
The path to stronger agriculture is under our feet.
Building High Functioning and Resilient Soil and Regenerative Systems

Poll
S#3, Q1

Session #3

Soil Health: Basics, Practices, Benefits, & Barriers

Part 1

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Objectives

Cochrane, NRCS

Many slides in this presentation have been modified from USDA-NRCS | SHD | Soil Health and Sustainability Course | v2.3

Become comfortable discussing:

1. Why soil health matters and the benefits
2. What is “soil health”
3. How soil health relates to regenerative agriculture and climate resiliency
4. Soil health management systems principles and the conservation practices that improve soil health
5. Some barriers to adoption

Agenda

1. Introduction to Basics and Benefits of Soil Health
2. Soil Health Management Systems Principles and Practices
3. Barriers to Soil Health Adoption

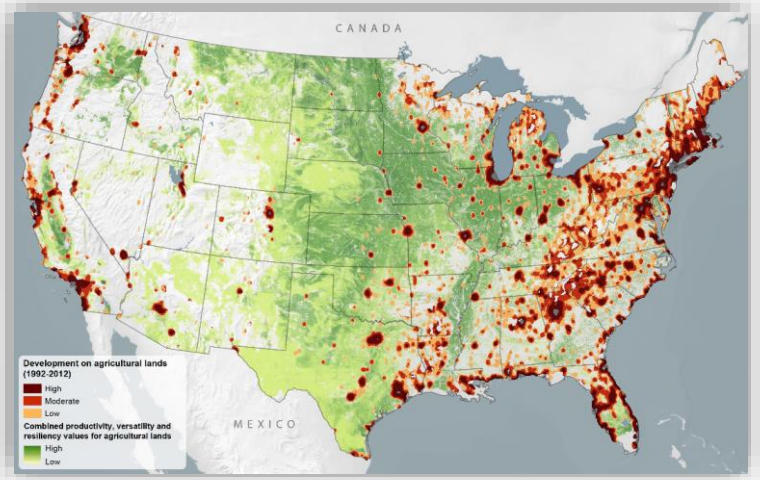
Cochrane, NRCS

Introduction to Basics and Benefits of Soil Health

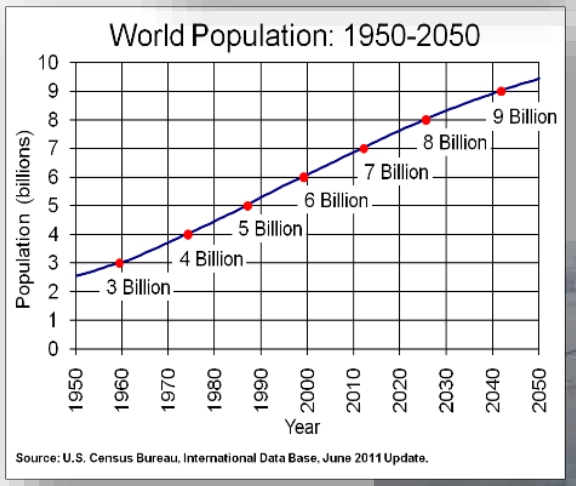
Cochrane, NRCS

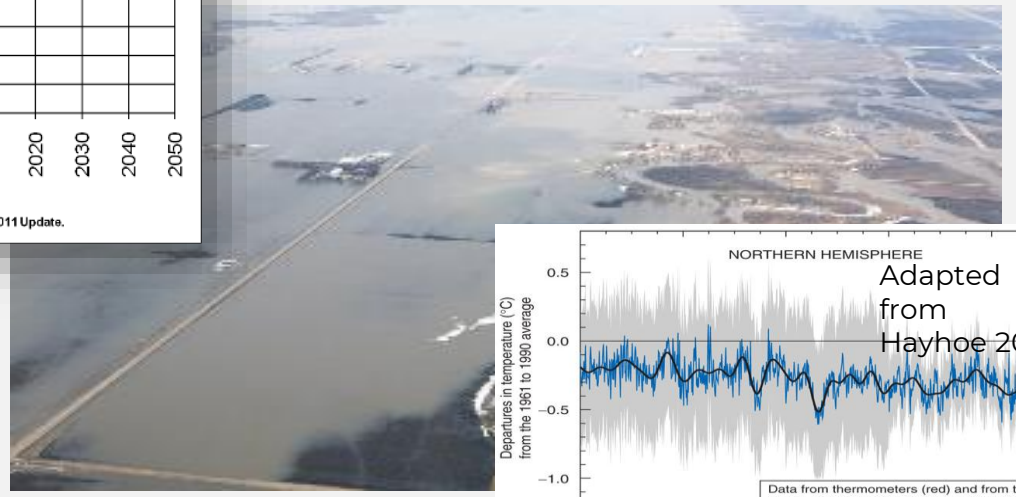
Challenges for Agriculture and Society

- Changing climate
- Population growth
- Food security
- Farm economy
- Water quality and quantity
- Air quality
- Human health
- Consumer demands
- Loss of agricultural soils



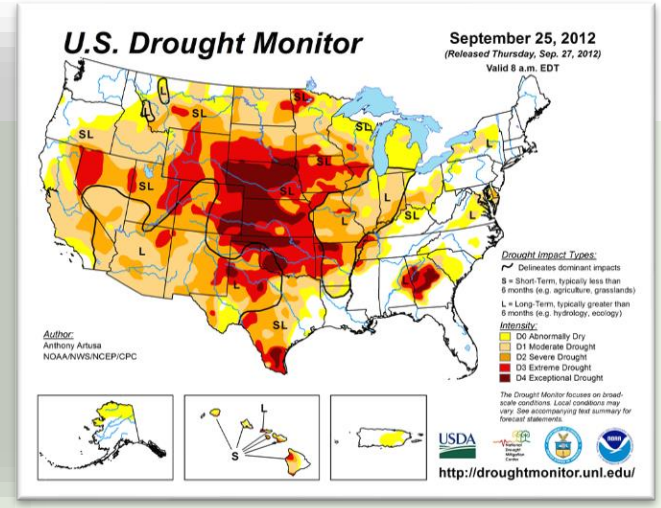
Farms Under Threat, American Farmland Trust, May, 2018

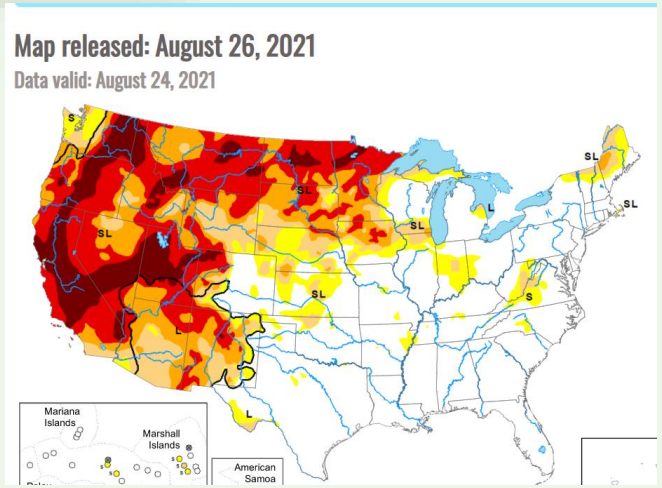




Challenges for Our Producers

- Climate change
- Water quantity and reliability
- Pests and Disease
- Risk
- Prices
- Inputs
- Markets
- Loss of land
- Land access
- Consumer needs





Win-Win Solutions by Building High Functioning, Resilient Soil and Regenerative Systems

Wikipedia

“If we are bold in our thinking, courageous in accepting new ideas, and willing to work with instead of against our land, we shall find in conservation farming an avenue to the greatest food production the world has ever known…”

