Soil Health: Basics, Benefits, Principles, Practices, Barriers

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Objectives for your Mini-Soil Health Journey

Become Conversant and Inspired

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

1. Basics and Benefits
   a) What is “soil health”, why does it matter?
   b) Relation to climate mitigation, adaptation, and resiliency
   c) See healthy soils in action!
2. Adoption: Practices and Barriers
   a) Soil health management systems principles and practices to improve soil health
   b) Barriers to adoption and a snapshot of AFT’s work in this space
3. Producer perspective: Jeremy Brown
   a) Soil health journey and lessons learned
4. Q&A, Discussion
   a) What questions do you have?
   b) What keeps you up at night?
   c) What inspires you, what can you do?

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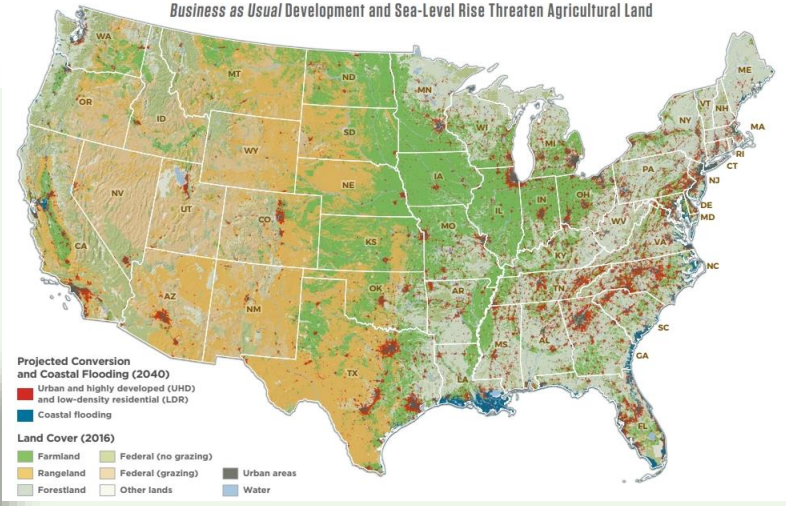
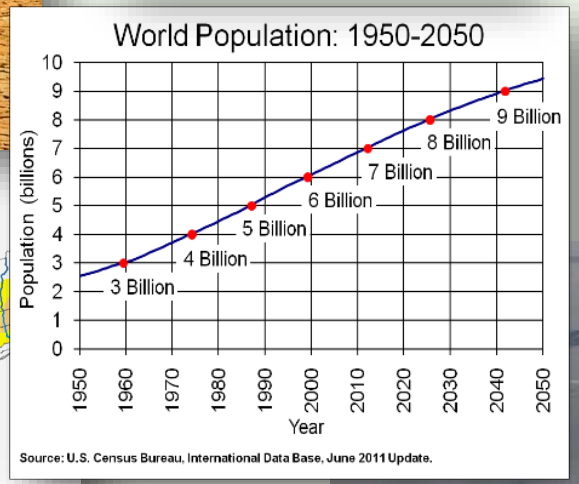
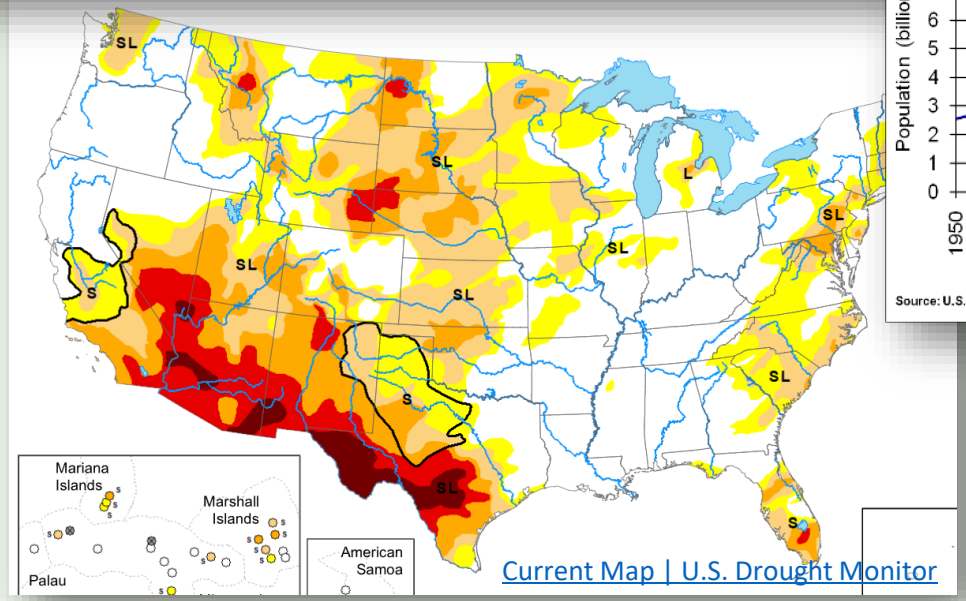
Challenges for Agriculture and Society

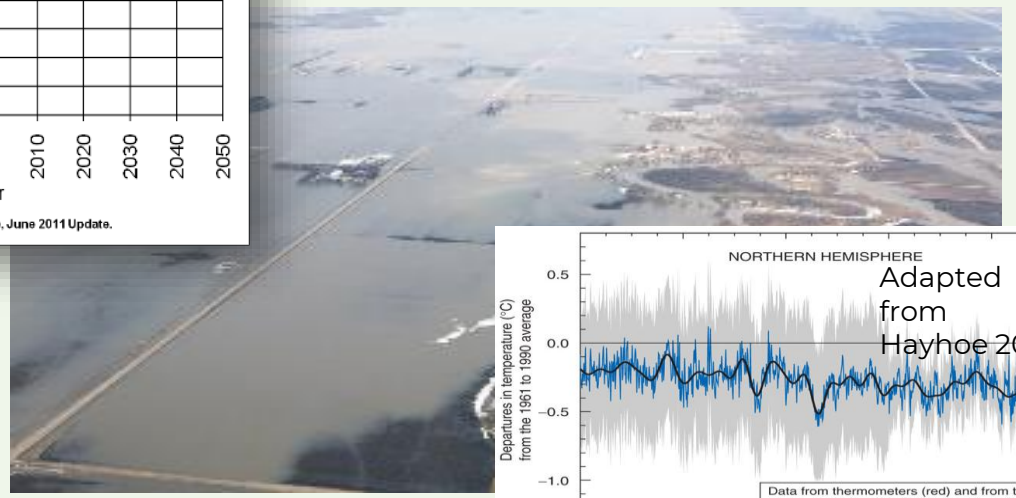


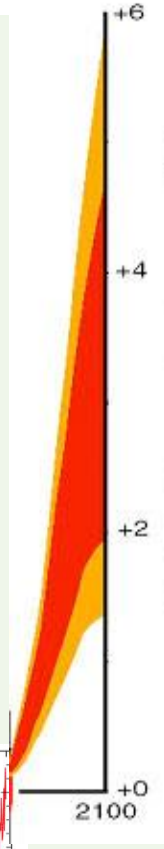
Farms Under Threat 2040, American Farmland Trust, 2022



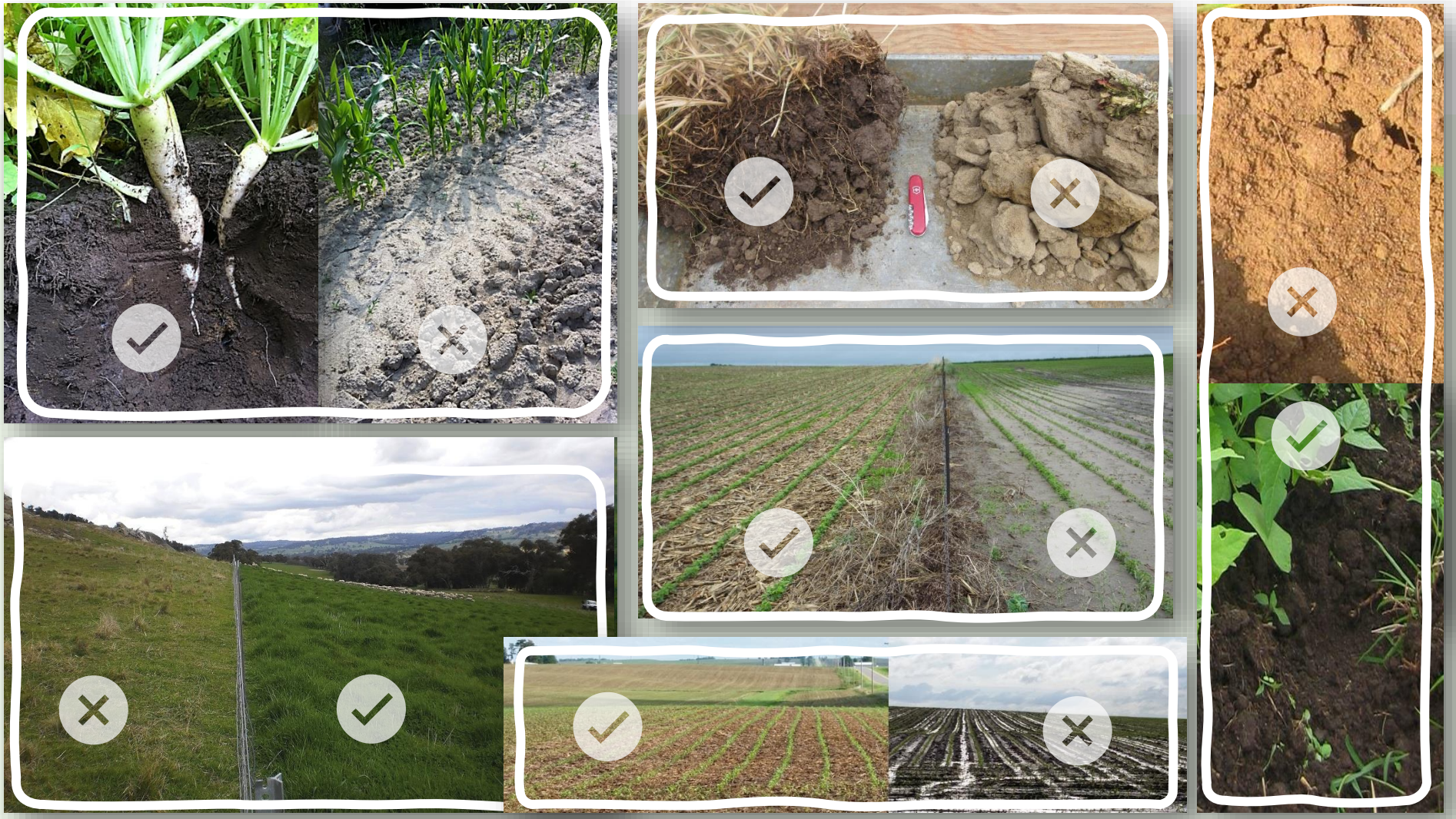


[Current Map | U.S. Drought Monitor]





