



# Soil Considerations in Agroforestry

Allen Casey, NRCS  
Plant Materials Center  
[allen.casey@usda.gov](mailto:allen.casey@usda.gov)



# What Functions Would We Like our Soil to Provide?

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- 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

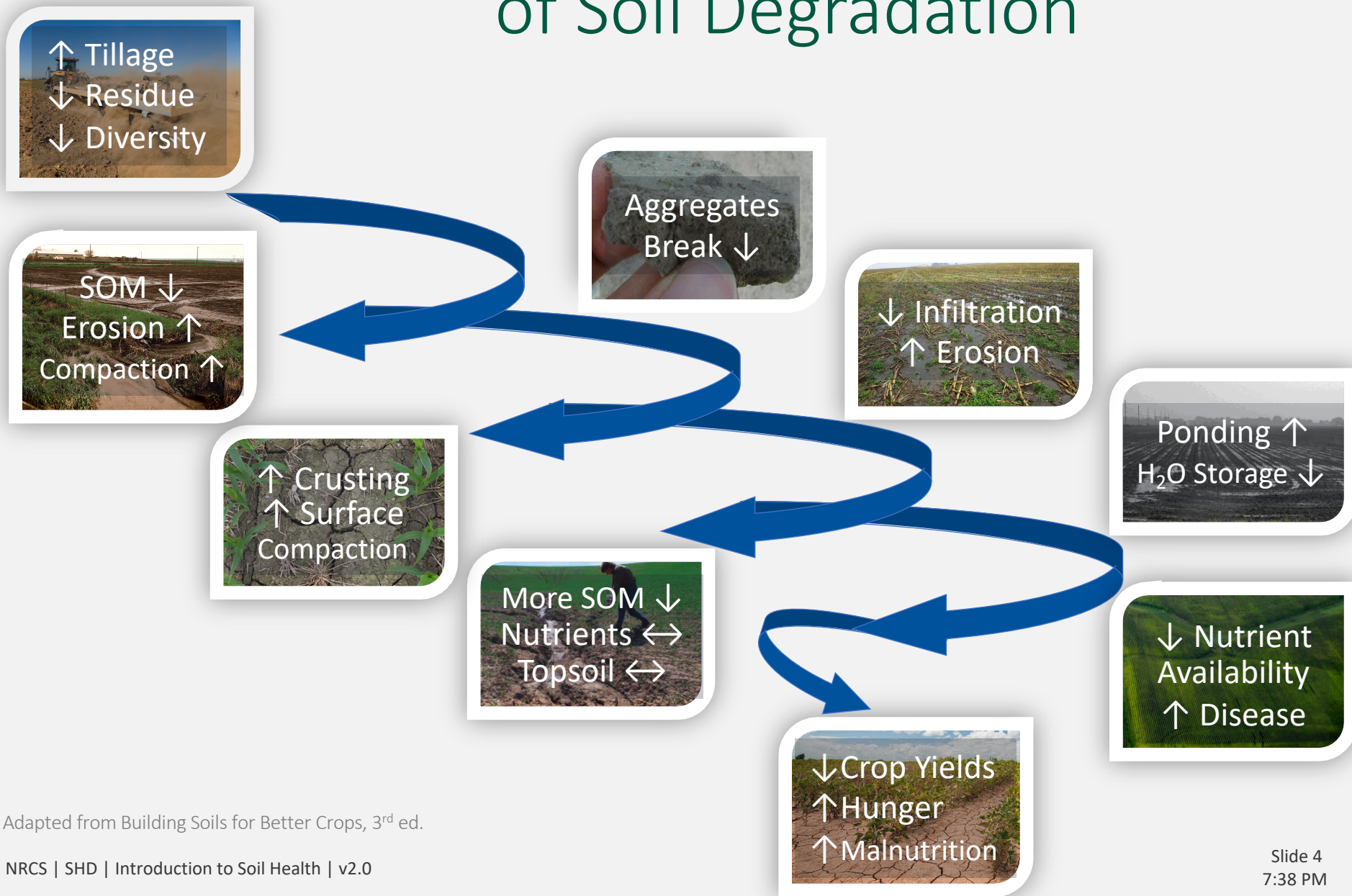


# How does NRCS Define Soil Health?

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



# Downward Spiral of Soil Degradation





# 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

[in](#) [t](#) [f](#) [g](#) [e](#) [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