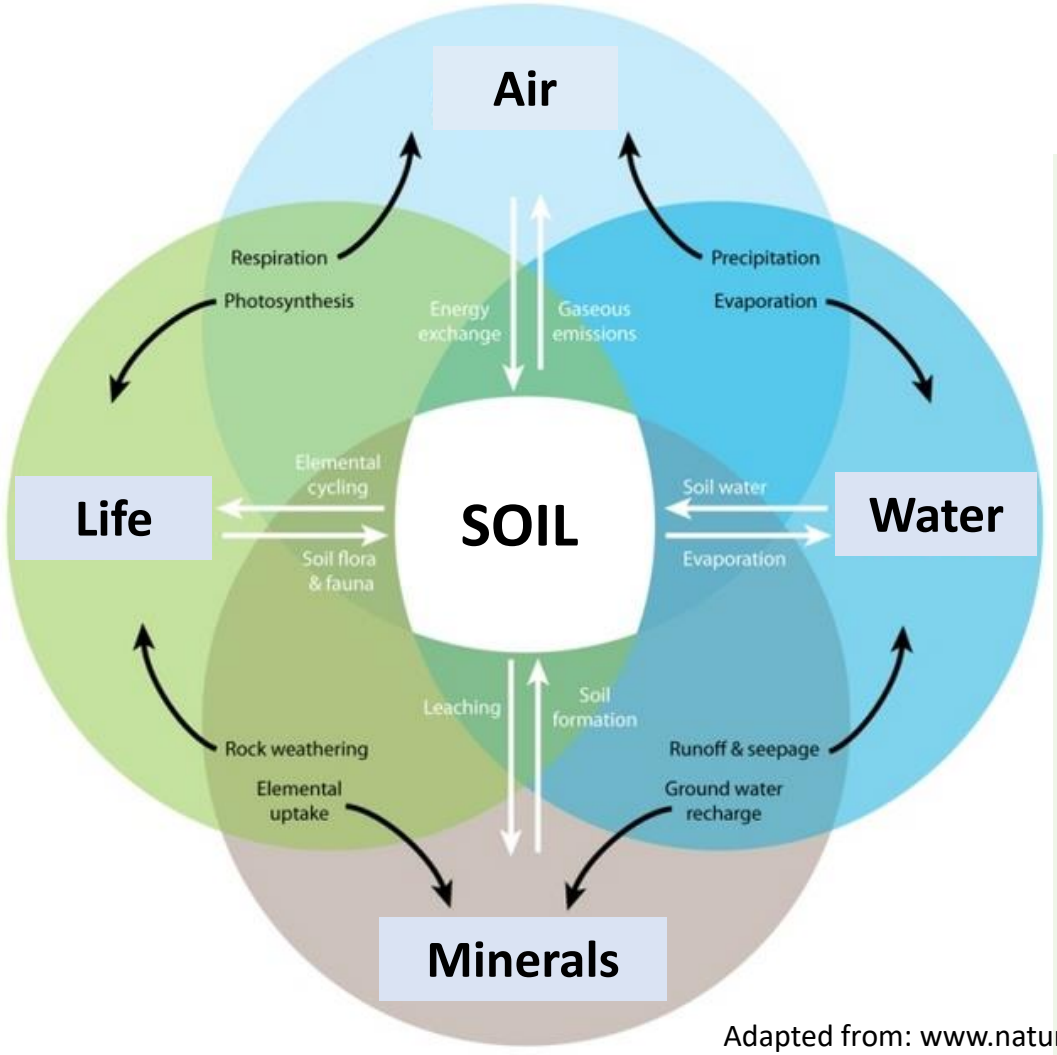
-Hugh Hammond Bennett
September 18, 1943

What functions would we like our soil to provide?

- Produce food, feed, fiber, biofuels & medicine
- Capture, filter, and store water
- Cycle and recycle nutrients
- Resilience to drought, flood & temp extremes
- Protect plants from pathogens and stress
- Detoxify pollutants
- Store C and moderate release of gases
- Resist erosive forces
- Habitat for Biodiversity

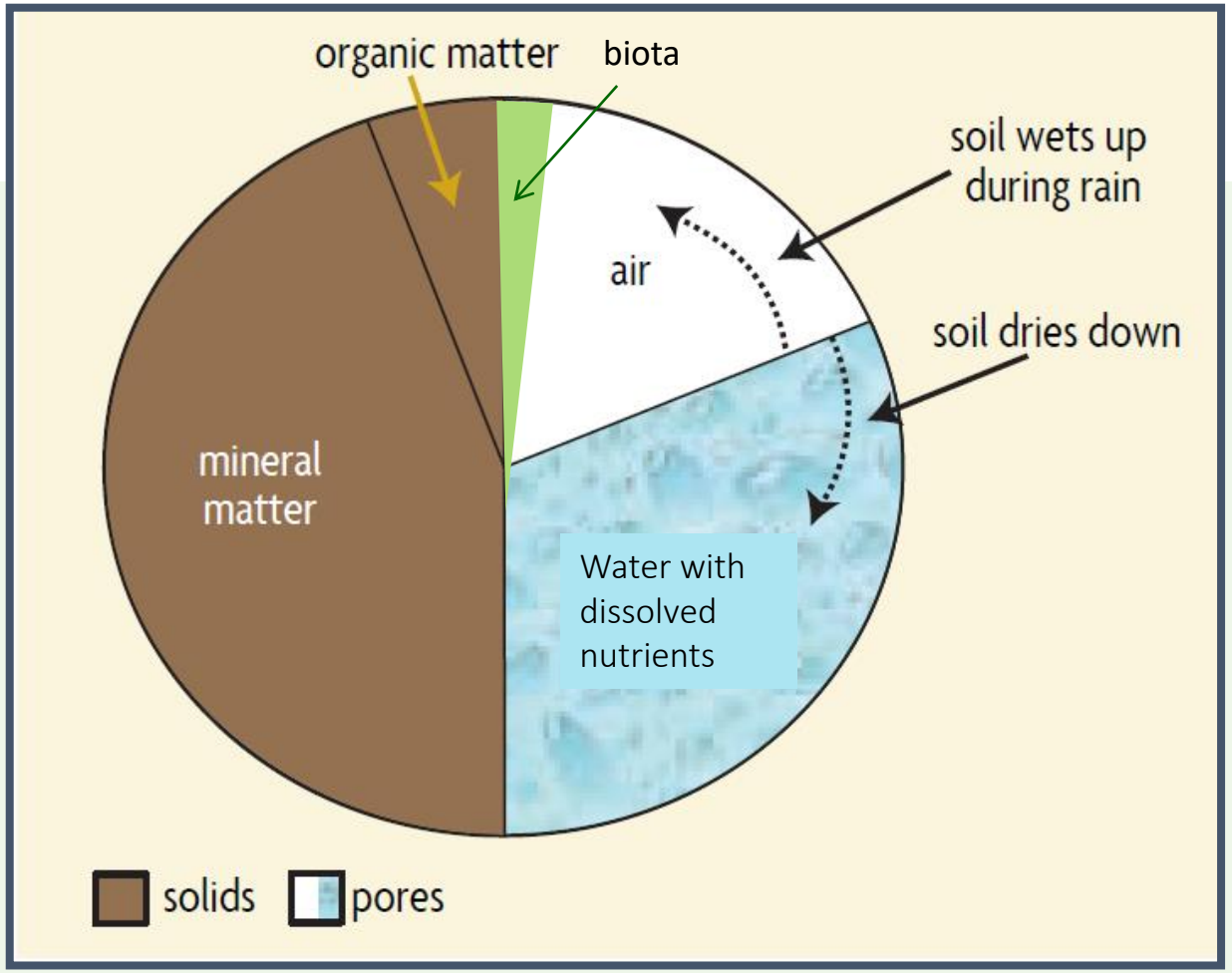
What's so special about soil and its health?

"Soil" is an Interface and Foundation



Adapted from: www.nature.com

Soil Composition



Adapted from: Building Soils for Better Crops

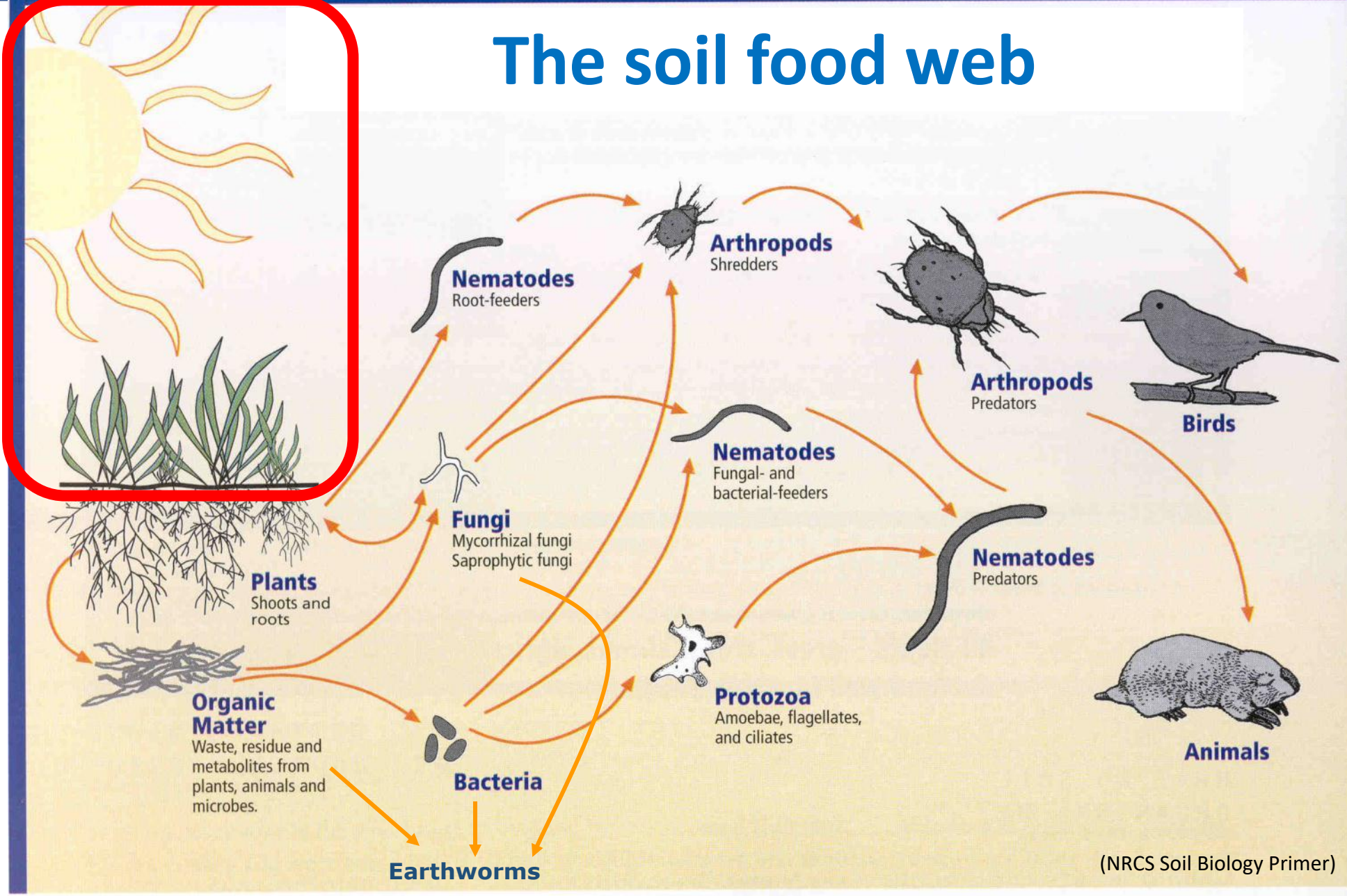
Defining Soil Health

The continued capacity of the soil to function as a vital living ecosystem that sustains plants, animals, and humans