Win-Win Solutions: Build High Functioning, Resilient, Healthy Soils and Economically Viable Regenerative Climate Neutral or Better Systems



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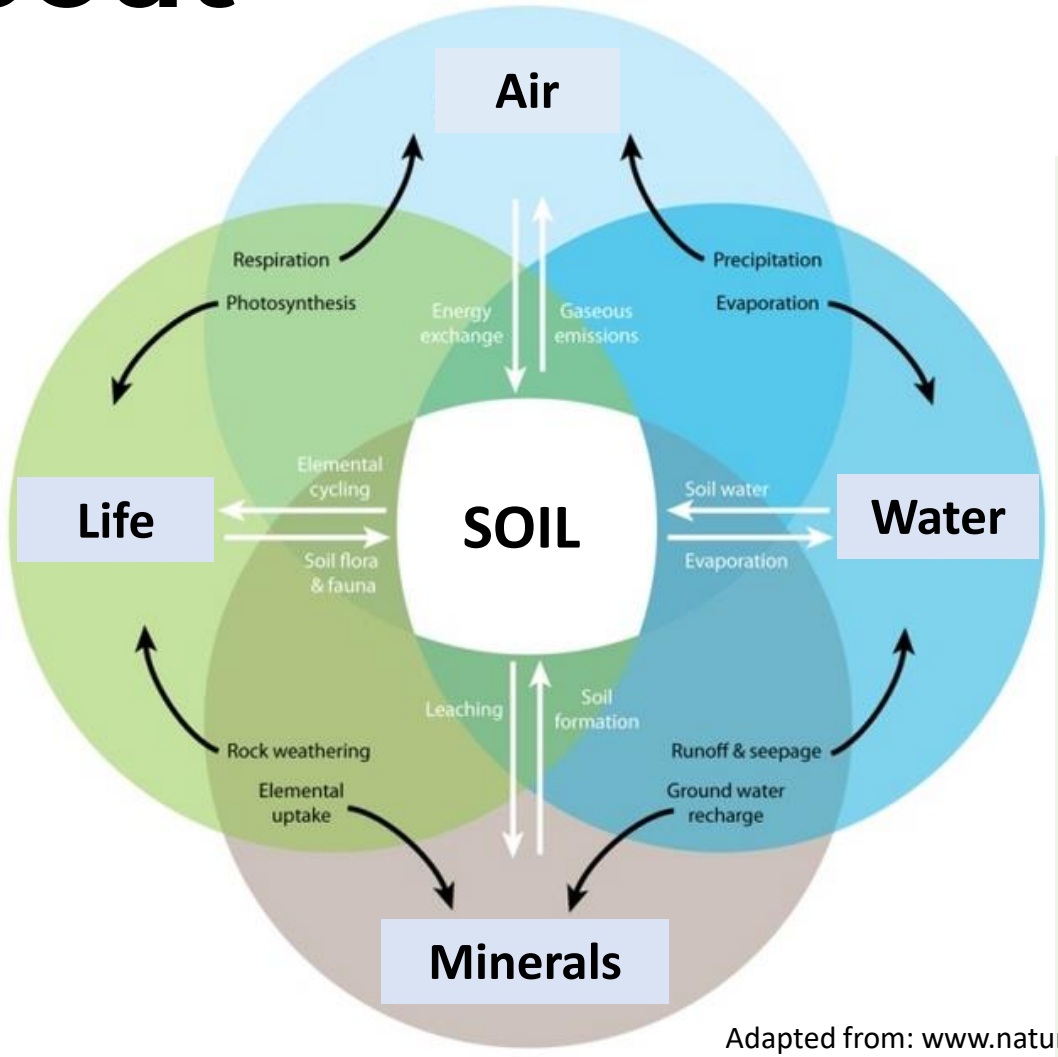
Wikipedia

“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's so special about soil and its health?

"Soil" is an Interface and Foundation



Adapted from: www.nature.com

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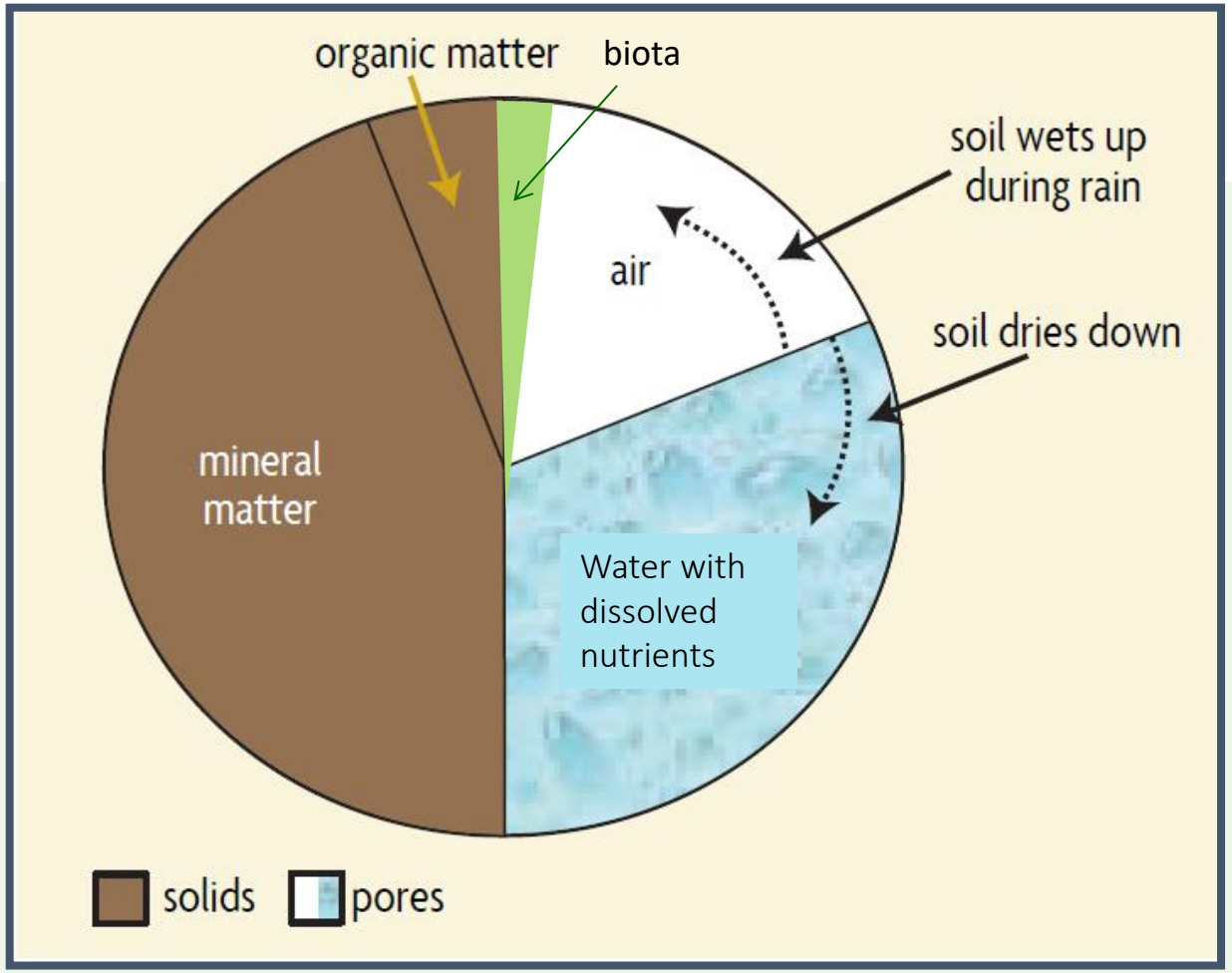
Soil Composition



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.

