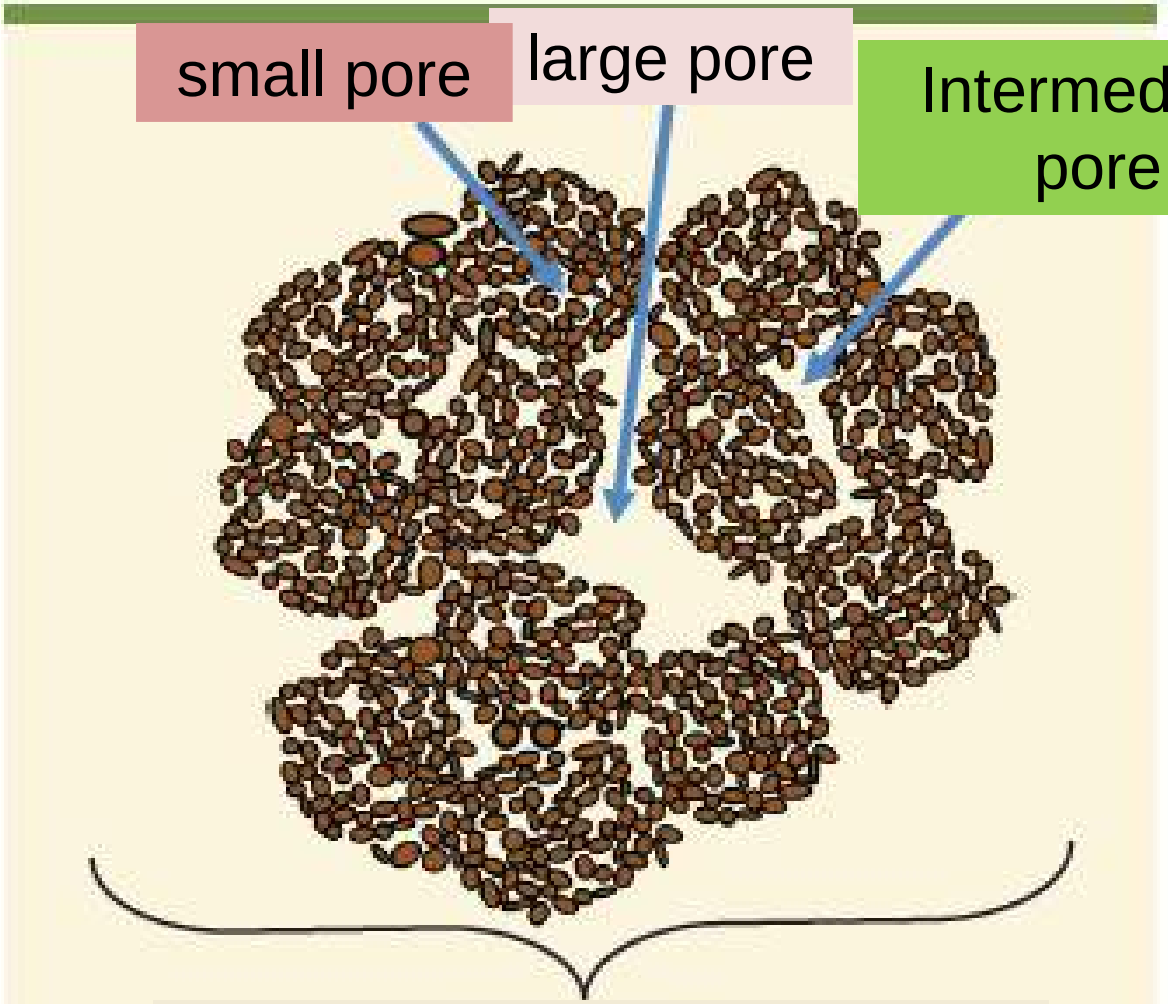
USDA-SARE, CTIC Survey 2013

2012 Corn Yield, Drought States