An Aggregate is like a House

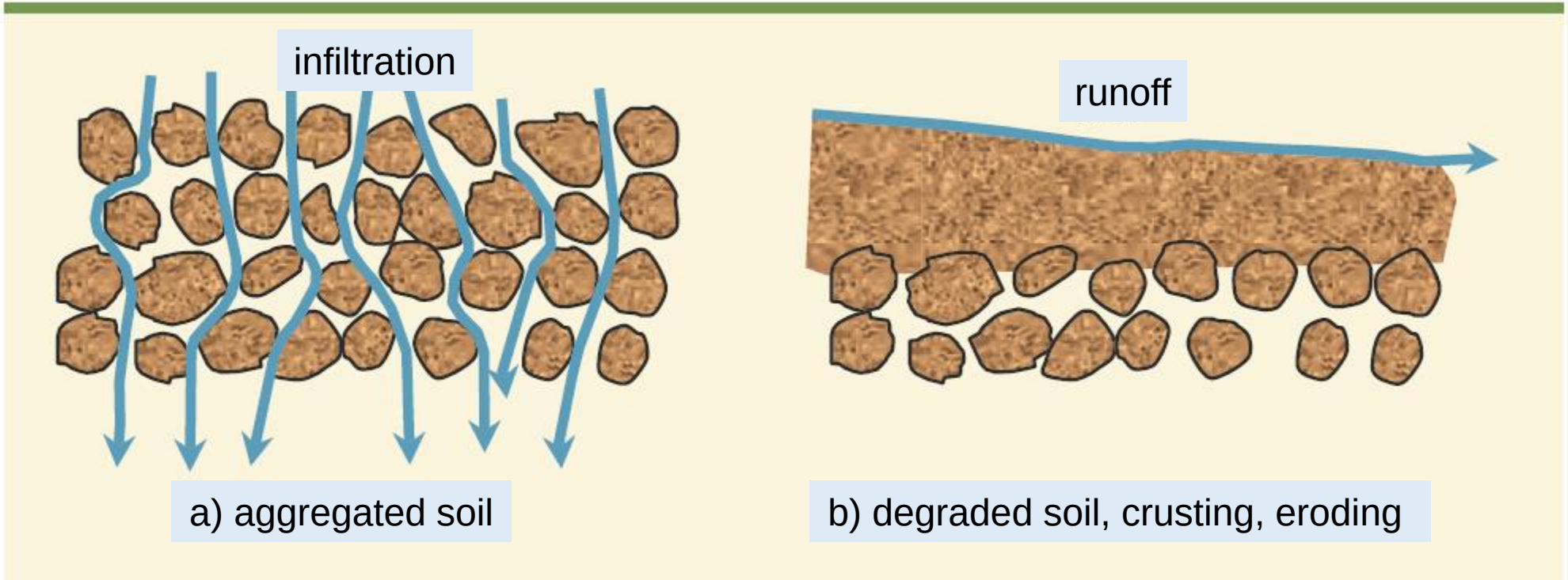
The interesting stuff is going on in the "empty" spaces!

The soil food web



(NRCS Soil Biology Primer)

Good soil structure important for <u>Adapting</u> to extreme weather



- In degraded soil, essential functions of water storage and movement are reduced
- Especially problematic at dry and wet extremes

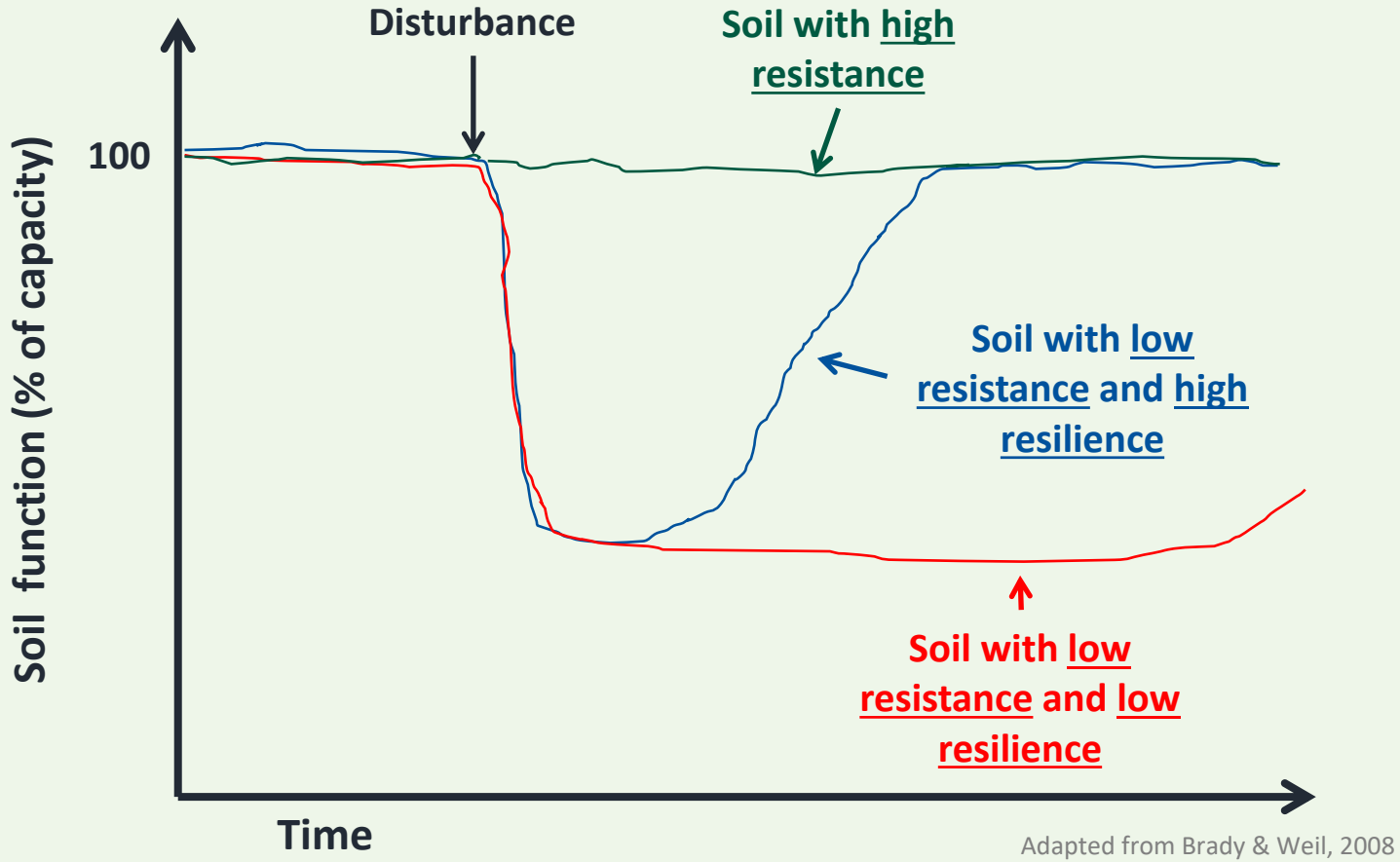
Soil Health, Function, and Resilience

Resilience is the ability and rate of a soil to return to its pre-disturbance state.

Most of our soils have lost considerable function.

We need to SEE the root cause of the problem.