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

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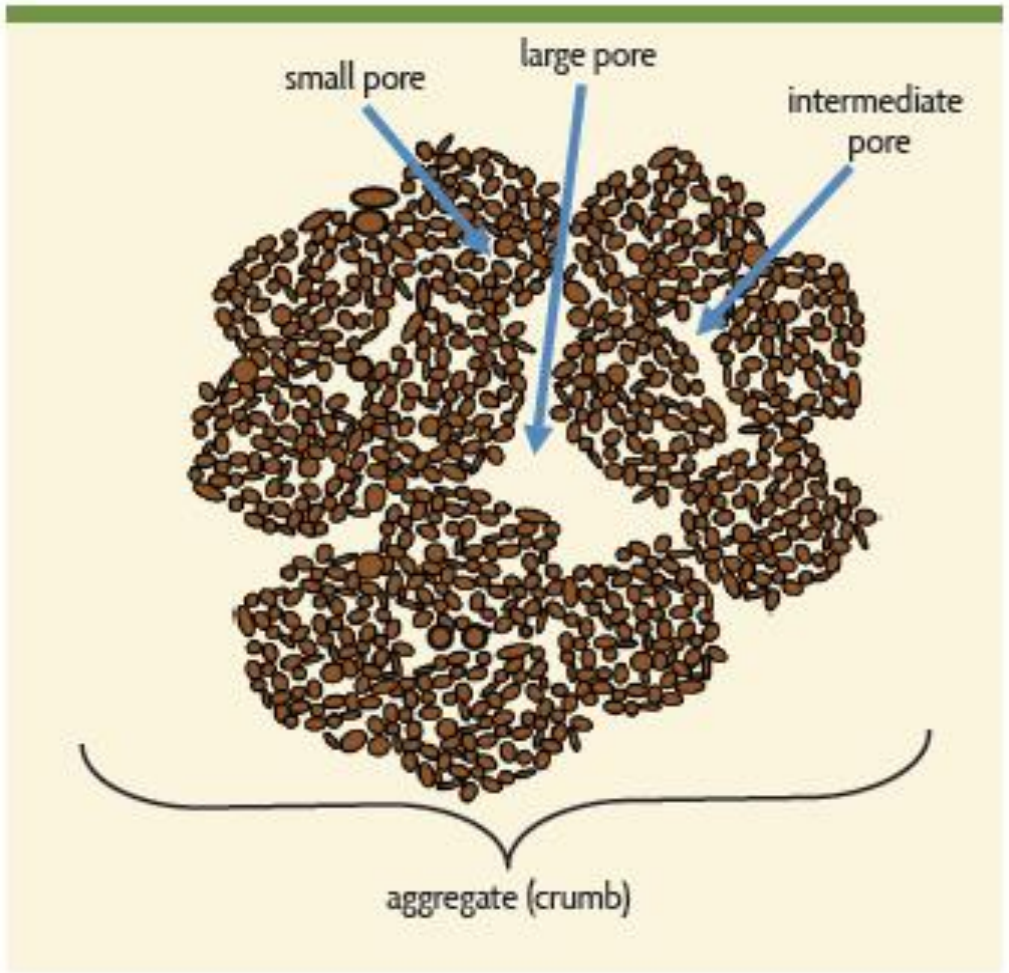
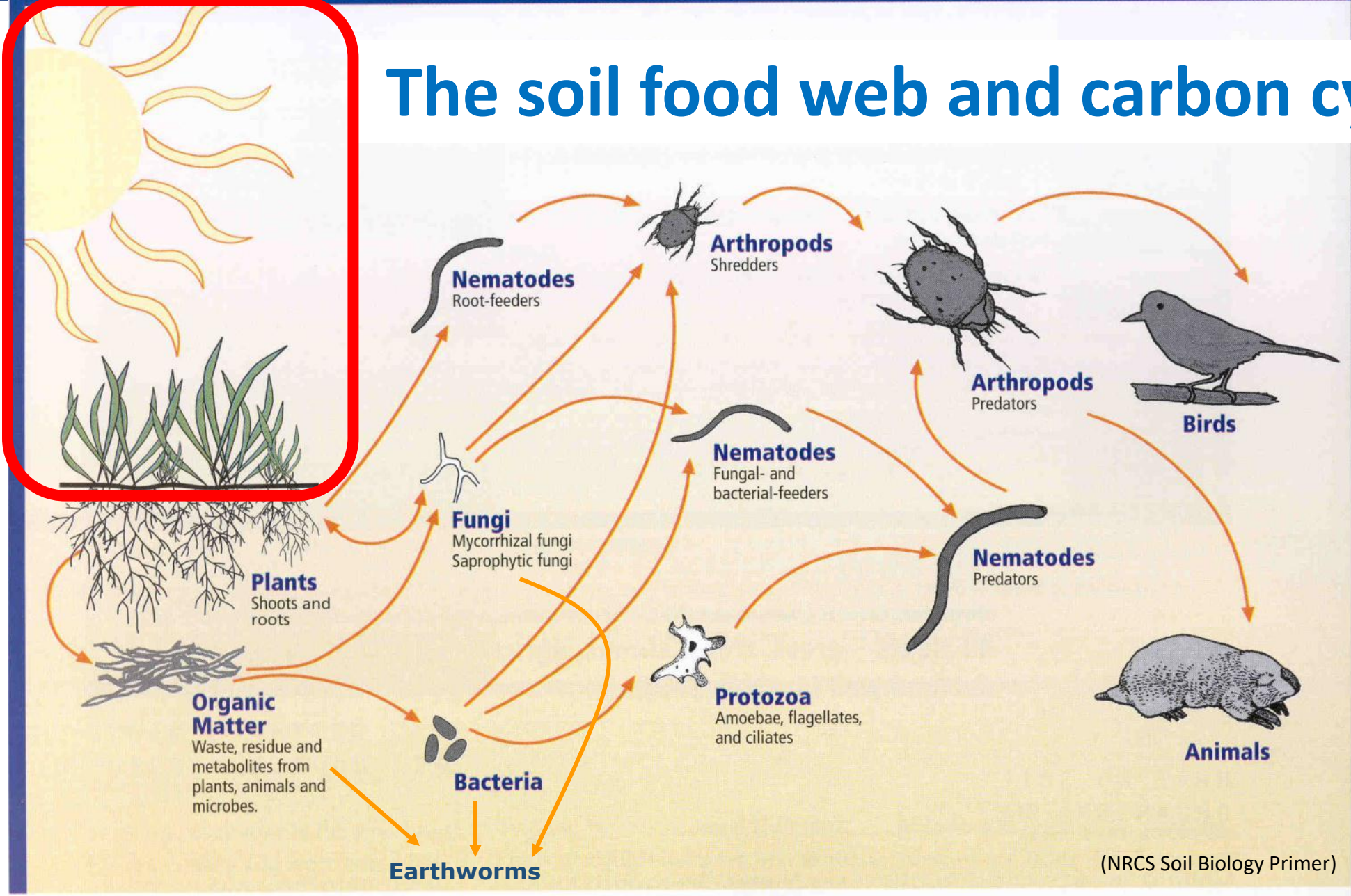
An Aggregate is like a House

The interesting stuff is going on in the “empty” spaces!



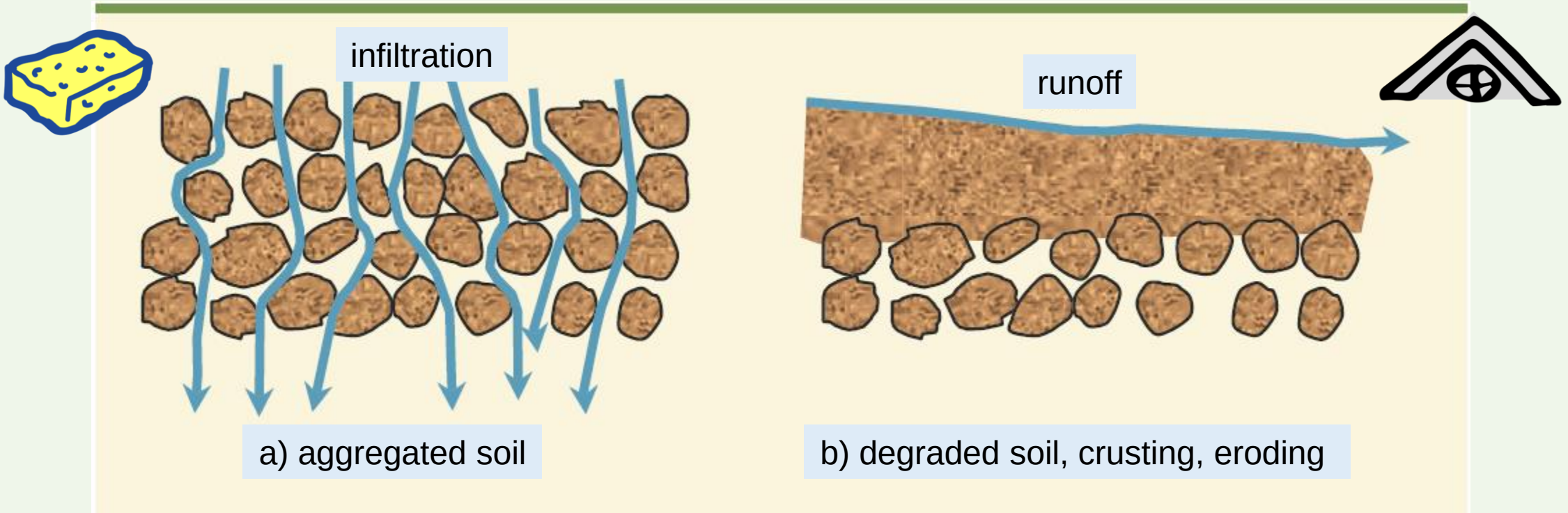
The soil food web and carbon cycling



(NRCS Soil Biology Primer)

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

Good soil structure important for Adapting to extreme weather



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

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

Soils of Poor Soil Health are not Resilient

- Hard soil, plowing up cloddy soil and poor seedbeds
- Rapid onset of stress or stunted growth during dry or wet periods
- Rutting and ponding
- Discolored crop leaves
- Signs of runoff & erosion
- Poor growth of plants
- Soil crusting
- High disease or pest pressure
- Declining yields
- Increasing costs, same returns
- More on this in the soil health assessment break out session


Ponding, rutting


Clods


Poor growth


Crusting


Crusting


Plowing up cloddy


Hard soil, horizontal cracking

Soil Function Loss!


Lynn Betts, USDA-NRCS


Lynn Betts, USDA-NRCS


Bob Nichols, USDA


B.Moebius-Clune


Inflation Solutions

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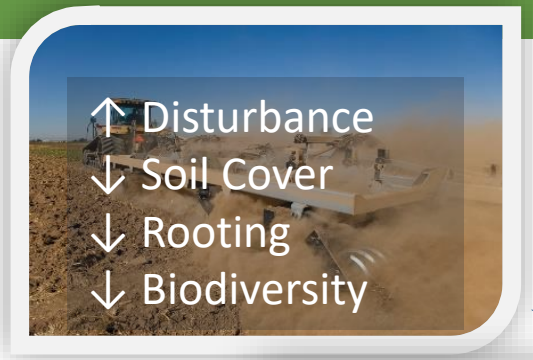
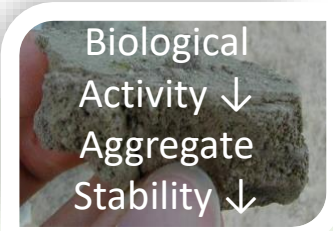
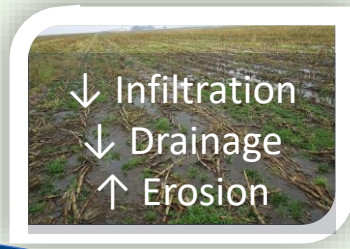
Downward Spiral of Soil Degradation

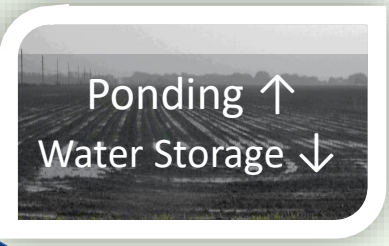
Bianca Moebius-Clune, PhD

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









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

Dust storms on the Great Plains more common and intense in the past 20 years with increased droughts

A dust storm in the Texas panhandle in 2020.
Image: Keith Ladzinski/ National Geographic

Research source: Lambert et al. 2020. **Dust Impacts of Rapid Agricultural Expansion on the Great Plains. Geophysical Research Letters** https://doi.org/10.1029/2020GL090347

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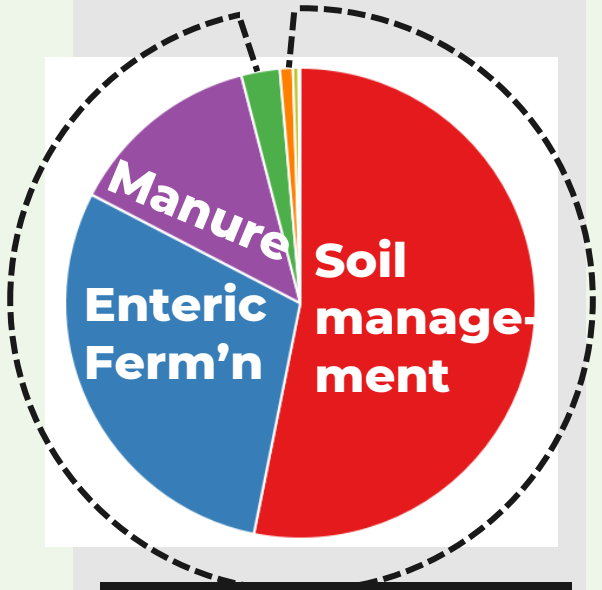
Ag: a solution for our climate challenge

US GHG emissions from Ag by Activity



>98% emissions from ag are CH_4 and N_2O

Climate Adaptation and Mitigation Solutions by Ag:

Many of the same systems of practices that reduce net ag emissions, also build farm viability & resilience to climate change.