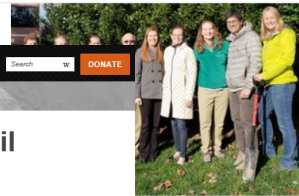
Posted:

Jan 22, 2019 - 09:05 AM EST



**SOIL HEALTH**  
INSTITUTE

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



ies Ph.D., Gregory Macfarland Bean Cope Ph.D., Paul Tracy Ph.D., Kelsey

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MARKETS WEATHER MACHINERY CROPS TECHNOLOGY FARM MANAGEMENT LIVESTOCK FAMILY

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## 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.

[f](#) [t](#) [t](#)



nature

ENVIRONMENT

## Secrets of Life in the Soil

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



OUR WORK

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## How cover crops help keep soil healthy and productive



*The New York Times Magazine*

FEATURE

## Can Dirt Save the Earth?

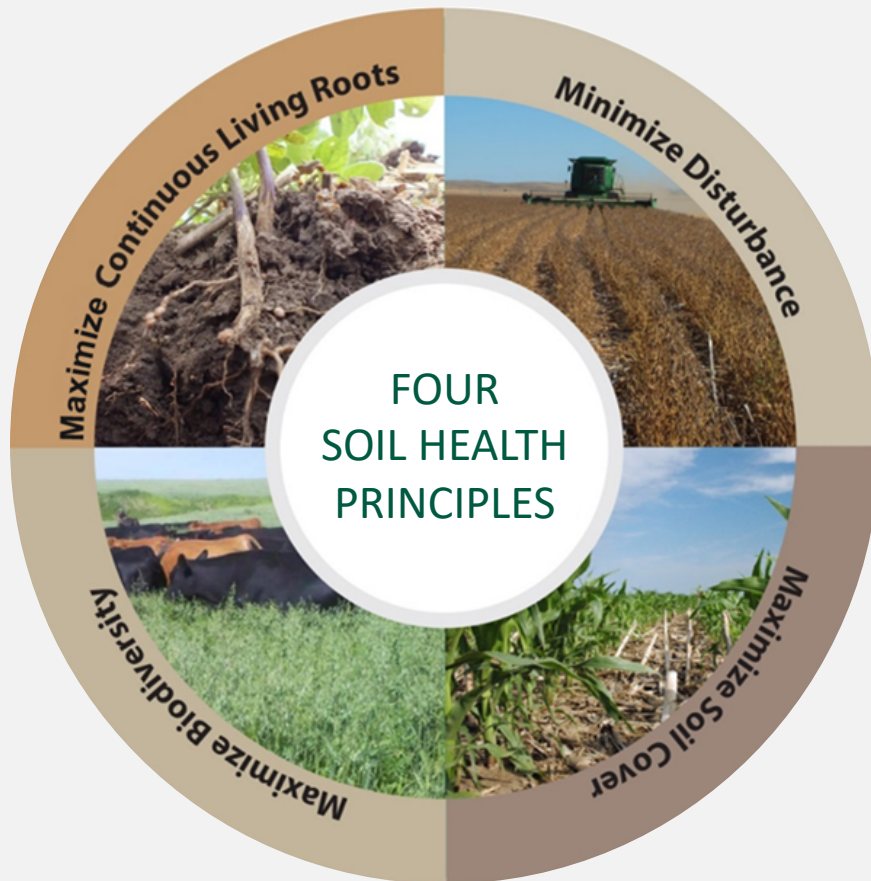
Agriculture could pull carbon out of the air and into the soil — but it would mean a whole new way of thinking about how to tend the land.