Then we need to regenerate that function through management



Adapted from Brady & Weil, 2008

Characteristics of Soil Function Loss

Lynn Betts, USDA-NRCS

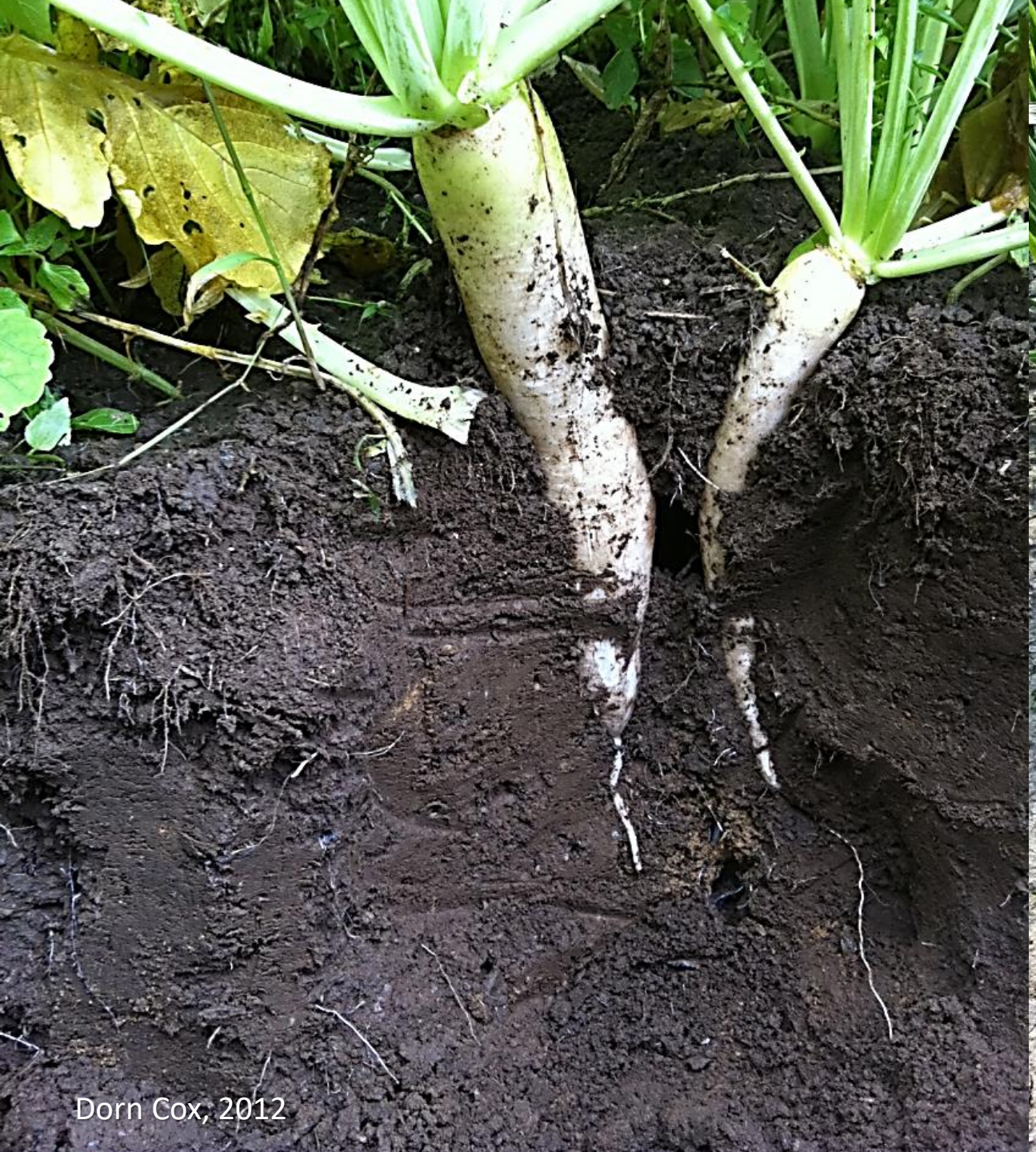
Lynn Betts, USDA-NRCS

Bob Nichols, USDA

University of Tennessee

Inflation Solutions

Case IH


Dorn Cox, 2012


Bianca Moebius-Clune, 2012

Return on our Nation's Soil Health Investment

Changing the Face of Agriculture and How We Feed our Nation

Infiltration - Brookings County, SD

We can't control the weather, but we can manage the soil to handle it!

September 8, 9, & 10, 2021

National Agricultural Land Network
A PROJECT OF AMERICAN FARMLAND TRUST

Resilience – Drought Impact differs with Soil Management Carroll, Ohio 2012

Same soil type & location, different management

We can't control the weather, but we can manage the soil to handle it!

40 yrs No-till and winter cover crops.
144 bu/ac. Farmer: Dave Brandt, OH

Contributed by Archuleta, 2012, NRCS

>20 yrs Tillage: disk "vertical tillage".
Conventional. 40-80bu/ac. Neighbor.

Invest in Managing for Soil Health for a Long List of Benefits:

- Consistent good production
- Healthy crops
- Reduced risk during weather extremes
- Field trafficability
- Reduced runoff, erosion, flooding
- Reduced temperature extremes
- Clean and plentiful water
- Air quality
- Healthy environment
- Habitat for beneficial organisms
- Improved soil organic matter
- Energy savings
- Reduced pest pressure
- Improved nutrient and carbon cycling
- Carbon sequestration
- Long-term economic, social, environmental viability
- Sustained reliable productivity – to feed 9 billion

Soil Health in Popular Press

REGENERATIVE AGRICULTURE

Healthy Soil: Good for the Farmer, Good for the Planet

By Regeneration International | May. 02, 2018 08:28AM EST

CSR News

Print Alerts

Soil Health Institute Selects Seven Scientists, Begins Sampling Phase of North American Project to Evaluate Soil Health Measurements

The project will assess 31 indicators of soil health, partnering with teams from long-term research sites and scientific laboratories across Canada, the United States, and Mexico.

Submitted by: The Soil Health Institute
Categories: Environment, Research, Reports & Publications
Posted: Jan 22, 2019 – 09:05 AM EST

SOIL HEALTH INSTITUTE

RESEARCH TRIANGLE PARK, N.C., Jan. 22 /CSRwire/ - The Soil Health Institute

nature

ENVIRONMENT

Secrets of Life in the Soil

Diana Wall has built a career on overturning assumptions about underground ecosy she is seeking to protect this endangered world

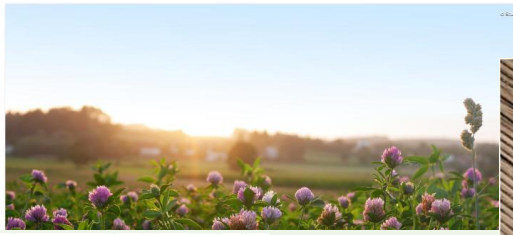
By Rachel Cernansky, Nature magazine on September 13, 2016

WWF

OUR WORK SPECIES PLACES ABOUT US HOW TO HELP DONATE

WORLD WILDLIFE MAGAZINE SPRING 2018

How cover crops help keep soil healthy and productive



SF Successful Farming

RKETS WEATHER MACHINERY CROPS TECHNOLOGY FARM MANAGEMENT LIVE

The New York Times Magazine

FEATURE

Can Dirt Save the Earth?

Agriculture could pull carbon out of the air and into the soil — but it would mean a whole new way of thinking about how to tend the land.

Home • News

BIG FOOD TAKES SOIL HEALTH SERIOUSLY

FROM SOIL HEALTH SUMMIT, MCDONALD'S SUSTAINABILITY DIRECTOR TALKS INVESTING IN SUSTAINABILITY PROGRAMS.

By Bill Spiegel
1/23/2019

Minnesota Farmers Use Buried Underwear to Test Soil Health

Some southern Minnesota farmers are using underwear as a creative way to test soil health.

By Associated Press, Wire Service Content Sept. 29, 2018, at 10:28 a.m.

State of the US potato industry: Tariffs, transportation, soil health top issues

BY LUKIE PIETERSE ON JANUARY 28, 2019

September 8, 9, & 10, 2021

Soil Health Stewards:
Promoting Soil Health on Protected Agricultural Lands

National Agricultural Land Network
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Books Promoting Soil Health

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Soil Health Stewards:
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Farmers and ranchers embrace regenerative approaches, build healthy soils, gain resilience, mitigate climate change, and improve farm viability.

Regenerative systems become common place: America's irreplaceable land is used wisely, balancing the needs for a healthy planet, food production for healthy people, new development, and renewable energy.

American agriculture is climate neutral – or better!

AFT's Vision

Demonstrations

Logistical note: find your volume controls as I start these videos – the video may be louder that I am – protect your ears!

1 min Slake Demo – Ray Archuleta

17 min Demonstration Training – Doug Peterson

Cochrane, NRCS

Polls (S#3, Q2-6), Q&A and Discussion

Taking it back to your Day to Day:

1. Where in your community have you seen signs of poor soil health?
2. Have you experienced healthy high functioning soils? Where?
3. How might you use local examples for improving soil health awareness and adoption with your stakeholders?