Biophysical levers for change

- *Reduce CH_4 emissions*
- *Reduce N_2O emissions*
- *Build soil organic C*

We also work with social levers of change: ADOPTION!

Data source: US EPA Inventory of US GHG emissions and sinks: 1990-2020. Photo by Rebecca Drobis for AFT. Lever icon by Arthur Shlain via the Noun Project.

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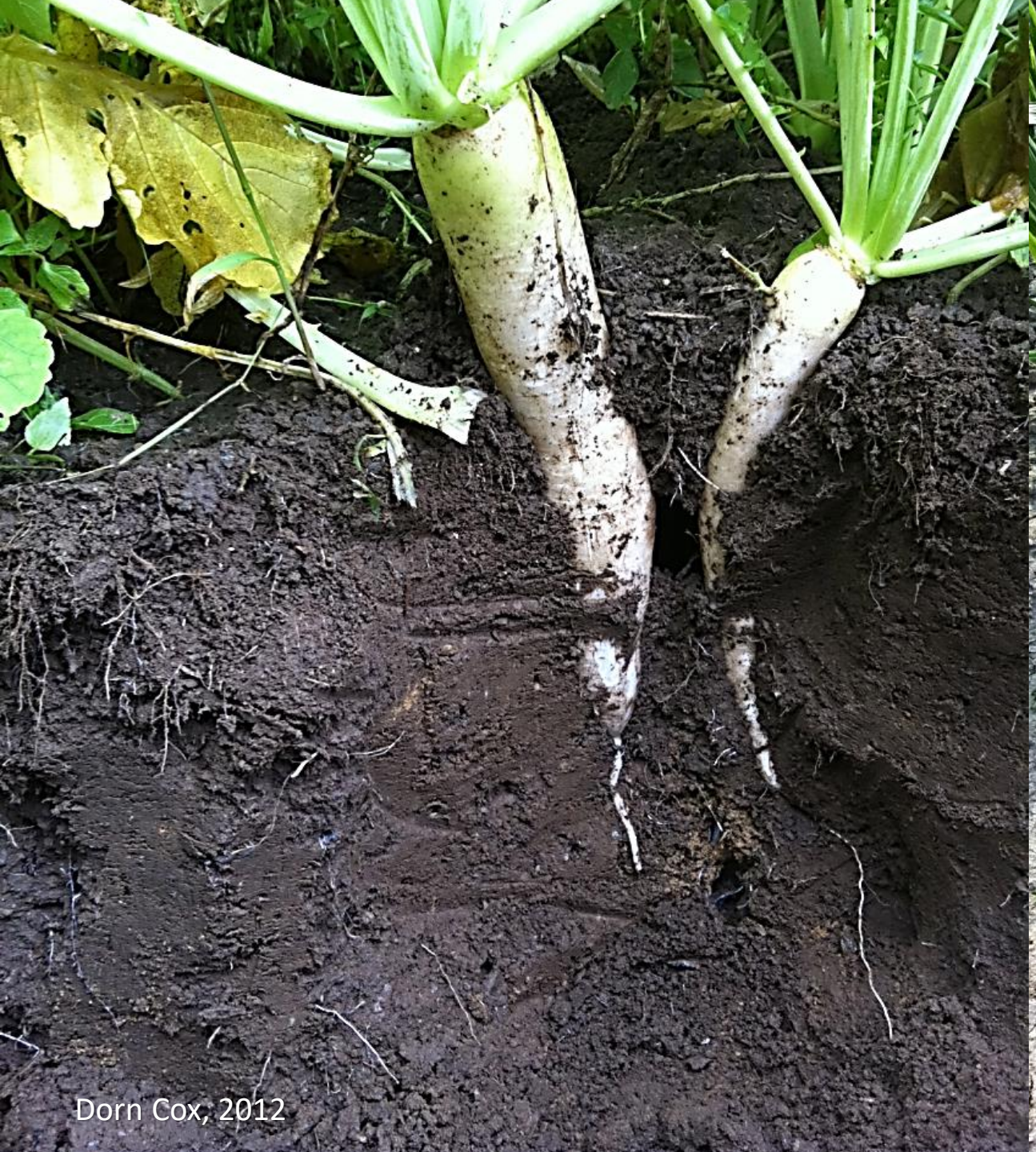
Dorn Cox, 2012


Bianca Moebius-Clune, 2012

Return on our Nation's Soil Health Investment

Changing the Face of Agriculture and How We Feed our Nation

Return on our Nation's Soil Health Investment

Changing the Face of Agriculture and How We Feed our Nation

Dust Bowl farm field. Source: USDA Soil Conservation Service.

Cotton seedlings in a terminated small grain cover crop in the Texas Rolling Plains. Source: Texas A&M AgriLife by Paul DeLaune.

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Infiltration - Brookings County, SD

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

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

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

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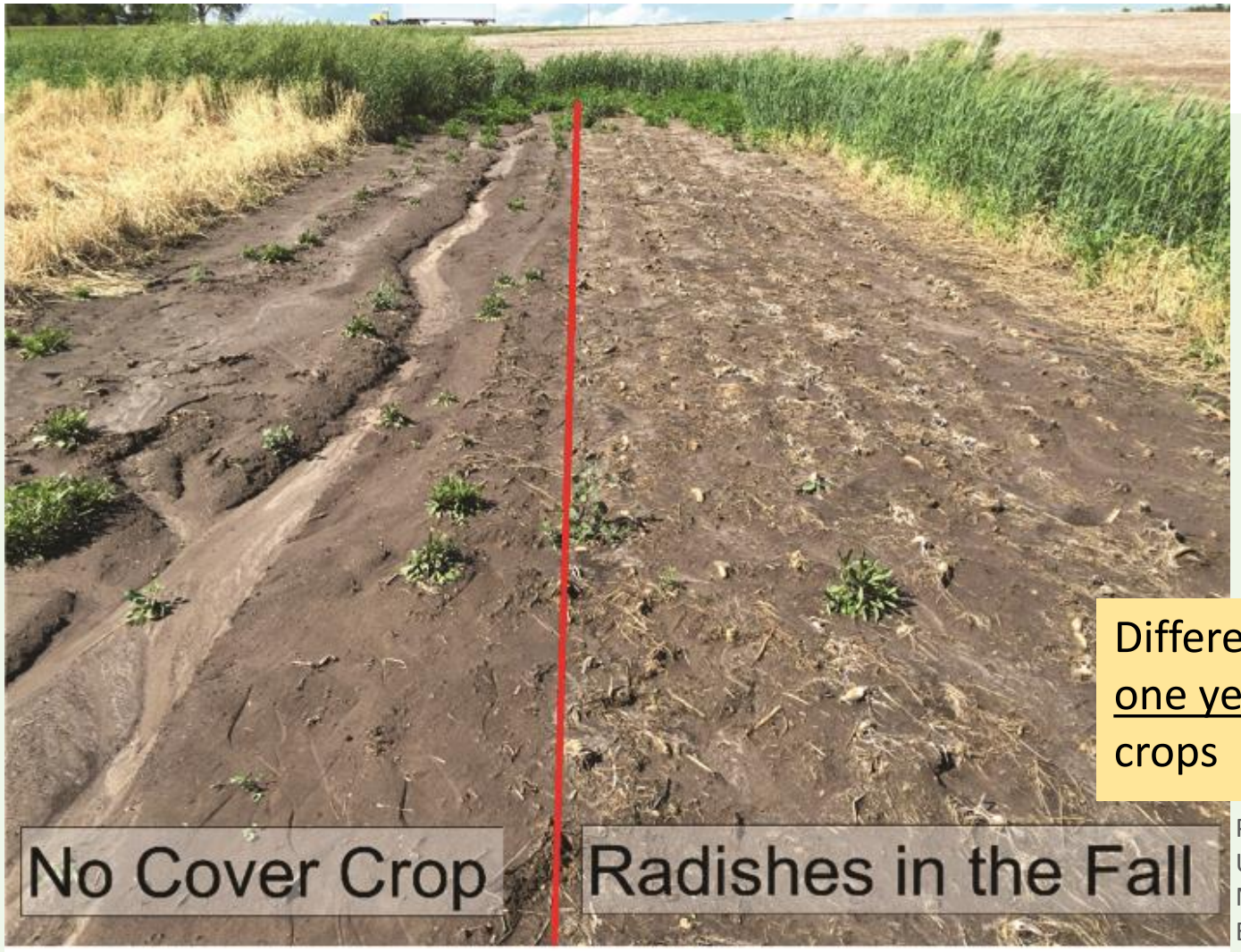
Resilience – Erosion differs with Soil Management

East Nebraska
May 2016

Same soil type & location, different management

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



Difference from just <u>one year</u> of cover crops

Photo by University of Nebraska Extension

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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

4 Soil Health Principles that Conserve the Soil Ecosystem

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

<u>ALL adapted</u> to the unique production system, soil, climate, and farmer/rancher, who now also needs to adapt their use of technology, nutrient and pest management to this new system