## State of the

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

BY [LUKIE PIERSE](#) ON JANUARY 28, 2019

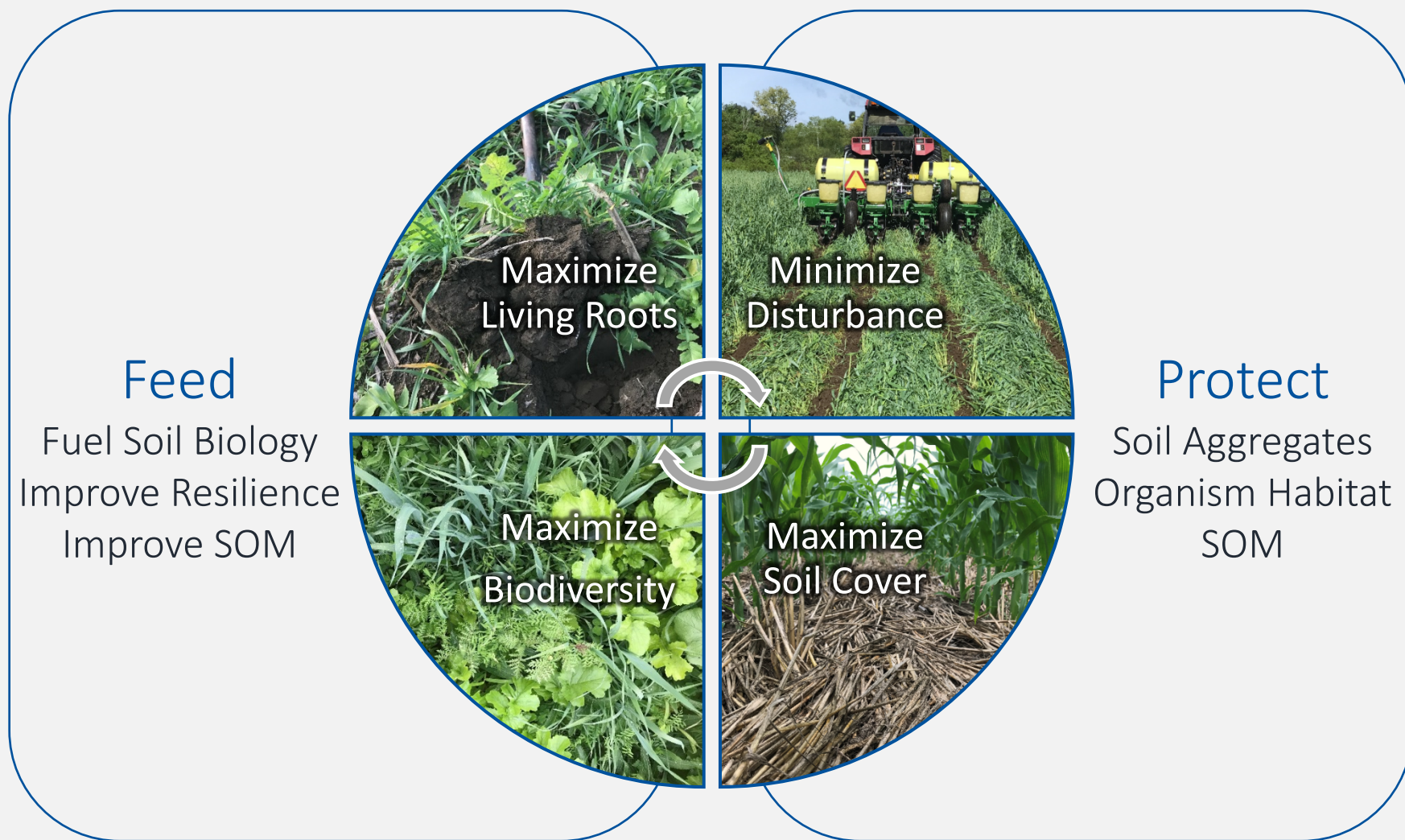
# The 4 Principles that Conserve the Soil Ecosystem