Soil Health Management Systems Principles and Practices

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Soil Health Stewards:
Promoting Soil Health on Protected Agricultural Lands

National Agricultural Land Network
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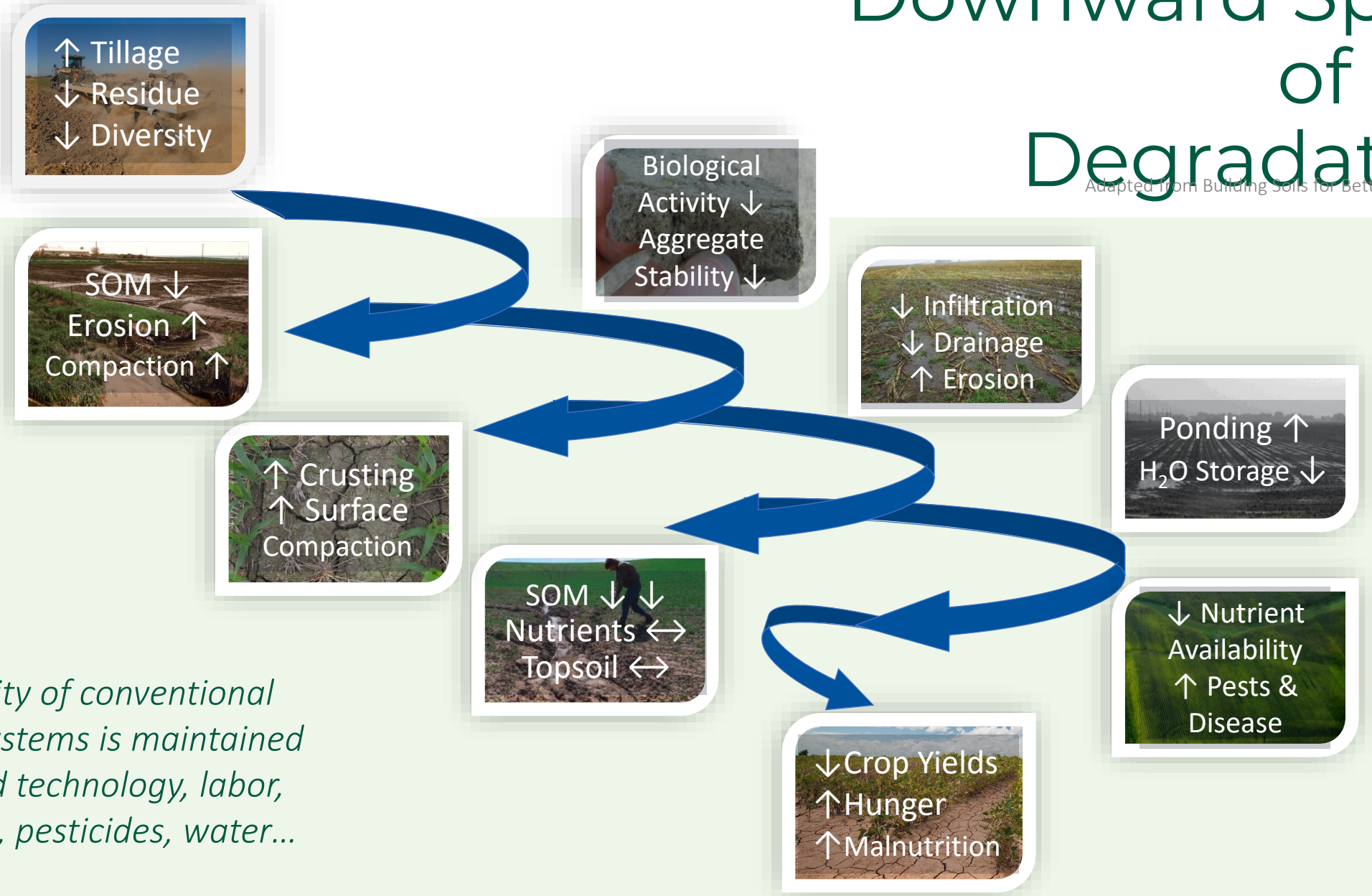
Downward Spiral of Soil Degradation

Adapted from Building Soils for Better Crops, 3rd ed.



The productivity of conventional agricultural systems is maintained with increased technology, labor, fuel, nutrients, pesticides, water…

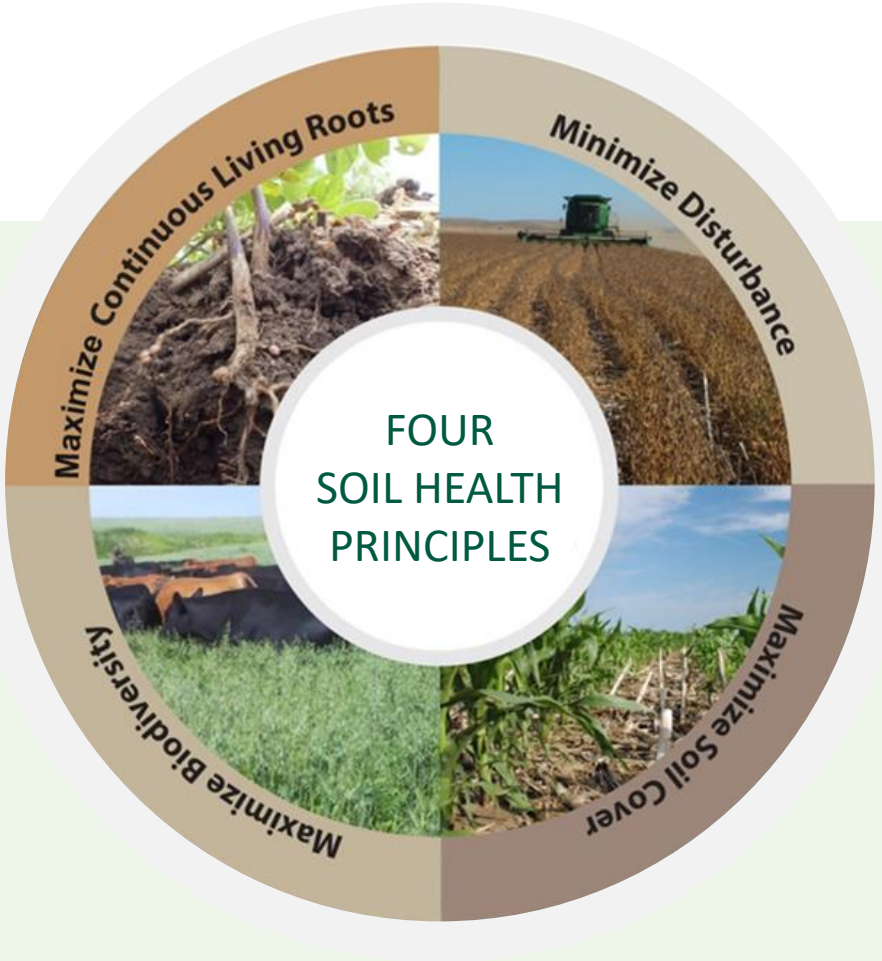
General Signs of Poor Soil Health

- Hard soil, plowing up cloddy soil and poor seedbeds
- Rapid onset of stress or stunted growth during dry or wet periods
- Discolored crop leaves
- Signs of runoff & erosion
- Poor growth of plants
- Soil crusting
- High disease or pest pressure