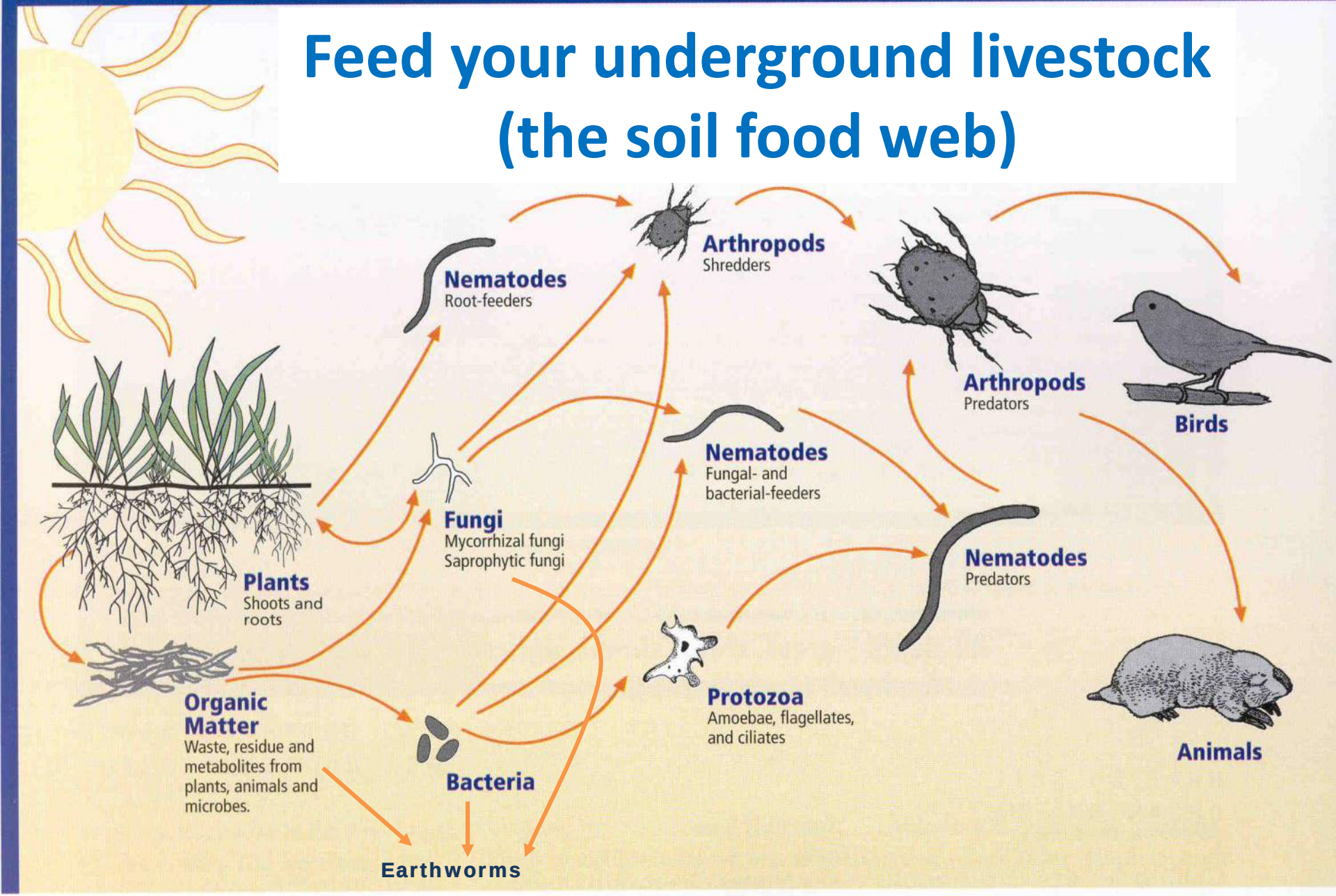


An Aggregate is like a House

The interesting stuff is going on in the "empty" spaces!