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



# Soil Health Principles to Support High Functioning Soils



# How Soil Health Principles Support Soil function – PROTECT



- Maintain stable aggregates
- Manage erosion
- Buffer temperature
- Reduce evaporation
- Maintain soil organic matter



# Why Maximize Soil Cover?

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



# How Soil Health Principles Support Soil Function – FEED



- Stimulate below-ground diversity
- Increase SOM
- Improve nutrient cycling
- Enhance plant growth
- Break pest cycles
- Increase predator & pollinator populations





# How Do We Maximize Living Roots?

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- Grow crops in the off-season
- Avoid fallow & ↓ re-cropping interval
- ↑ time in perennial crops
- Manage rotations & forage height

## What Practices?

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- Alley Cropping (311)
- Multi-Storied Cropping (379)
- Silvopasture (381)
- Forage & Biomass Planting (512)
- Prescribed Grazing (528)





# How Do We Maximize Biodiversity?

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- ↑ diversity of crop rotations
- Integrate livestock & graze cover crops
- ↑ time in diverse perennial crops

## What Practices?

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- Alley Cropping (311)
- Multi-Storied Cropping (379)
- Silvopasture (381)
- Forage & Biomass Planting (512)
- Prescribed Grazing (528)
- Conservation Crop Rotation (328)
- Cover Crop (340)
- Forage & Biomass Planting (512)
- IPM (595)
- Prescribed Grazing (528)



# What Practices can be used in Agroforestry to Promote Soil Health?

- Alley Cropping (311)
- Multi-Storied Cropping (379)
- Windbreak and Shelterbelt Establishment (380)
- Silvopasture (381)
- Windbreak and Shelterbelt Renovation (650)
- Cover Crop (340)
- Residue & Tillage Mgmt. (329/345)
- Conservation Cover (327)
- Mulching (484)
- Forage & Biomass Planting (512)
- Prescribed Grazing (528)





# Social & Economic Considerations



# Adopting Soil Health and Agroforestry Practices

- “Requires not only an understanding of the physical resource data but also social data.”
- Awareness a understanding key human social & economic considerations can assist with implementation & long term adoption

What is the current perception of Agroforestry in your region?

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



# Attributes promoting technology adoption

## Personal

- Above average income
- Formal education
- High participation in ag groups
- Greater reliance on mass media
- Willing to take risks

## Farm

- Farm Size
- Diversity
- Owner operator
- Smaller scale & low to medium gross sales may be more likely to adopt soil health

## Practice

- Economically feasible
- Observable; easy to use
- Compatible with producer beliefs
- Flexibly fit with the rotation



# What are Some Obstacles to Agroforestry Adoption?

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- Lack of technical information
- Lack of community support (socially or economically)
- Inter-Agency organizational barriers
- Landlord/tenant relationships
- Economic
  - Installation cost
  - Management capability
  - Risk aversion



# Economic Considerations

- How many producers have used these arguments to not implement agroforestry practices?
  - It costs too much
  - Lack of time to manage
  - Uses too much water
  - Don't have the right equipment