4 Soil Health Principles that Conserve the Soil Ecosystem

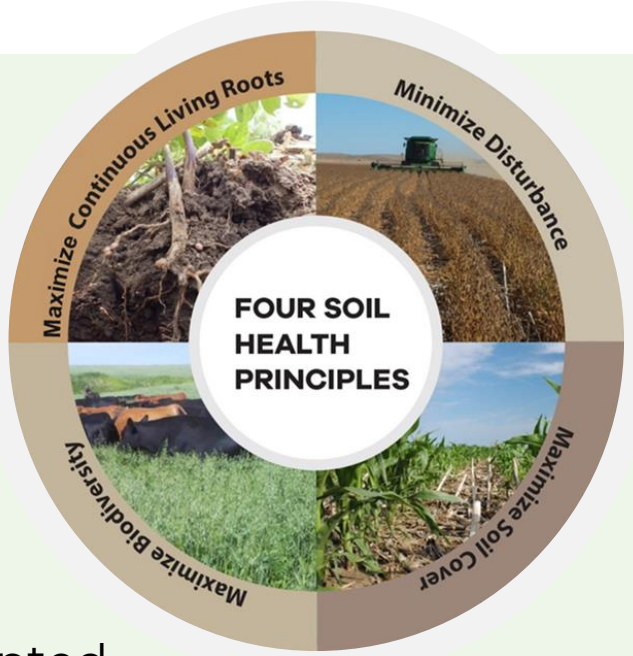


1. Minimize Disturbance
2. Maximize Soil Cover
3. Maximize Biodiversity
4. Maximize Continuous Living Roots

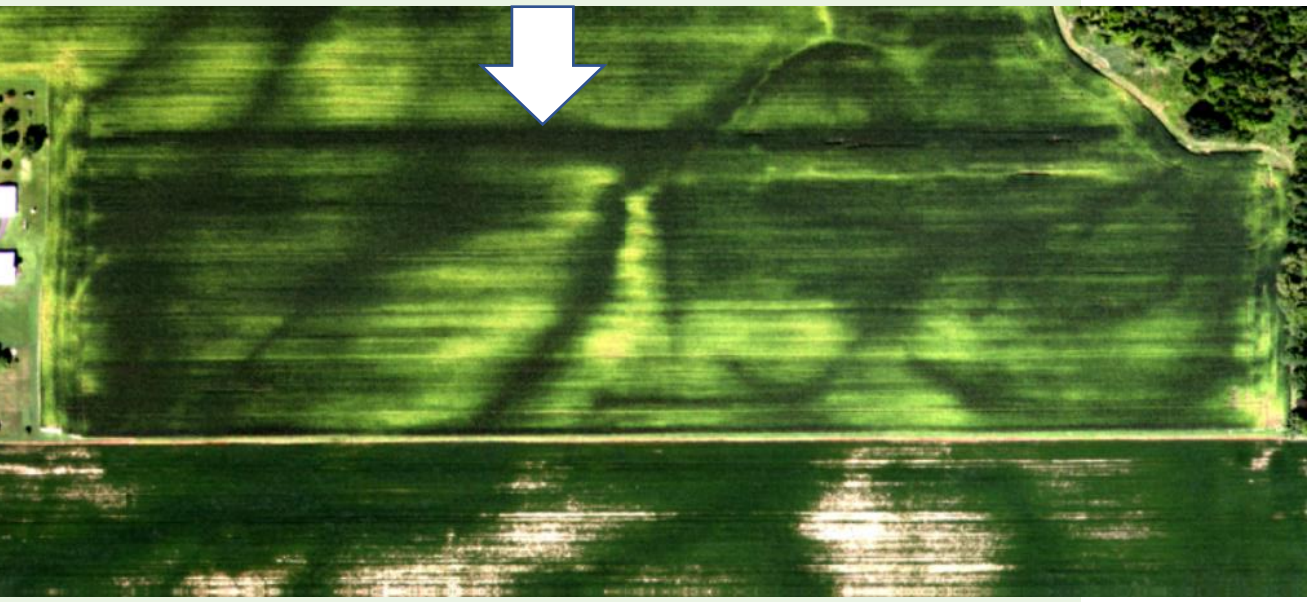
Plus adapted use of technology, nutrient and pest management to the unique production system, soil, climate, and farmer/rancher

What is a Soil Health Management System?

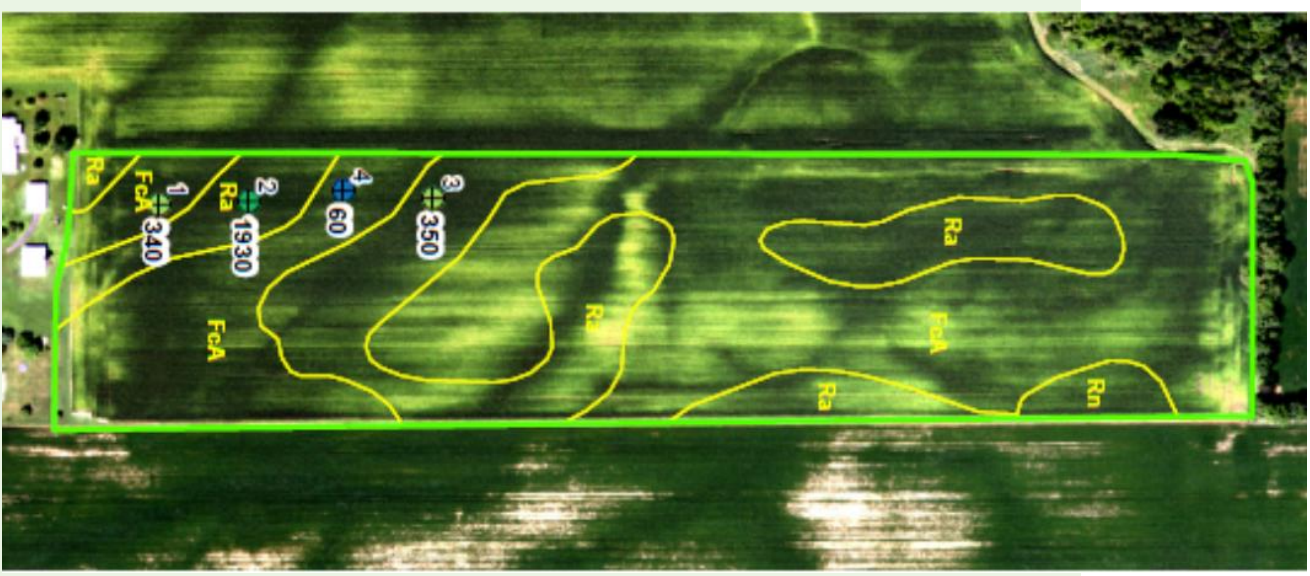
A collection of management practices that focuses on increasing soil carbon levels and improving (or regenerating) soil health by addressing all four soil health management principles.



- Principles apply to all production systems, but must be adapted
- When implemented together, adaptively as appropriate for a given production system, principles are synergistic and regenerate (rebuild) and maintain soil health and the many ecosystem services soils provide.
- Specific combinations and applications of practices chosen to successfully implement the principles still needs development and innovation to be successfully adapted to diverse production systems, climates, ecosystems, and soils to effectively build healthy, functioning soil.



The Fence Row Effect



Principles at work

Care for your belowground livestock as you would your aboveground livestock

Biota have two needs:

1. Protect the home: structure, water, air

2. Feed belowground life: diverse, year-round diet, including energy & nutrients

Soil Health Principles To Support High Functioning Soils

Feed diverse, continuous inputs: C sources, energy, nutrients

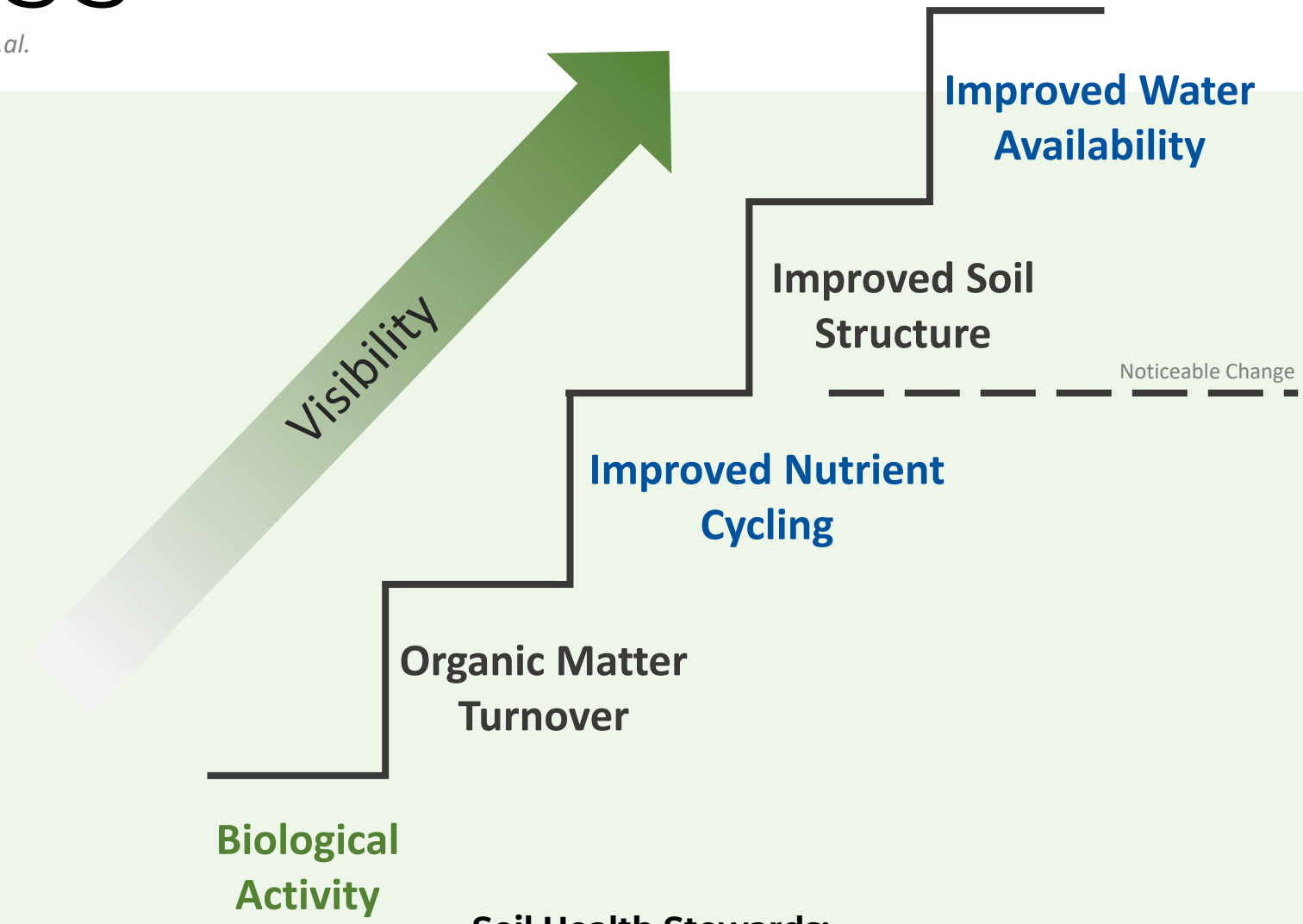
- Stimulate diversity
- Break disease cycles
- Increase SOM and nutrient cycling
- Enhance plant growth
- Increase beneficials

Protect habitat aggregates, structure, water, air, temperature

- Maintain SOM & aggregates
- Reduce erosion & runoff risk
- Buffer temperature
- Reduce evaporation

Soil Aggradation Climb

Adapted from Hatfield *et.al.*



Soil Health Principles: How to Protect Below Ground Livestock

- **Protect** habitat aggregates, structure, water, air, temperature

- Maintain SOM & aggregates
- Reduce erosion & runoff risk
- Buffer temperature
- Reduce evaporation

Minimize Disturbance

What Types of Disturbance are Common in Agriculture?