Feed your underground livestock (the soil food web)



First trophic level:	Second trophic level:	Third trophic level:	Fourth trophic level:	Fifth and higher trophic levels:
Photosynthesizers	Decomposers Mutualists Pathogens, Parasites Root-feeders	Shredders Predators Grazers	Higher level predators	Higher level predators

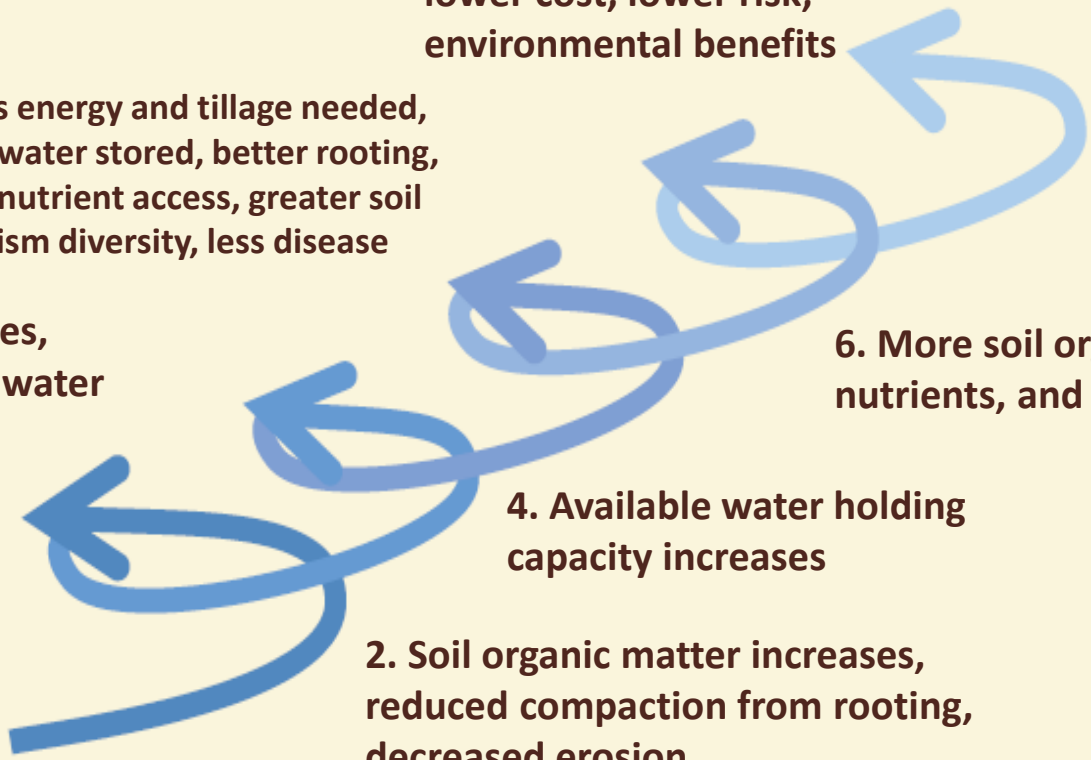
Downward Spiral of Soil Degradation

in annual systems

1. Intensive tillage, insufficient added residues, low diversity, no surface cover
2. Soil organic matter decreases, erosion, subsoil compacted
3. Aggregates break down
4. Surface becomes compacted, crust forms
5. Infiltration decreases
   Erosion by wind and water increases
6. More soil organic matter, nutrients, and top soil lost
7. MORE ponding & persistent wetness, but LESS soil water storage; less rooting; lower nutrient access by plants; less diversity of soil organisms, more disease
8. Crop yields decline
9. Hunger and malnutrition, especially if little access to inputs

Modified from *Building Soils for Better Crops*

WIN-WIN Regenerative Soil Health Management Systems for Healthy Soils



Modified by Dr. Bianca Moebius-Clune and Dr. Dorn Cox from *Building Soils for Better Crops*

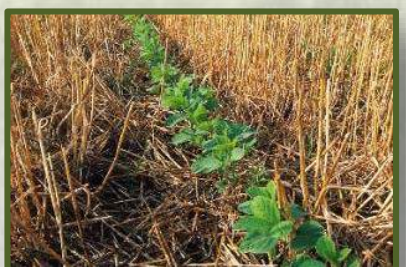
Return on our Nation's Soil Health Investment

Changing the Face of Agriculture and How We Feed our Nation

BENEFITS

- Nutrient cycling
- Pest suppression
- Carbon sequestration and energy savings
- Water infiltration
- Less runoff, erosion, flooding
- Water storage and availability
- Resilience
- Biodiversity, groundwater, clean water and air …
- Long-term economic viability
- Sustained reliable productivity – to feed 9 billion

Photos: NRCS and Dorn Cox, 2012



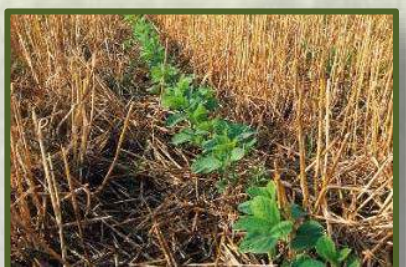
What's in Soil Health for the Fertilizer Industry?