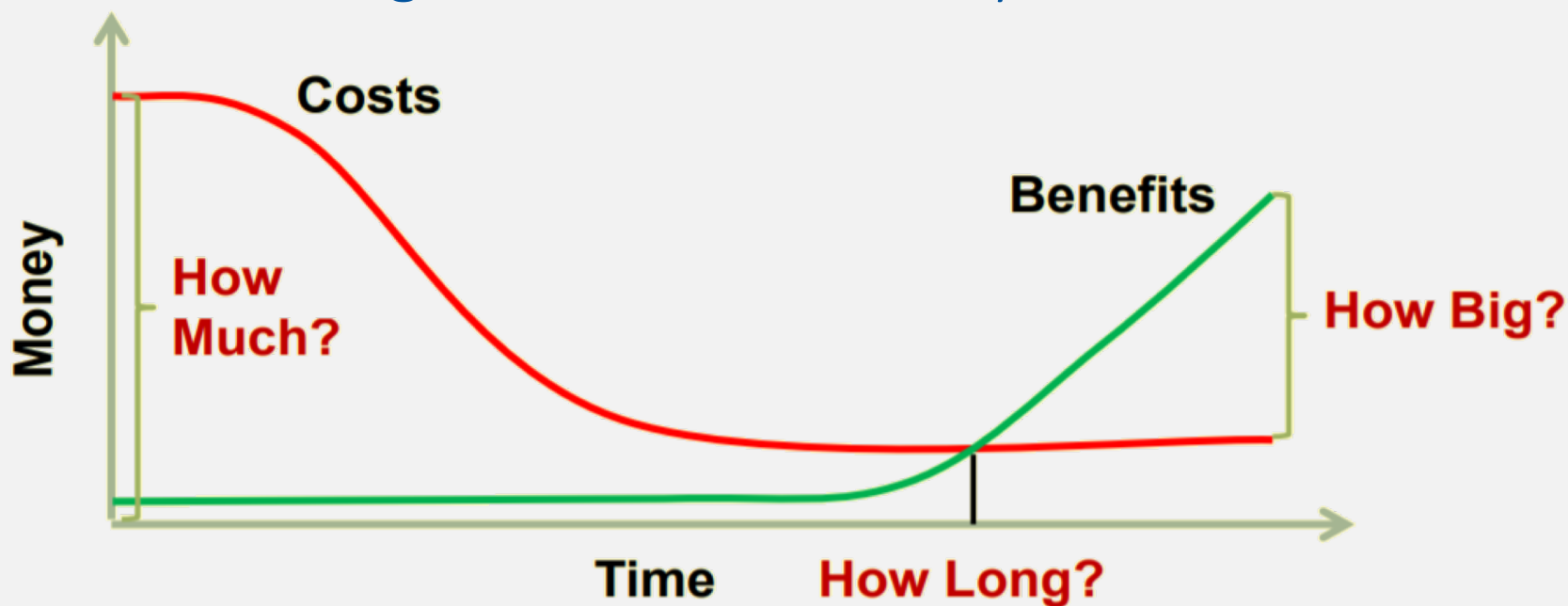


Remsburg, SARE



# Agroforestry Practices as a Farm Investment

- There are immediate costs, risk and uncertain long-term benefits
- The investment does not have a guaranteed payoff
- Find long-term users to show benefits, to inspire and maintain long-term investments by farmers