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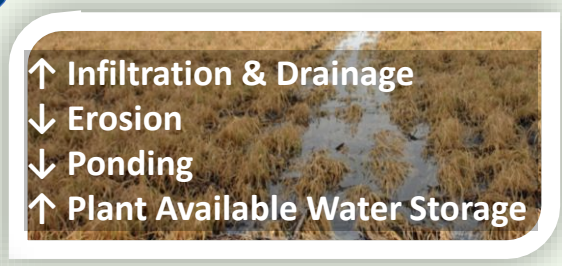
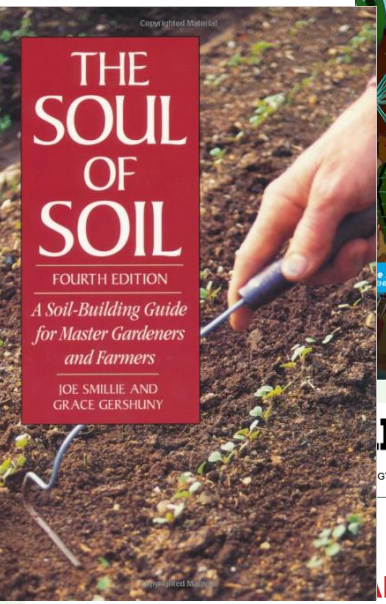
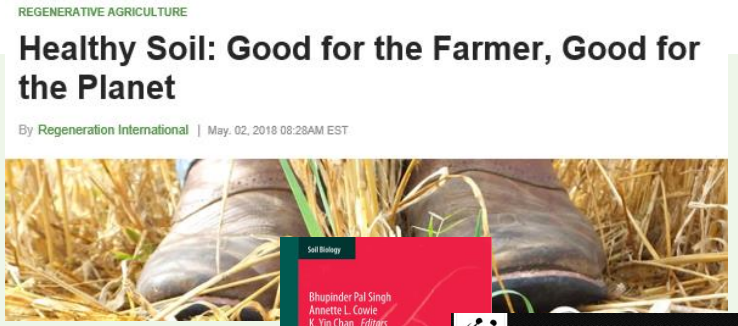
Goal: Win-Win Soil Health Management Systems are Commonplace

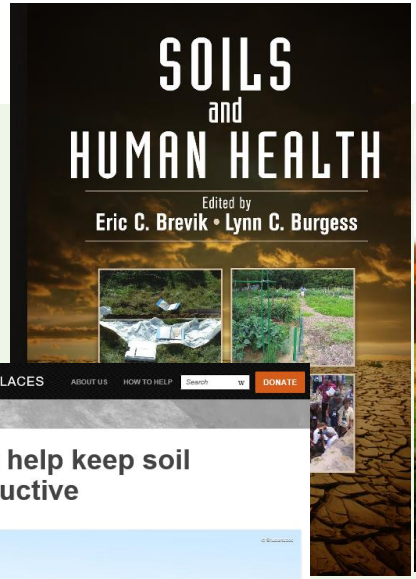


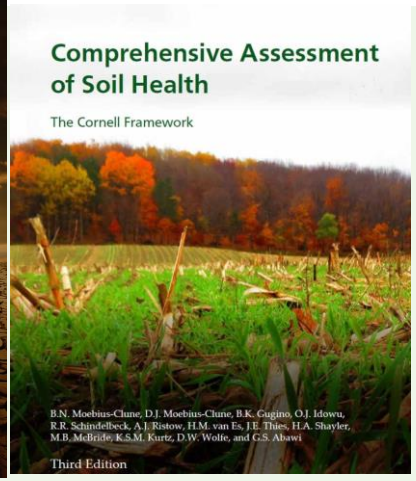
Adapted by Moebius-Clune and Cox from Building Soils for Better Crops, 3rd ed.

Soil Health in Popular Press and Books has been Gaining Momentum for Decades!

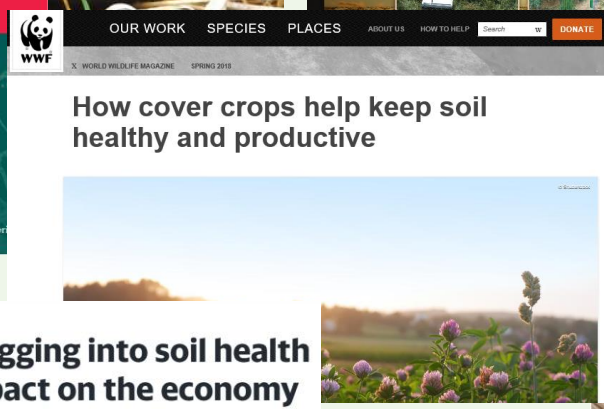


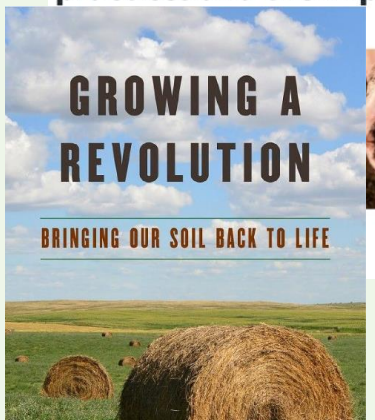


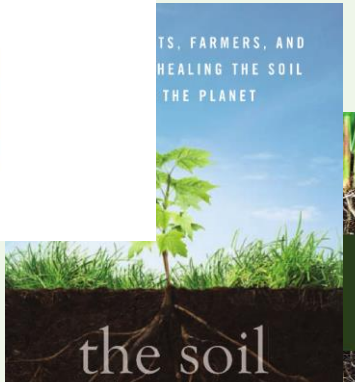


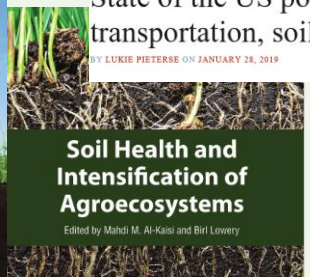


SERIOUSLY
FROM SOIL HEALTH SUMMIT, MCDONALD









Federal lawmakers digging into soil health practices and the impact on the economy

State of the US potato industry: Tariffs, transportation, soil health top issues
BY LUKIE PIETERSE ON JANUARY 28, 2019

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VISION:
A New Conventional Agriculture

… where diverse, climate-smart, and soil health-promoting agricultural systems ensure a prosperous and resilient future for farmers and the land that sustains us

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Healthy Soils in Action

Cochrane, NRCS

[Also on Youtube: 1 min Slake Demo – Ray Archuleta]

[17 min Demonstration Training – Doug Peterson]

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Care for your belowground livestock as you would your aboveground livestock!

Biota have two needs:

1. **HOME: *Protect*** their home – soil structure, water, air

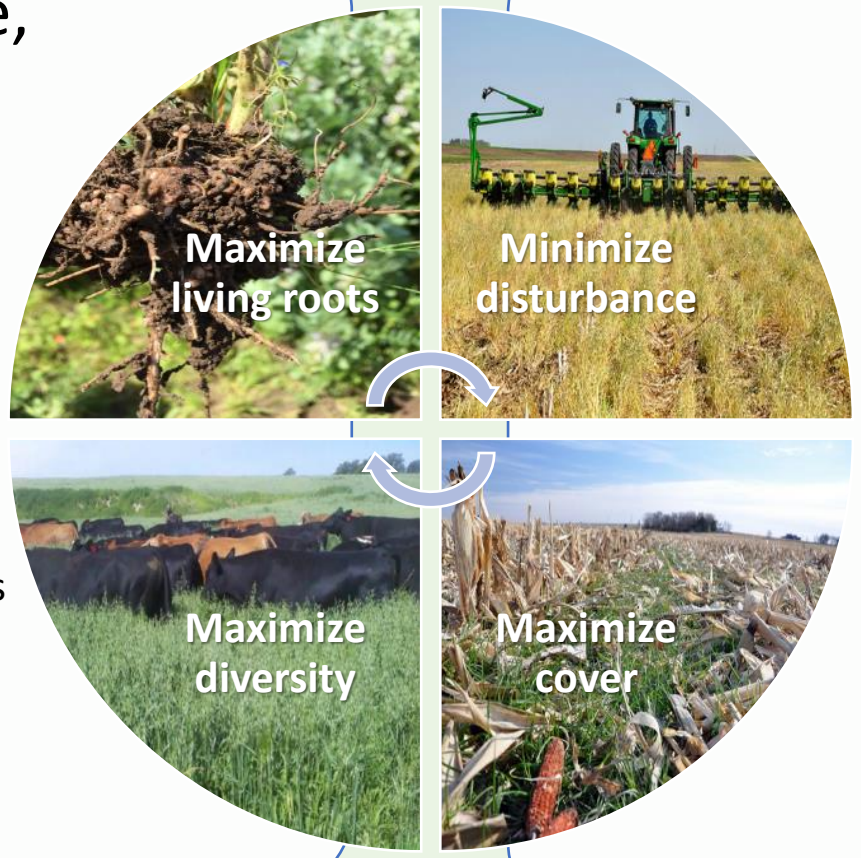
2. **FOOD: *Feed*** belowground life a diverse, year-round diet, including energy & nutrients

NRCS Publications - Item Detail (usda.gov)

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

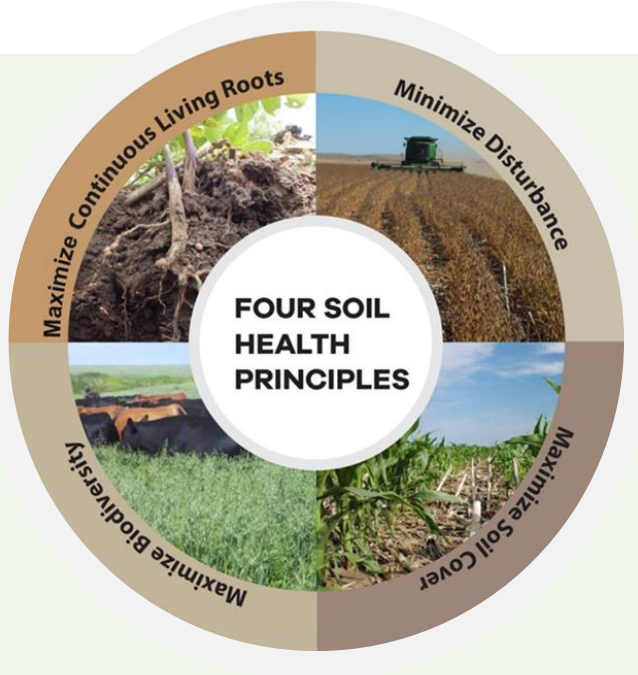


Protect habitat aggregates, structure, water, air, temperature

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

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, adapted to 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 need development and innovation to be successfully adapted to diverse production systems, climates, ecosystems, and soils to effectively build healthy, functioning soil.

Practices to meet Soil Health Management Systems Principles?

https://directives.sc.egov.usda.gov/44340.wba

Conservation Practice

Soil Health Principle	Conservation Cover (327)	Conservation Crop Rotation (328)	Cover Crop (340)	Forage & Biomass Planting (512)	Pest Mgmt. Conservation System (595)	Mulching (484)	Nutrient Mgmt. (590)	Prescribed Grazing (528)	Residue & Tillage Mgmt. (329/345)
Minimize Soil Disturbance	✓			✓	✓		✓	✓	✓
Maximize Soil Cover	✓		✓	✓		✓		✓	✓
Maximize Biodiversity	✓	✓	✓	✓				✓	
Maximize Living Roots	✓	✓	✓	✓				✓	

Table 1. Conservation practices that can be used in a soil health management system to help achieve the soil health principles.