- Physical (tillage, grazing compaction, heavy equipment traffic)
- Chemical (fertilizer, pesticides, soil amendments)
- Biological (grazing, non grazing, fallow systems, monoculture

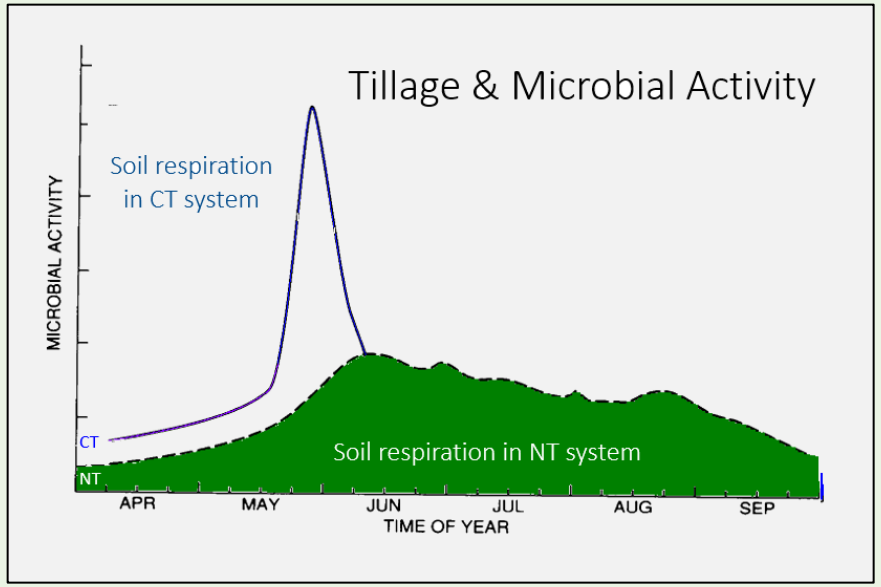
Effects of Excessive/Chronic Disturbance:

- ↓Quality of Habitat for soil organisms
- ↓ Soil structure

Dr. Don Reicosky

What Practices Minimize Disturbance?

Photo: Echo –Y Farms



- Residue & Tillage Mgmt. (329/345*)
- Conservation Cover (327)
- Nutrient Management (590)
- Integrated Pest Management, IPM (595)
- Prescribed Grazing (528)

** NRCS conservation practice standard codes for those working with NRCS*

Why Maximize Soil Cover?

- ↓ Erosion
- ↑ Infiltration
- ↓ Evaporation
- Moderate Soil Temp
- Habitat for Soil Organisms ↑
- Food for Biota ↑
- Mitigate Compaction from Machines & Livestock

What Practices Maximize Soil Cover?

- Cover Crop (340)
- Residue & Tillage Management (329/345)
- Conservation Cover (327)
- Mulching (484)
- Controlled Traffic (334)
- Forage & Biomass Planting (512)
- Prescribed Grazing (528)

Soil Health Principles: How to Protect Below Ground Livestock

Feed diverse, continuous inputs: C sources, energy, nutrients

- Stimulate diversity
- Break disease cycles
- Increase SOM and nutrient cycling
- Enhance plant growth
- Increase beneficials

Maximize Presence of Living Roots

How?

- Grow crops or cover crops in off-season
- Avoid fallow
- Increase time in perennial crops
- Manage rotations, intercropped mixtures, forage height

What Practices?

- Conservation Crop Rotation (328)
- Conservation Cover (327)
- Cover Crop (340)
- Forage & Biomass Planting (512)
- Prescribed Grazing (528)

Maximize Biodiversity

How?

- Grow diverse cover crops & legumes
- Increase diversity of crop rotations and mixtures
- Integrate livestock & graze cover crops
- ↑ time in diverse perennial crops

What Practices?

- Conservation Crop Rotation (328)
- Conservation Cover (327)
- Cover Crop (340)
- Forage & Biomass Planting (512)
- IPM (595)
- Prescribed Grazing (528)

Dorn Cox, roller crimping

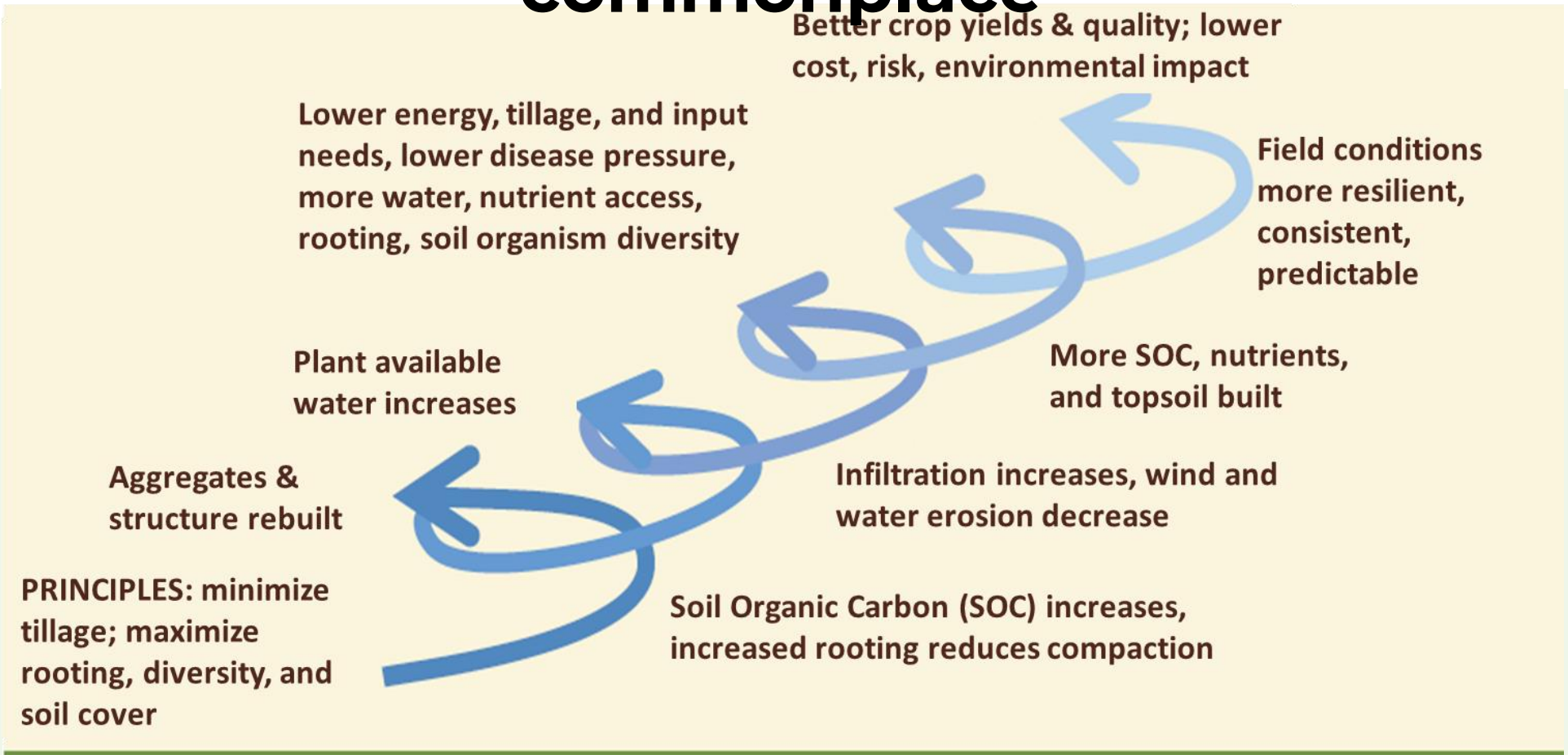
Chad Branton, High Clearance Cover Crop Interseeding and SIdedressing

Dorn Cox, Triticale and Winter Peas

Zone tillage

https://blog.uvm.edu/pasture-vtpasture, rotational grazing

Goal: Win-Win Soil Health Management Systems are commonplace



Modified by Moebius-Clune and Cox from *Building Soils for Better Crops*

Soil Health Catching On

"Soil Health and cover crops have brought people into this office that I have never seen before."

– Scott McClure, District Conservationist, Bethany, MO NRCS Field Office

"I see guys getting pushed into covers with bad advice…it takes a serious management technique."

– Tim Recker, October, 2018 *Farm Journal*

Anson Farms, now uses no-till and cover crops on nearly all of their ~20,000 acres.

"…I came to a soil health meeting…on the way home I ended up calling a couple of the presenters from that day because I was on fire with what needed to change at our farm…Currently my life is all about Healthy Soils, Healthy Water, Healthy Life."