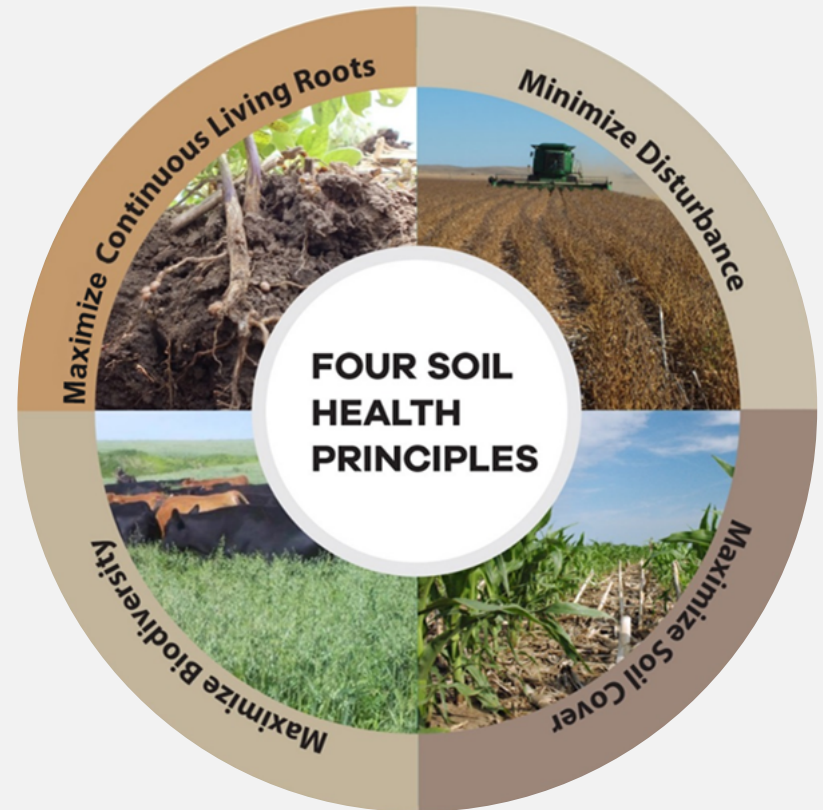




# Improved Soil Function can Lead to Benefits for the Producer

- Potential Benefits

- Reduced Erosion
- Increased Soil Organic Matter
- Increased Nutrient Cycling
- Increased Drought Resilience
- More Available Water
- Improved Filtering and Buffering
- Reduced Pest and Disease incidence
- Reduced Risk



# How can we help landowners evaluate the impact on their farm (& society)?

## BENEFITS

Soil  
Water  
Air  
Plants  
Animals  
Energy  
“Human”

## COSTS

Land  
Labor  
Capital  
Management  
Risk



# How do Economists Compare?

## Partial Budget Approach

We are looking at **WHAT CHANGES** – Before and After  
(or between “Baseline” and “Alternative(s)”)

| <b>Positive Effects</b><br>“+” | <b>Negative Effects</b><br>“-” |
|--------------------------------|--------------------------------|
| <b>Increased Revenues</b>      | <b>Increased Costs</b>         |
| <b>Reduced Costs</b>           | <b>Decreased Revenue</b>       |

# Agroforestry Practice Benefit-Cost Templates aka “T-Charts”

## Silvopasture Establishment (Ac) 381

**Definition:** An application establishing a combination of trees or shrubs and compatible forages on the same acreage.

**Major Resource Concerns Addressed:** Soil productivity and livestock habitat.

**Benchmark Condition:** Sparse woodlot adjacent to pasture land.

**Date:** October, 2016 **Developer/Location:** Hal Gordon, OR

| Positive Effects   | Negative Effects  |
|--|---|
| <b>Soil</b> <ul style="list-style-type: none"> <li>• Sheet, rill, wind, gully and streambank erosion is reduced by establishing a combination of trees, shrubs and forages which reduce erosion by water.</li> <li>• Permanent vegetation, roots, vegetative matter and livestock waste may increase soil organic matter.</li> <li>• Tree root penetration and organic matter counteracts soil compaction from livestock.</li> <li>• Contaminants taken up by forage plants will be returned to the soil as manure.</li> </ul> | <b>Land</b> <ul style="list-style-type: none"> <li>• Cultural resources may be harmed during earth moving or tree planting.</li> <li>• Change in land use and land in production.</li> </ul> <b>Capital</b> <ul style="list-style-type: none"> <li>• Additional field equipment may be required (crop, hay or livestock).</li> <li>• Installation, materials &amp; planting costs.</li> <li>• Annual operation and maintenance costs to maintain vegetation and manage pests.</li> </ul> <b>Labor</b> <ul style="list-style-type: none"> <li>• Increase in labor managing tree and</li> </ul> |