New addition 336 Soil Carbon Amendment

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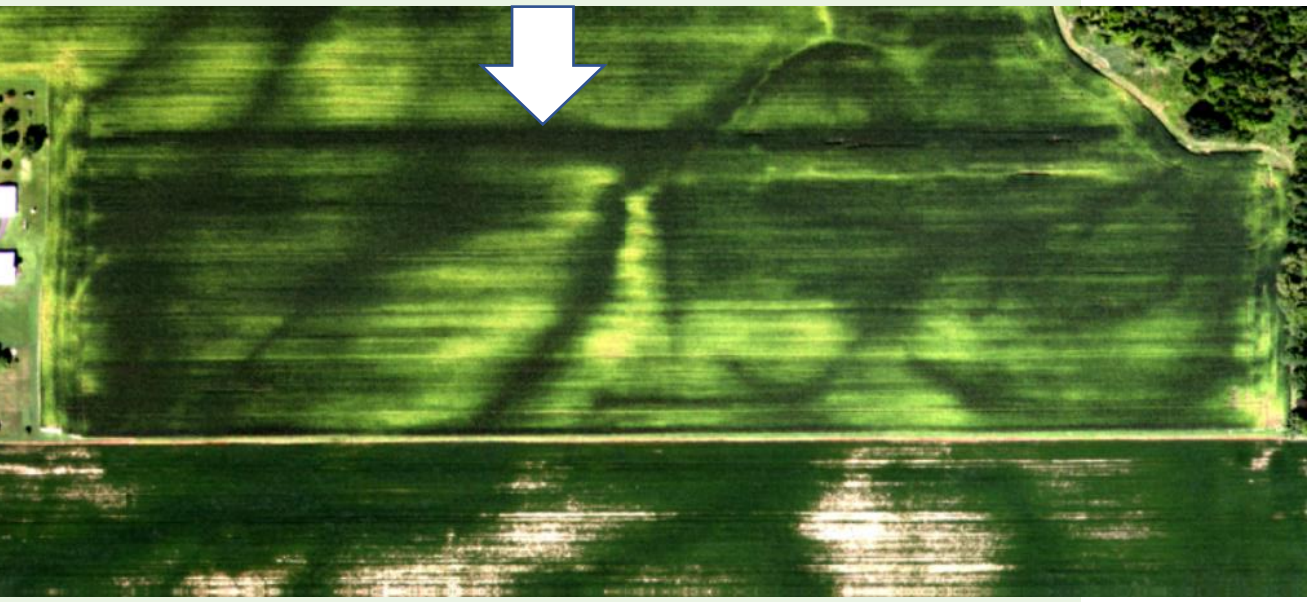
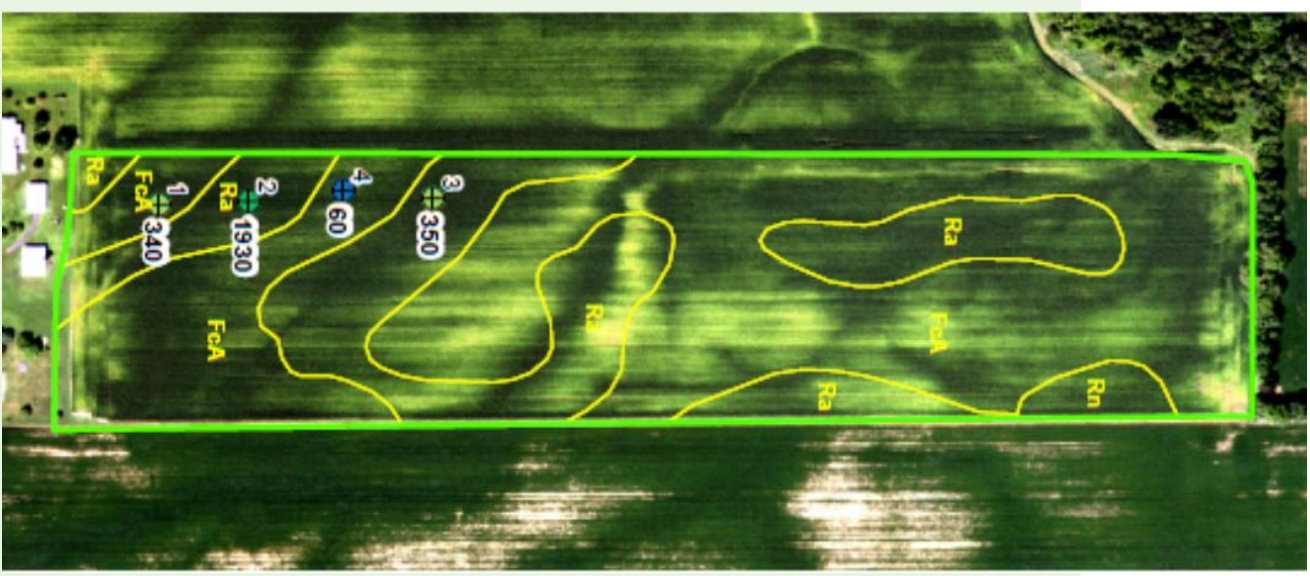


The Fence Row Effect



Principles at work

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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 (non-optimal fertilizer, pesticides, soil amendments)
- Biological (over grazing, non grazing, fallow systems, monoculture plant community)

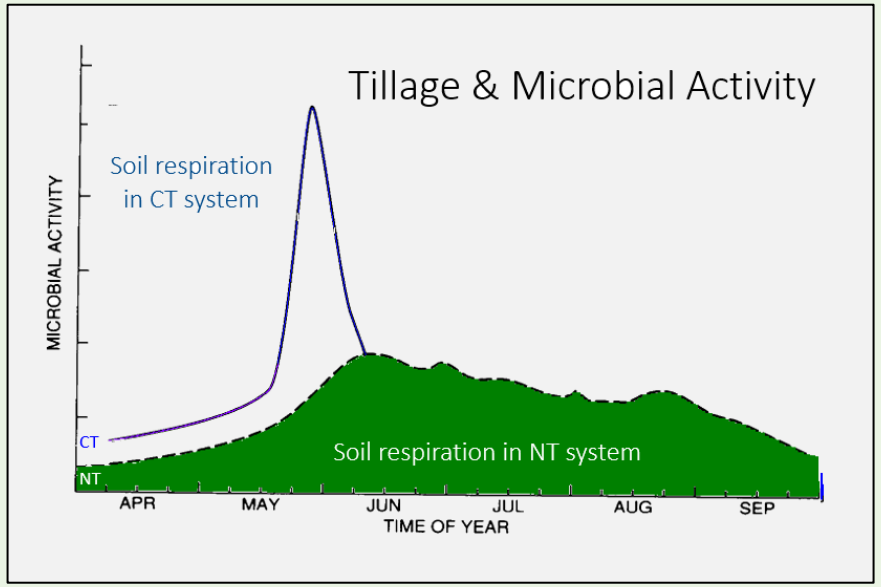
Effects of Excessive/Chronic Disturbance:

- ↓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

Photo by John Haverfield

What Practices Maximize Soil Cover?

Cotton seedlings in a terminated small grain cover crop in the Texas Rolling Plains. Source: Texas A&M AgriLife by Paul DeLaune.

- 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/graze crops or cover crops in what is off-season for annual crops
- Avoid bare fallow
- Avoid overgrazing
- Increase time in perennial crops
- Manage rotations, intercropped mixtures, forage height, grazing timing

What Practices?

- Conservation Crop Rotation (328)
- Conservation Cover (327)
- Cover Crop (340)
- Forage & Biomass Planting (512)
- Prescribed Grazing (528)
- Soil Carbon Amendment (336)

Maximize Biodiversity

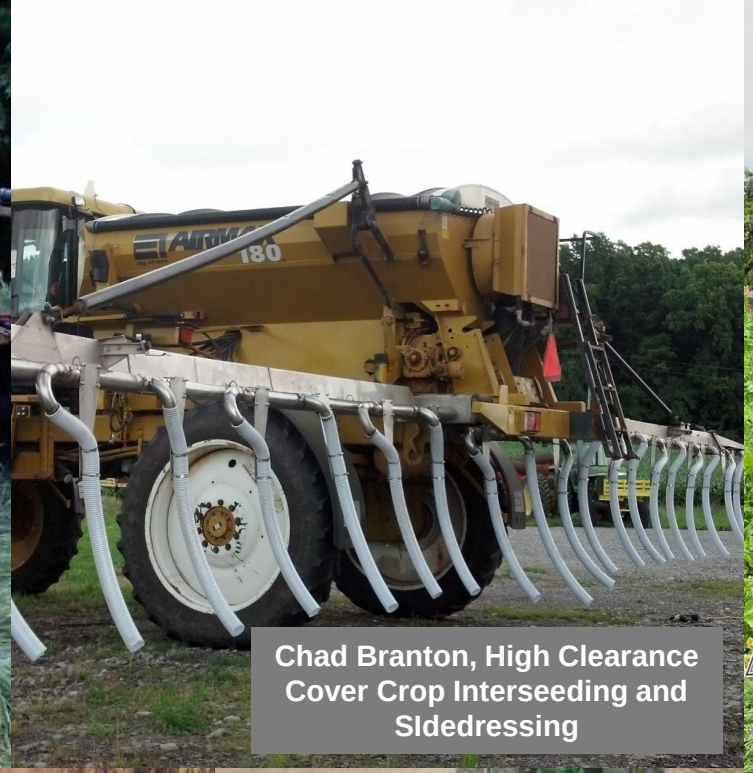
How?

- 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)
- Soil Carbon Amendment (336)

Roller crimping, credit Dorn Cox



Chad Branton, High Clearance Cover Crop Interseeding and SIdedressing

Alli Fish & Daikon radish cover crop in California, credit Rose Hayden-Smith

Dorn Cox, Triticale and Winter Peas

Zone tillage

Biochar, credit Kristin Trippe

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

Taking Soils to the Doctor: Soil Health Assessments Available

Improve awareness of Soil Health, its benefits & opportunities

Understand, diagnose constraints or resource concerns beyond nutrient limitations and excesses

Target management practices to alleviate identified constraints

Feed & Shelter Your Underground Livestock!