- Higher productivity → greater nutrient uptake
- Lower risk of crop and soil loss
  - lower risk of nutrient loss to the environment
  - Reduced regulatory risk
- Opportunities to expand services to
  - **Other products:** cover crop seed
  - **Application services:** sidedressing N as needed, fertilizer injection in no-till, etc
  - **Information services**: Soil Health improves nutrient use efficiency → opportunity to provide precision soil health adjusted nutrient management consulting

How do we get there?

- Producers and service providers must understand basic processes
- Assess current soil health status
- Develop appropriate plan
- Implement and adjust!
- Need economic info for broader adoption

Photos: NRCS and Dorn Cox, 2012



Soil Health Campaign

- Raised awareness
- Expanded demand for system adapted information
- Raising many good questions

Adapting Soil Health Management Principles to soils, regions, and cropping systems requires broad collaboration!

- Minimize soil disturbance.
- Maximize diversity (plants, animals, amendments, inoculants…).
- Keep the soil covered.
- Maximize living roots.

Staffing up the USDA-NRCS Soil Health Division

unlock the SECRETS IN THE SOIL

Division Director
Dr. Bianca Moebius-Clune

National Communications & Partnership Liaison
To be hired in FY16

National Soil Health Team Leader
Mr. David Lamm

National Soil Health Specialist
Dr. Diane Stott

Regional Team Leaders (4)
Mr. Barry Fisher – Central
Dr. Brandon Smith – Northeast
Dr. Dennis Chessman – Southeast
Dr. Jennifer Moore-Kucera – West

Regional Soil Health Specialists (12)

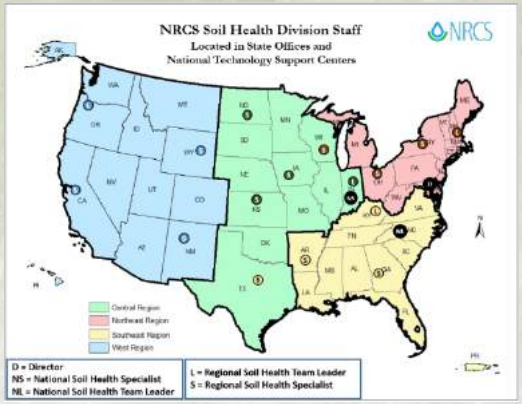
West: ***Rudy Garcia – NM; Marlon Winger – WY;***

Central: ***Candy Thomas – KS; Doug Peterson – IA;***

Southeast: ***William Durham – TX; Nathan Lowder – GA; Ray Archuleta – AR;***

Northeast: ***Justin Morris – WI; Paul Salon – NY;***

3 others to be hired



Staffing up to represent varied production systems, leverage efforts, address critical issues