# Categories not as easy to quantify

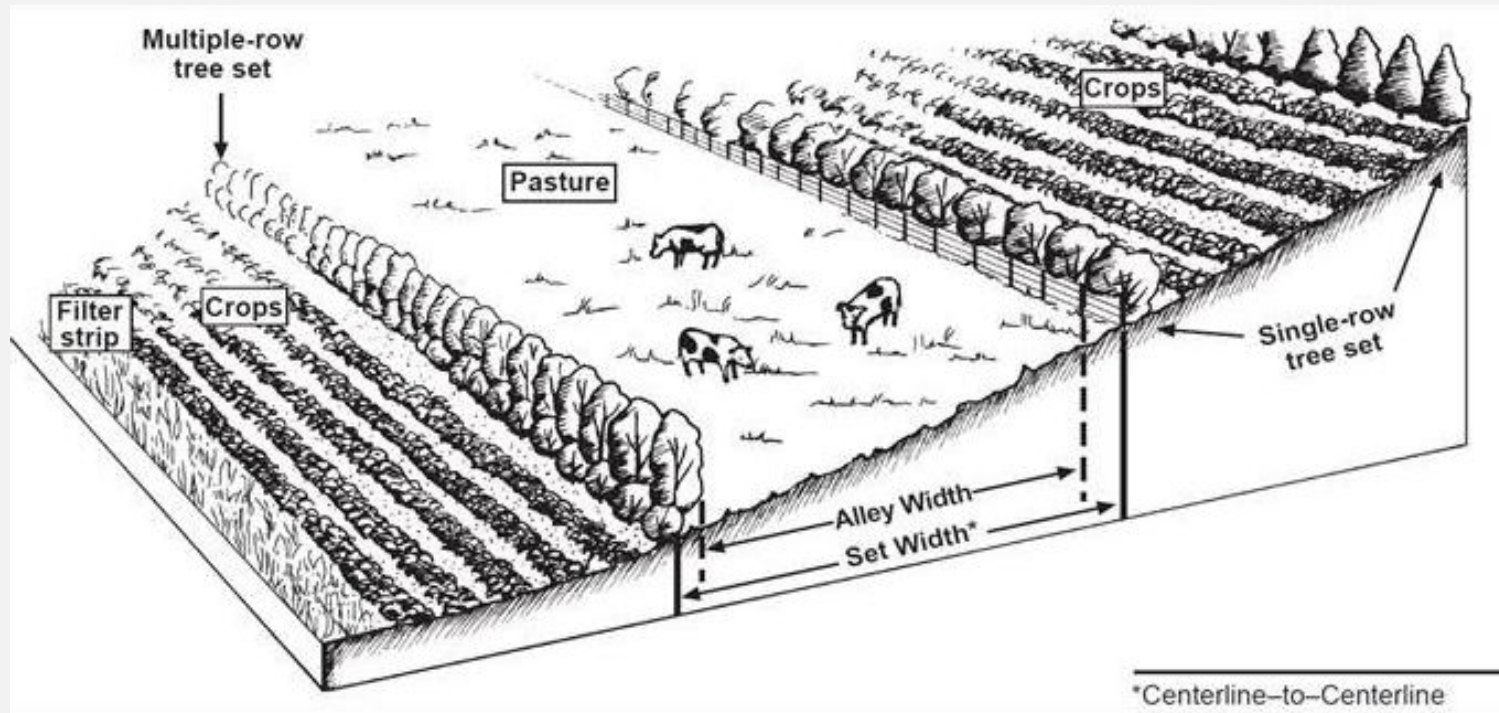
*(but important to consider)*

- Changes in labor (timing)
- Soil health characteristics difficult to tie to actual dollars spent or saved
  - e.g. earthworms, SOC
- Risk
  - e.g. increased soil health can help reduce crop loss due to weather extremes
- Social Impacts

# Things to Remember

1. Adopting a soil health and agroforestry conservation system is a long-term investment.
2. Just like soil degradation does not happen over night, improving soil health also takes time.
3. There are agroforestry 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 Agroforestry Soil health system, we must find what works best for a producer given THEIR objectives and goals.





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