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Adopting Soil Health Practices

For implementation & long-term adoption, need to understand

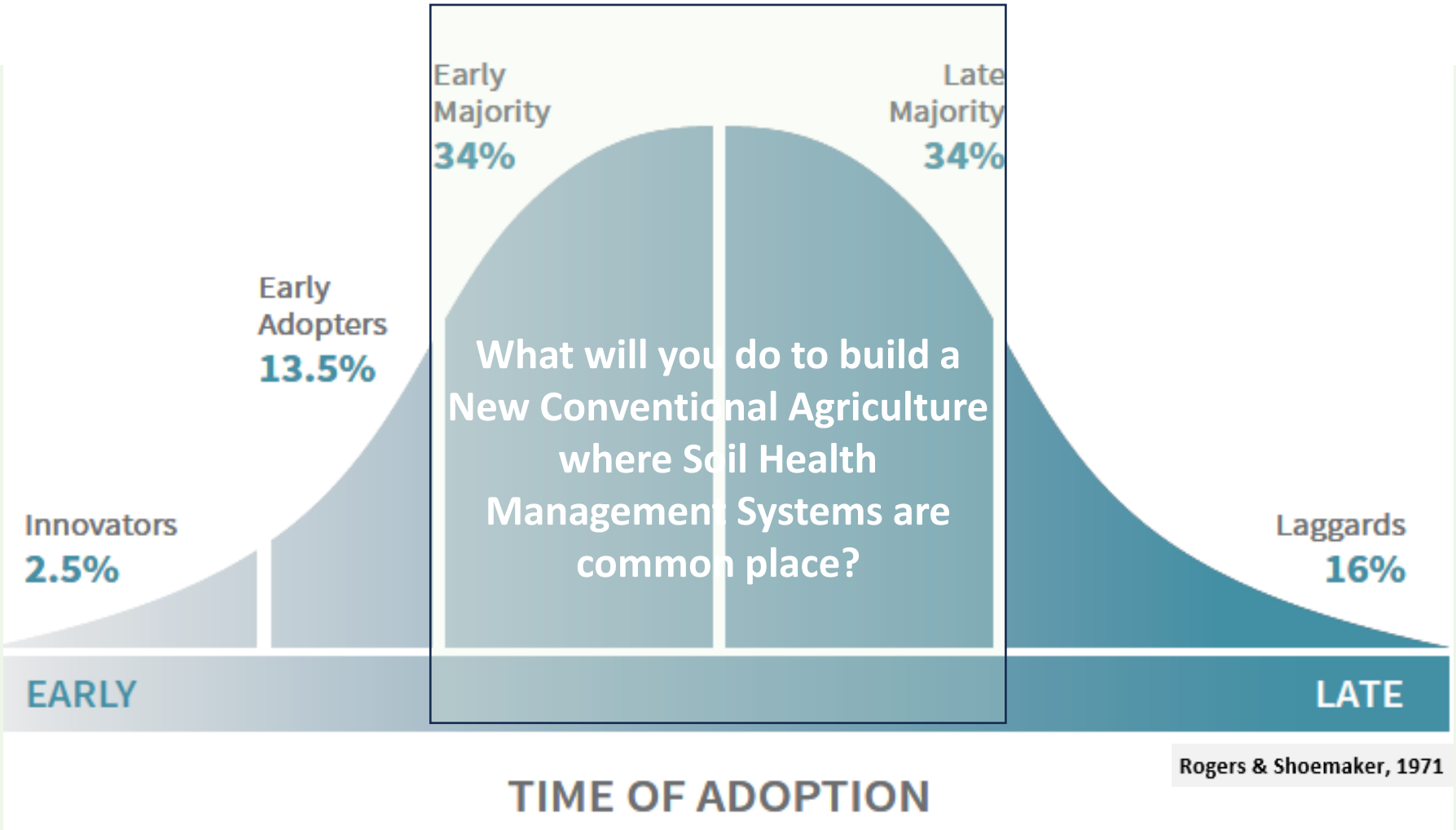
- Physical resource and production system
- Key human social & economic considerations

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

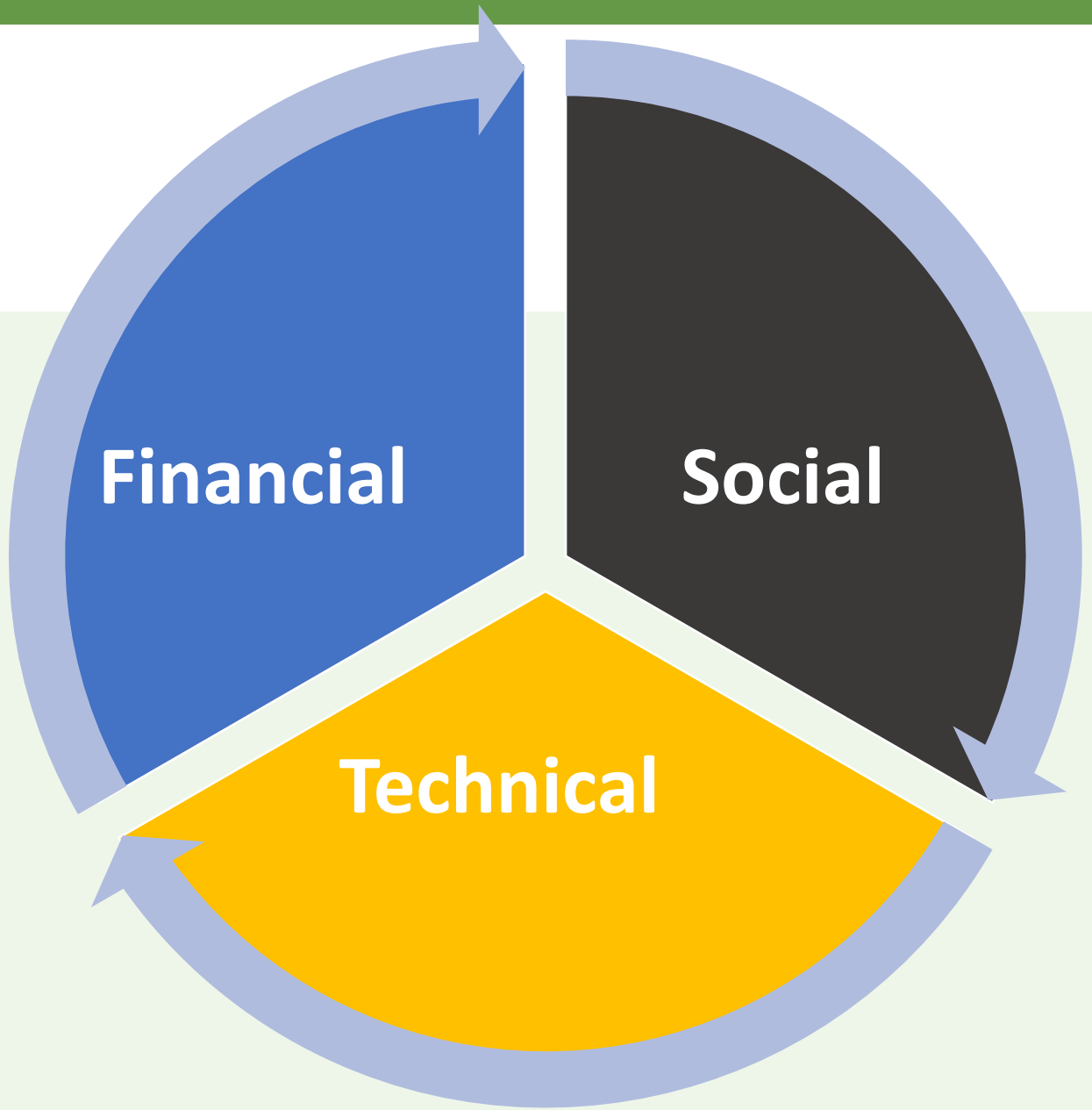
What keeps people from implementing & how have others overcome these obstacles?

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

Adoption Categories



AFT Tackles Barriers to Soil Health Adoption



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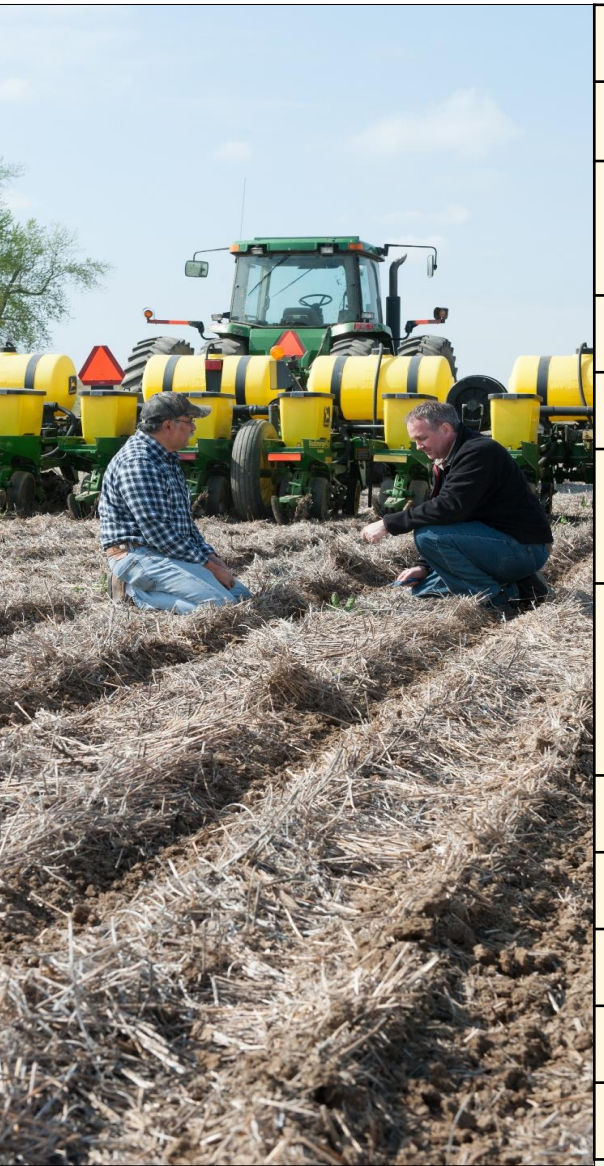
Common Barriers to Soil Health Adoption



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 – how do you start and build up for a production system? (e.g. crop 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

Moving from Awareness to Adoption

For your Soil Health Action Plan Consideration

- Develop relationships with and among producers
- Pursue opportunities for producer education and networking: soil health-related events, coffee shop discussions, social media groups
- Have a conversation in the field and assess soil health together.
- Conduct demos at meetings, field days, equipment auctions, fairs, farms, etc.

What are some Solutions to these Barriers?