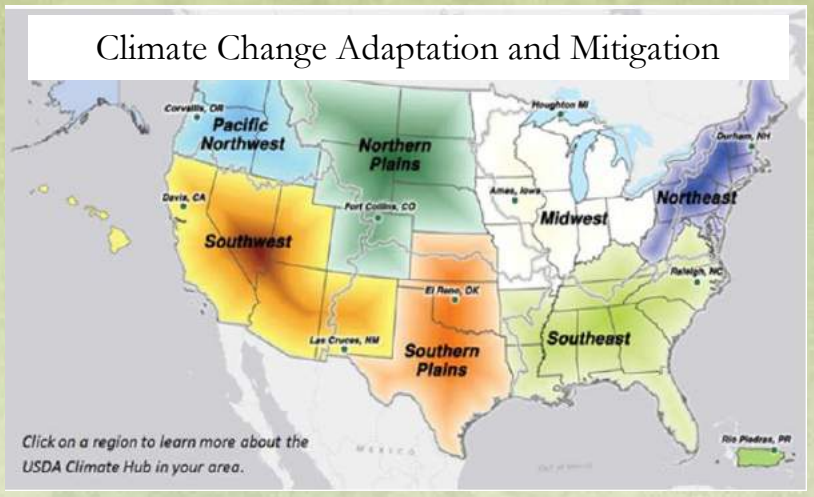
unlock the SECRETS IN THE SOIL

Ag Production Systems

Addressing the Nation's most critical issues through Soil Health

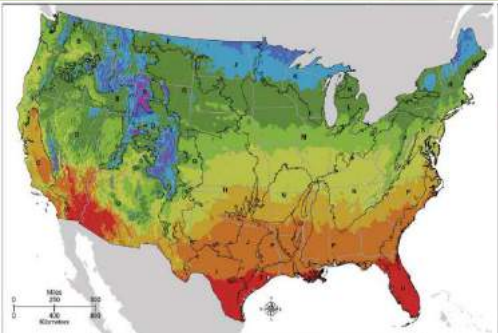
Plant Materials Centers

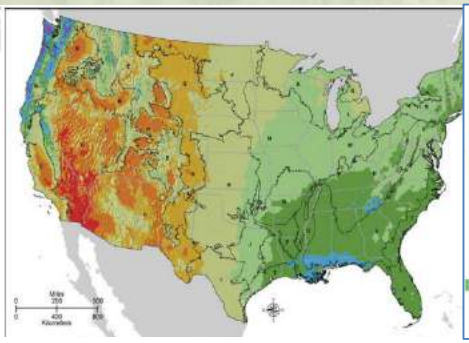
Climate Change Adaptation and Mitigation