– Mark Anson, Indiana Farmer

Polls (S#3, Q7-11), Q&A and Discussion

Taking it back to your Day to Day:

1. Are there key concepts or ways to articulate aspects of soil health that you'd like to incorporate into your communications with landowners and producers?
2. Is there anything you learned that particularly surprised you – any aha

Barriers to Soil Health Adoption

Most slides in this section adapted from NRCS | SHD | Social & Economic Considerations | v2.2

Cochrane, NRCS

Adopting Soil Health Practices

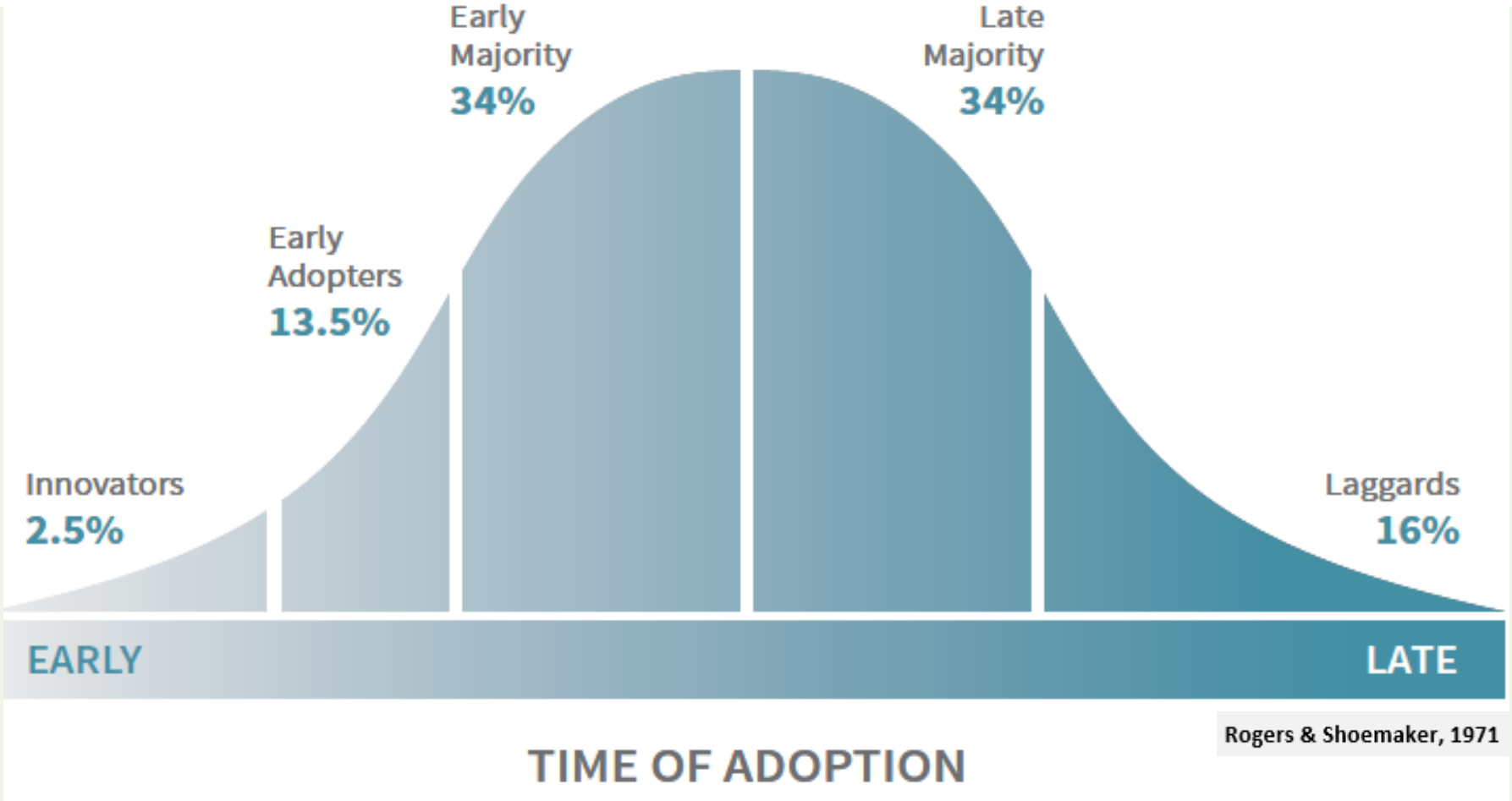
- Requires not only an understanding of the physical resource and production system but also social and economic considerations
- Awareness and understanding of key human social & economic considerations can assist with implementation & long-term adoption

What is the current perception of soil health in your region?

What keeps people from implementing & how have others overcome these obstacles?

Source: The Adoption and Diffusion of Conservation Technologies, People, Partnerships, and Communications, Issue 7, Updated June 2005

Adoption Categories



Individual stages of adoption

The producer can return to any one of these stages at any time during the adoption process

Rogers and Shoemaker, 1971

Some Barriers to Soil Health Adoption

Social/Psychological	Paradigm shift – why to adopt?
	Landlord/tenant relationships – lack of land tenure, perception
	Lack of community support – socially, economically, inter-agency organizational barriers and miscommunications
	Recovery from failures
	Risk aversion
Technical	Understanding the soil/plant processes and how management can influence them
	How to adopt management successfully (e.g. rotation, cover crop management, pest management, equipment purchase and set it up, livestock integration).
	How to solve problems/failures
Financial	Lack of information on economic costs vs. benefits and risk
	Installation/initial investment cost (equipment, seed, learning time)
	Markets
	Impacts of policies
OTHER?	

What are some Solutions to these Barriers?

- Facilitate paradigm shifts – build relationships
- Mentor, develop cohorts and peer-to-peer networks
- Develop technical assistance networks
- Develop financial assistance networks
- Train on benefits and agronomic skills/knowledge
- Train on how to transition, how to use technical and economic decision support tools
- Connect producers to available resources, and where they lack; help producers do their own learning

Moving from Awareness to Adoption

- Work to develop relationships with producers
- Pursue opportunities for producer education
- Invite and accompany them to soil health-related events, coffee shop discussions, social media groups
- Invite them to the field and do the assessment together.
- Conduct demos at meetings, field days, equipment auctions, fairs, their farms, etc.

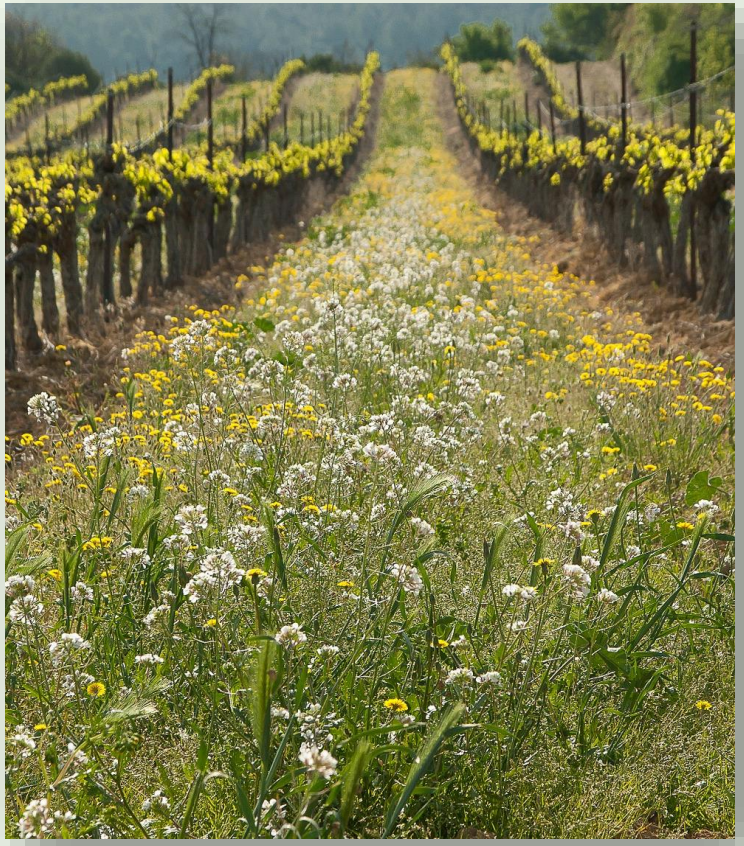
Invest in Managing for Soil Health for a Long List of Benefits:

- Consistent good production
- Healthy crops
- Reduced risk during weather extremes
- Field trafficability
- Reduced runoff, erosion, flooding
- Reduced temperature extremes
- Clean and plentiful water
- Drought resilience
- Air quality
- Healthy environment
- Habitat for beneficial organisms
- Reduced disease & pest pressure
- Improved soil organic matter
- Improved nutrient and carbon cycling
- Carbon sequestration
- Energy savings
- Long-term economic, social, environmental viability
- Sustained reliable productivity – to feed 9

Things to Remember

1. Adopting a soil health conservation system is a long-term investment.
2. Soil degradation does not happen over night, improving soil health also takes time.
3. There are agronomic benefits that result in economic benefits that may not be easily measured, such as reduced risk of yield variability.
4. To realize the greatest benefits from a SHMS, we must find what works best for a producer given THEIR objectives and goals.

Poll (S#3, Q12) Q&A and Discussion



Taking it back to your Day to Day:

1. What's the perception of soil health in your community?
2. What barriers to adopting soil health management practices and systems do you think impact farmers in your area?
3. What solutions do you