For your Soil Health Action Plan Consideration

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

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Things to Remember

Cotton seedlings and cover crop thatch. Source: Texas A&M AgriLife by Paul DeLaune.

1. Adopting a soil health management 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 loss.
4. To realize the greatest benefits from a SHMS, we must find what works best for each producer given THEIR objectives and goals.

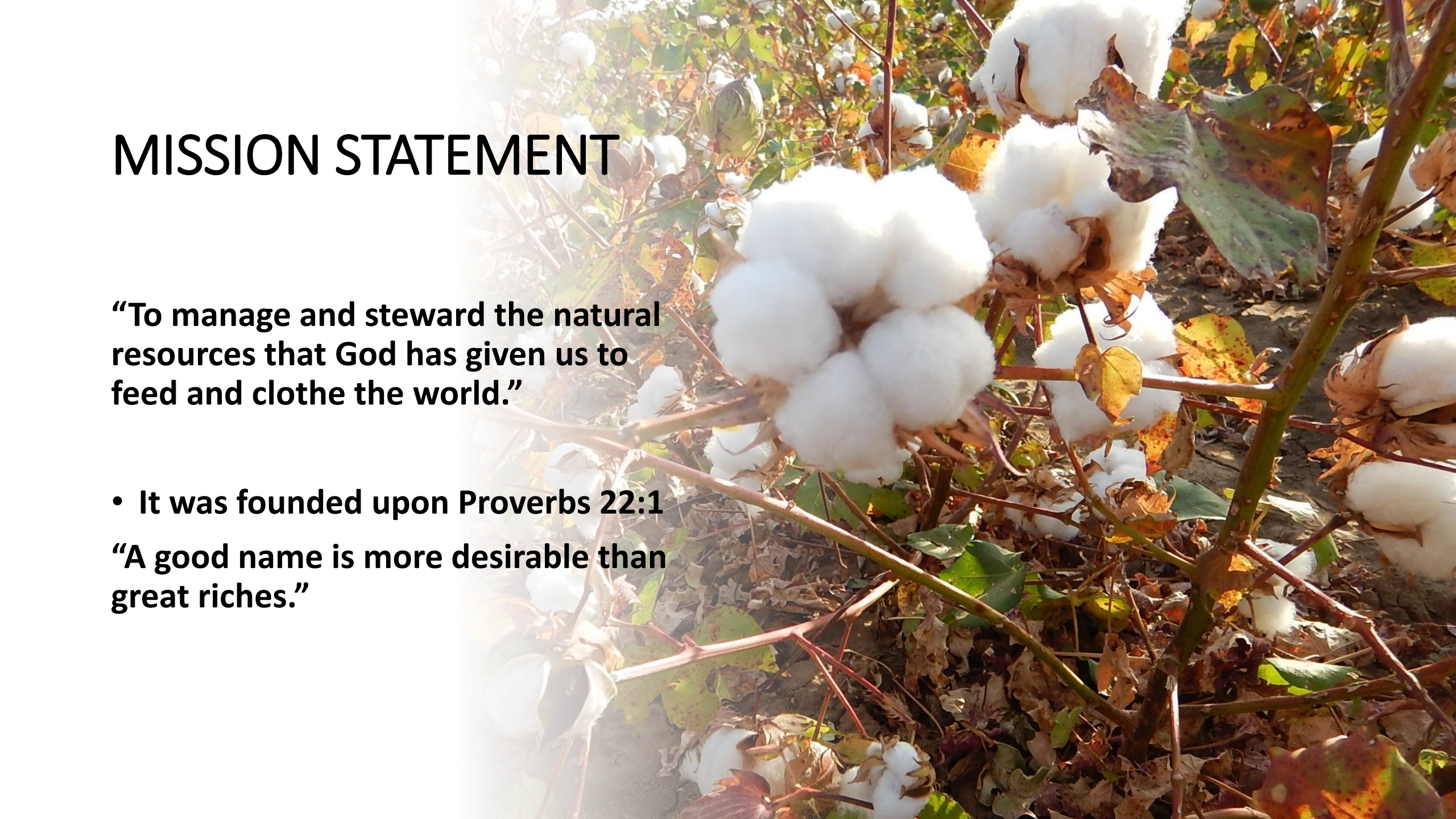
Jeremy & Sarah Brown

MISSION STATEMENT

“To manage and steward the natural resources that God has given us to feed and clothe the world.”

- **It was founded upon Proverbs 22:1**

“A good name is more desirable than great riches.”



Broadview Ag is committed to:

- Producing quality crops that will provide food and fiber for the world.
- Being a good steward of the land and its natural resources through regenerative practices.

Our Operation

- Our philosophy is that if you take care of the land, it will take care of you.

- Matthew 13:8 “… still other seed fell on good soil, where it produced a crop – a hundred, sixty or thirty times what was sown. “

Our Operation

- Breakdown of Acres
  - Total Acres 4200
  - 3700 acres certified organic
  - All acres are certified Regenerative through Regenfied.
  - 1500 acres irrigated (35%)

Our Operation

REGENIFIED CERTIFICATE

Broadview Agriculture

PO Box 64214 Lubbock, TX 79464

Meets the comprehensive Regenified standard to achieve

Tier 2 Regenified

Cotton, Grains

Certificate Reference Number: 0000273-19
Certificate Issued: 11-07-2023
Regenified Effective Date: 11-07-2023
Anniversary Date*: 11-07-2024

Regenified™

Doug Peterson, Regenified Verifier
On behalf of Verification Review Board

*The Anniversary Date is the date by which this operation must be re-evaluated for progress to maintain Regenified status.

6 Pillars of Regenerative Agriculture

- 1. Know Your Context
- 2. Limit Disturbance
- 3. Armor
- 4. Diversity
- 5. Living Roots
- 6. Integrate Livestock

1. Know Your Context

"You cannot outperform your environment" – Gabe Brown

1. Know Your Context

30-year average annual rainfall

18 inches

May – August

9 inches on average

Most rainfall comes in

May, June, & September

2. Limit Disturbance

Limit mechanical, chemical and physical disturbance

3. Armor

Keep the Soil Covered; Nature always works to cover itself.

Terminated Cover before Planting Cotton

4. Diversity

There is no monoculture in nature.

- Inter Seeding Multi Species Cover Crop August-September

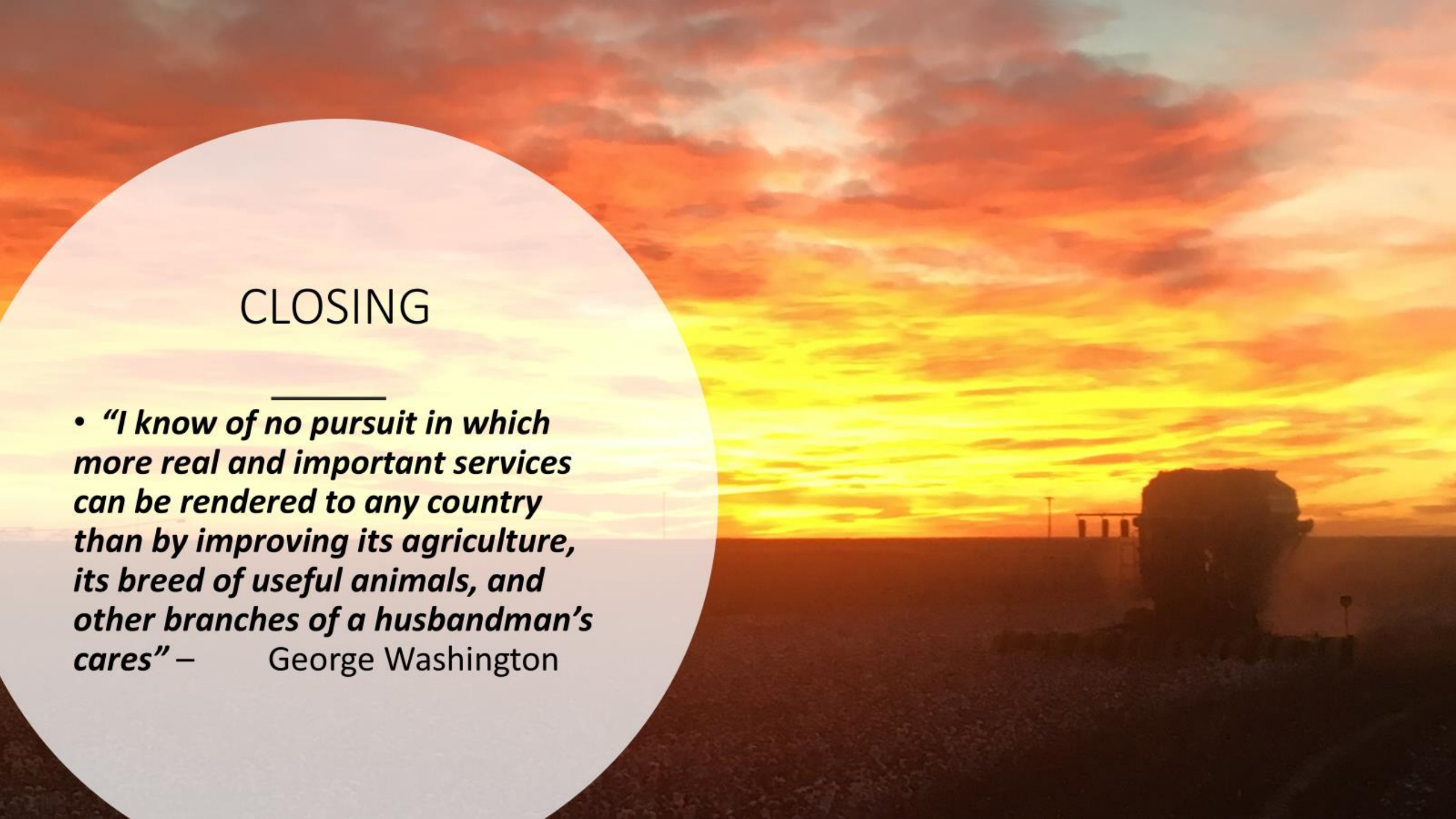
5. Living Roots

Maintain a living root in the soil as long as possible throughout the year.

6. Integrate Livestock

Nature does not function without animals.

Grazing plants stimulates the plants to pump more carbon into the soil.



CLOSING

- ***"I know of no pursuit in which more real and important services can be rendered to any country than by improving its agriculture, its breed of useful animals, and other branches of a husbandman's cares"*** – George Washington

Thank You

Q&A Discussion

Taking it back to your Day to Day:

1. Questions?
2. What challenges keep you up at night?
3. Any aha moments? – What did you learn that most surprised you?
4. What will you do with this experience?
5. What can you catalyze through your work?