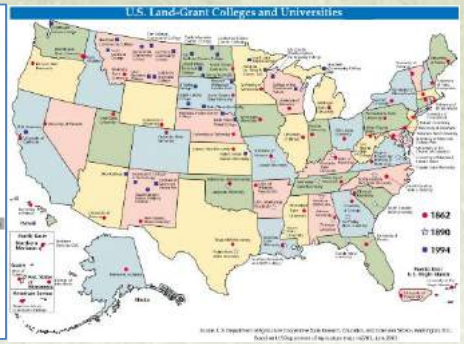
Soils

Critical Conservation Areas





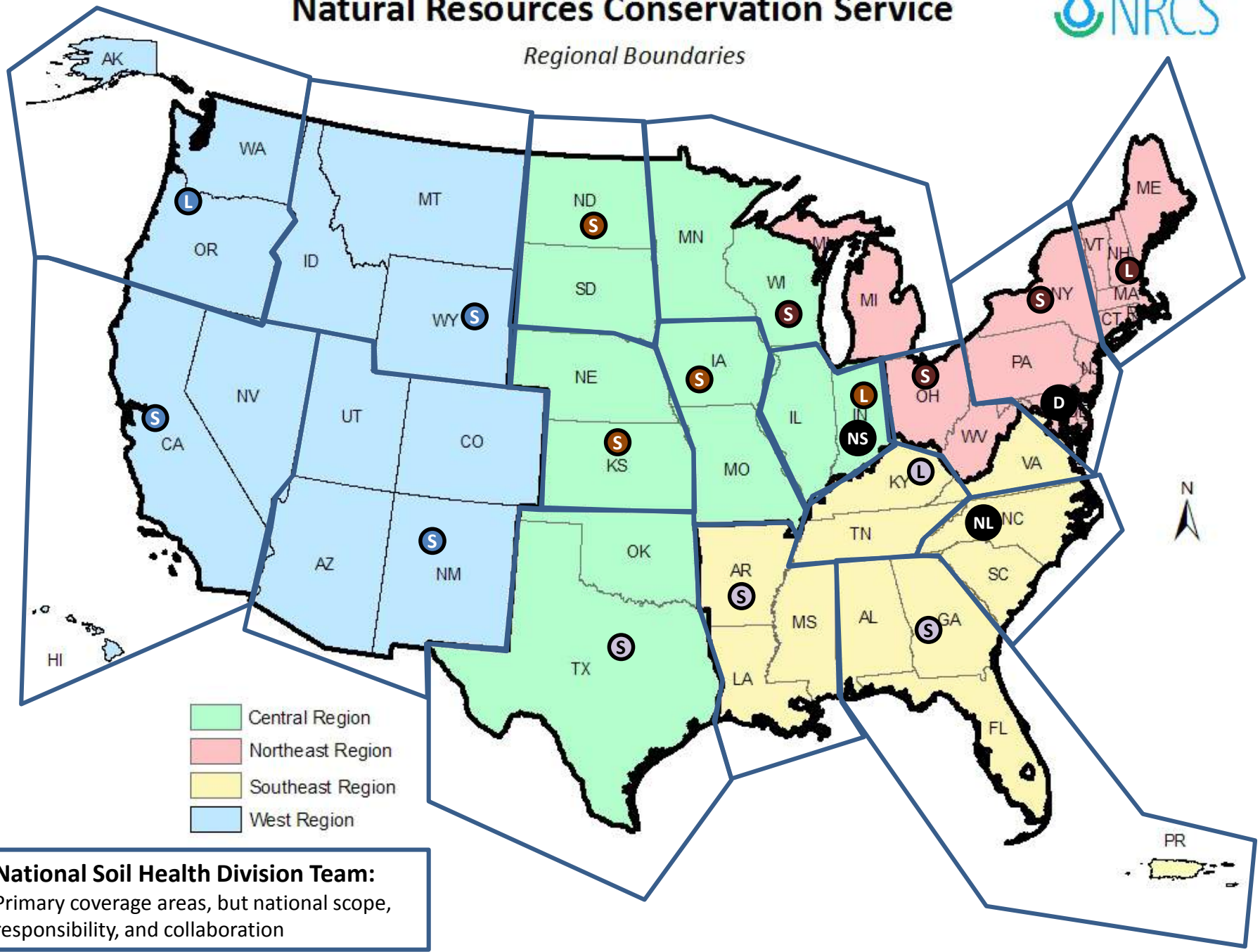
Climate



ARS & Land Grant Research Partners

Natural Resources Conservation Service

Regional Boundaries



National Soil Health Division Team:
Primary coverage areas, but national scope, responsibility, and collaboration

Goals of the new NRCS Soil Health Division

- **Leverage Partners**

NACD, SARE, TNC, EDF, Soil Renaissance, ARS, NIFA, Hatch, Universities, Nonprofits, Industry …

- **Ensure Scientific Basis**
- **Evaluate Economics**
- **Quantify Benefits**

Soil health training

Soil Health Assessment

Soil Health Management Planning

Soil Health Management Systems Implementation

Observation, Adaptation

unlock the SECRETS IN THE SOIL

NRCS Soil Health Assessment Initiative

- Will gather national soil health sample dataset
  - Initially ~1000 samples planned, contributions to larger national dataset welcome
  - Multiple commercially available soil health assessments on each sample (Cornell, Haney, PLFA, beta-glucosidase)
  - Long-term experiments
  - Commercial farm sites
  - Soil management history
  - Inputs
  - Yields
- Collaborations to expand dataset? (contact Diane Stott, National Soil Health Specialist, diane.stott@in.usda.gov)

Example Framework:

Cornell Soil Health Assessment

Advanced work from '90s and early 2000's by many soil scientists

Publically available since 2006, revised 2014 with new indicators

Measures 16 indicators

- Representing agronomically important bio/phys soil processes
- Includes std nutrient test
- Standardized methods and minimum data set
- Focus on individual indicators is key

Identifies soil constraints

Guide for management decisions

- Report now includes explicit written interpretations and management suggestions table
- Soil Health Management Planning Framework

Cornell Soil Health Assessment

Joe Vegland
123 Main St.
Anytown, NY, 12345

Agricultural Service Provider:
Smith, George
Jim's Consulting
George@jimsconsulting.com

Sample ID: A_123
Field/Treatment: Field
Tillage: No Till
Crops Crown: MIX, MIX, MIX
Date Sampled: 5/31/2014
Given Soil Type: Anytown
Given Soil Texture: Silt Loam
Coordinates: 42.44790 °N; 76.47570 °W

Measured Soil Textural Class: Silt Loam Sand: 5% Silt: 70% Clay: 25%

Test Report

	Indicator	Value	Rating	Constraint
Physical	Available Water Capacity	0.13	28	Water Retention and Availability
	Surface Hardness	148	62	
	Subsurface Hardness	425	8	Subsurface Pan/Deep Compaction, Deep Rooting, Water and Nutrient Access
	Aggregate Stability	22.5	26	Aeration, Infiltration, Rooting, Crusting, Sealing, Erosion, Runoff
Biological	Organic Matter	3.2	42	
	ACE Soil Protein Index	6.5	35	
	Root Pathogen Pressure	5.5	44	
	Respiration	1.17	15	Soil Microbial Abundance and Activity
	Active Carbon	391	12	Energy Source for Soil Biota
Chemical	pH	6.0	71	
	Phosphorus	9.3	100	
	Potassium	264.7	100	
	Minor Elements Mg: 419 Fe: 1.1 Mn: 12.9 Zn: 1.9		100	
	Overall Quality Score		49	Low

soilhealth.cals.cornell.edu

unlock the SECRETS IN THE SOIL

NRCS Natural Resources Conservation Service

Interpreting Soil Health Assessments in NH
NH-590 Quick Reference

Test Results	Suggested Management Practices		NH NRCS Practice
	Short Term	Long Term	(code)
Physical Concerns			
Low Aggregate stability	• Incorporate fresh organic materials • Use shallow-rooted cover/rotation crops • Add manure, green manure, mulch	• Reduce tillage • Use a surface mulch • Rotate with sod crops	**(328)** Conservation Crop Rotation; **(340)** COVER CROP; **(329)** Residue Mgmt No-Till/Strip-Till; **(484)** Mulching; **(512)** Forage & Biomass Planting; **(528)** Prescribed Grazing
Low Available Water Capacity	• Add stable organic materials, mulch • Add compost or biochar • Incorporate high biomass cover crop	• Reduce tillage • Rotate with sod crops • Incorporate high biomass cover crop	**(328)** Conservation Crop Rotation; **(329)** Residue Mgmt No-Till/Strip-Till; **(317)** Compost Facility; **(340)** COVER CROP; **(484)** Mulching; **(512)** Forage & Biomass Planting; **(528)** Presc. Grazing
High Surface Hardness	• Perform some mechanical soil loosening (strip till, aerators, broadfork, spader) • Use shallow-rooted cover crops • Use a living mulch or interseed cover crop	• Shallow-rooted cover/rotation crops • Avoid traffic on wet soils, monitor • Avoid excessive traffic/tillage/loads • Use controlled traffic patterns/lanes	**(328)** Conservation Crop Rotation; **(345)** Residue Mgmt, Mulch Till; **(340)** COVER CROP; **(484)** Mulching; **(528)** Prescribed Grazing **(512)** Forage & Biomass Planting **(548)** Grazing Land Mechanical Trt;
High Subsurface Hardness	• Use targeted deep tillage (subsoiler, yeomans plow, chisel plow, spader.) • Plant deep rooted cover crops/radish	• Avoid plows/disks that create pans • Avoid heavy loads • Reduce traffic when subsoil is wet	**(324)** Deep Tillage; **(329)** Residue Mgmt, No-/Strip-Till; **(345)** Residue Mgmt, Mulch Till **(340)** COVER CROP ; **(548)** Grazing Land Mechanical Trt; **(606)** Subsurface Drain
Biological Concerns			
Low Organic Matter	• Add stable organic materials, mulch • Add compost and biochar • Incorporate high biomass cover crop	• Reduce tillage/mechanical cultivation • Rotate with sod crop • Incorporate high biomass cover crop	**(328)** Conservation Crop Rotation; **(340)** COVER CROP; **(329)** Residue Mgmt No-Till/Strip-Till; **(317)** Compost Facility; **(484)** Mulching; **(528)** Prescribed Grazing **(512)** Forage & Biomass Planting;
Low Active Carbon	• Add fresh organic materials • Use shallow-rooted cover/rotation crops • Add manure, green manure, mulch	• Reduce tillage/mechanical cultivation • Rotate with sod crop • Cover crop whenever possible	**(328)** Conservation Crop Rotation; **(329)** Residue Mgmt, No-Till; **(340)** COVER CROP; **(345)** Residue Mgmt, Mulch Till; **(484)** Mulching; **(528)** Presc.Grazing; **(511)** Forage Harvest Management;

The Goal: Soil Health

Assessment

Management Planning

Implementation

Photos: Bianca Moebius-Clune and Dorn Cox, 2012

Results from Soil Health Management Planning and Implementation – Improved Productivity and Pond Eutrophication Cleared

Photos: Bianca Moebius-Clune and Dorn Cox, 2012

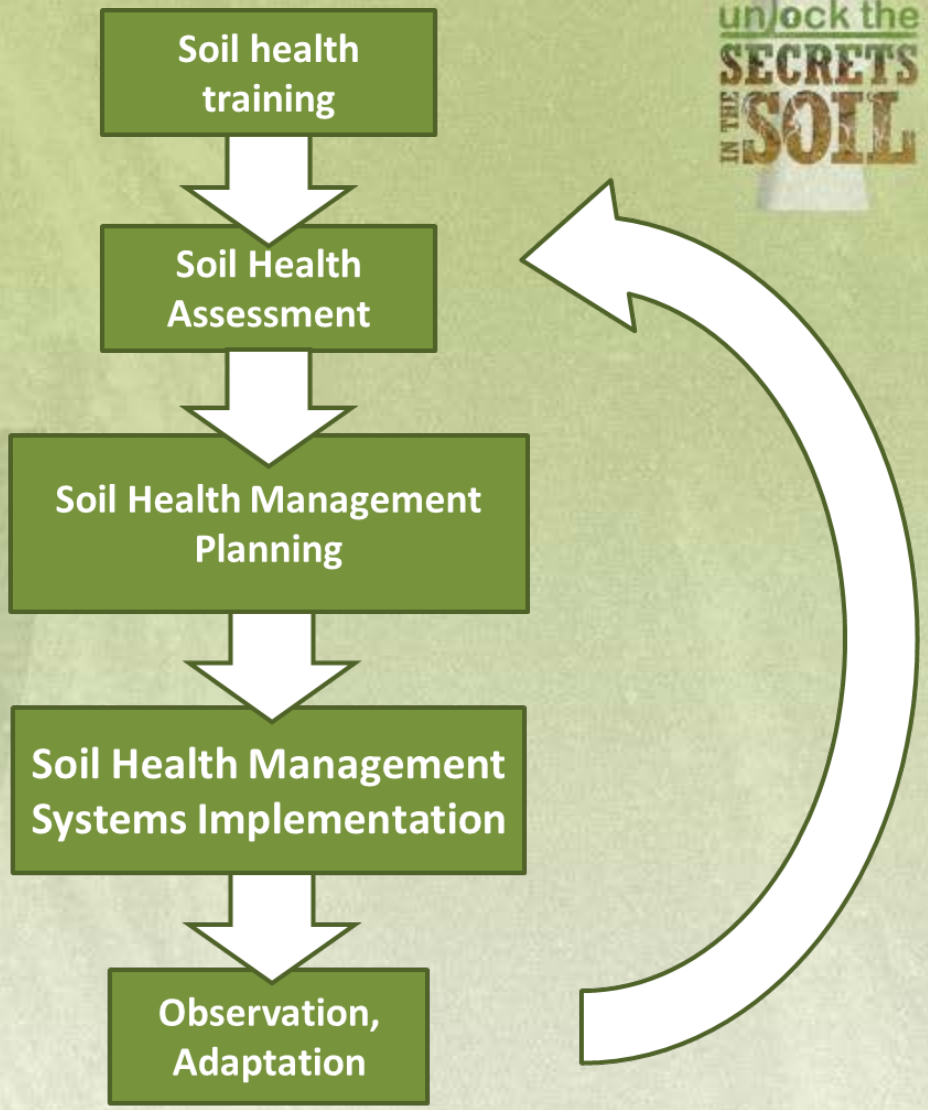
Photos: Dorn Cox

Moebius-Clune, et al., 2014. Implementation of a Soil Health Management Plan resolves pond eutrophication at Tuckaway Farm, NH. What's Cropping Up? https://blogs.cornell.edu/whatscroppingup/category/soil-health/

Thank you!

How can we collaborate best?

- Leverage Partners
- Ensure Scientific Basis
- Evaluate Economics
- Quantify Benefits



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