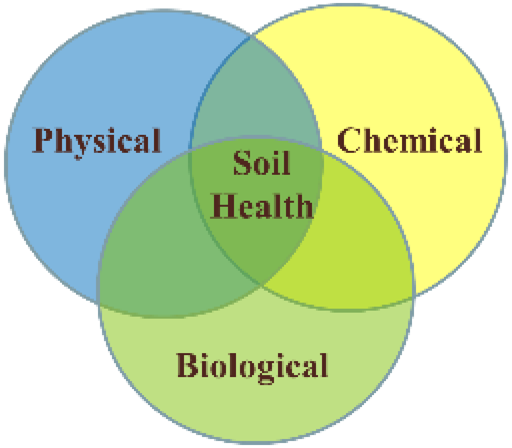
Cornell Soil Health Assessment: A Diagnostic Approach for Evaluating and Managing Soil Health



Bianca Moebius-Clune, Ph.D.
bianca.moebius-clune@wdc.usda.gov
Director, Soil Health Division
Science & Technology Deputy Area, NRCS

A Team Effort!

The Core Development Team at Cornell University:
George Abawi (Retired from Department of Plant Pathology, Geneva), Beth Gugino (now Penn State), John Idowu (now NMSU), Bianca Moebius-Clune (now NRCS), Daniel Moebius-Clune, Robert Schindelbeck, Janice Thies, Harold van Es (all in Department of Crop and Soil Sciences), David Wolfe (Horticulture), Many Growers and Extension Educators

Collaborators: Dorn Cox (Greenstart NH), Brandon Smith (NH-NRCS), Heather Darby (UVM), Ray Weil (UMD), Thomas Bjorkman (Horticulture), NRCS, Conservation Districts, and a growing network of other people and organizations

Funders:

USDA

Northern New York Agricultural Development Program

Northeast Region SARE
Sustainable Agriculture Research and Education Program

NRCS Natural Resources Conservation Service

IPM Integrated Pest Management

NY farm viability INSTITUTE

NH Dept of Ag
Food & Markets

NEW HAMPSHIRE CHARITABLE FOUNDATION

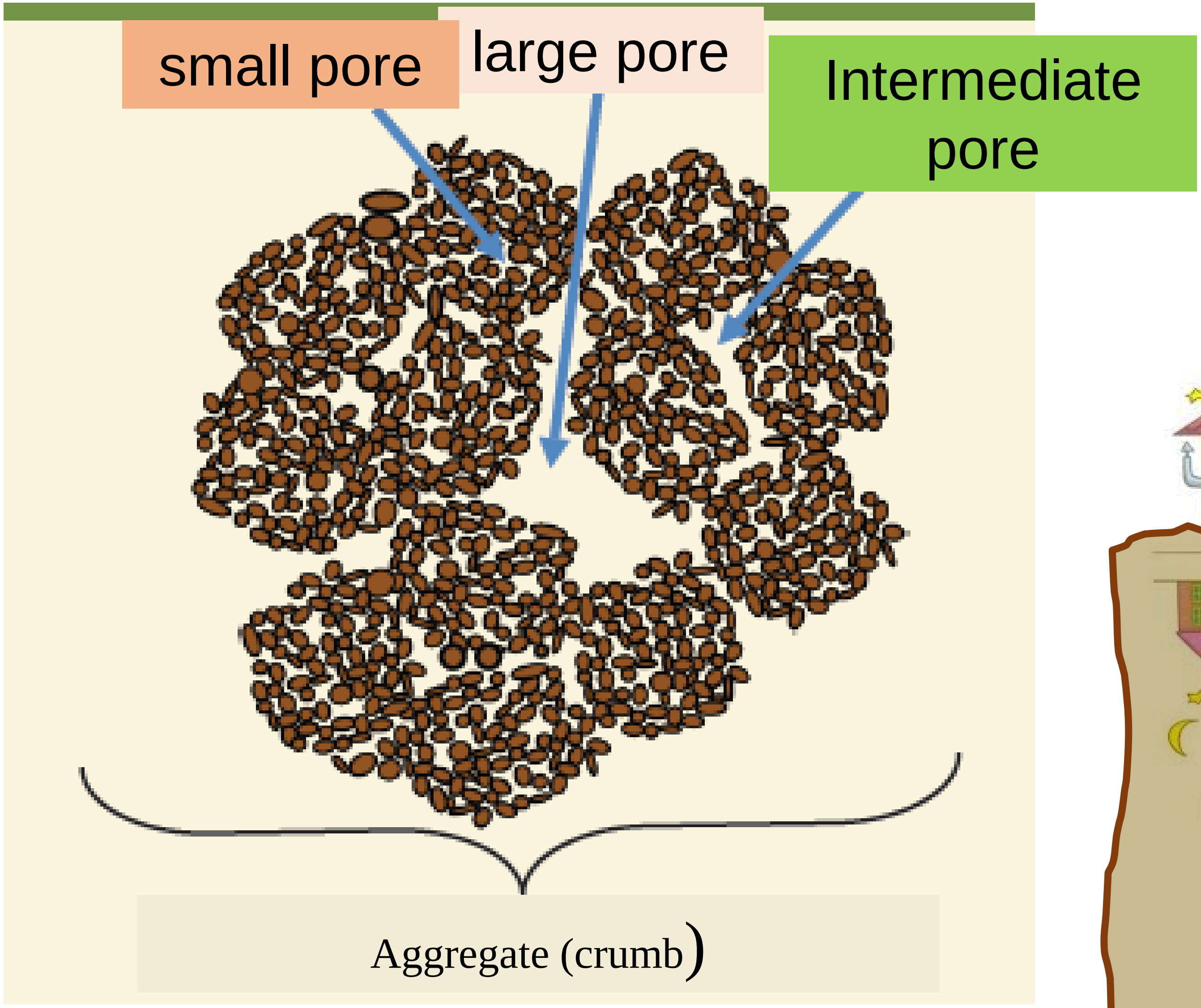
Cornell University Founded A.D. 1865

Cornell University
Cooperative Extension

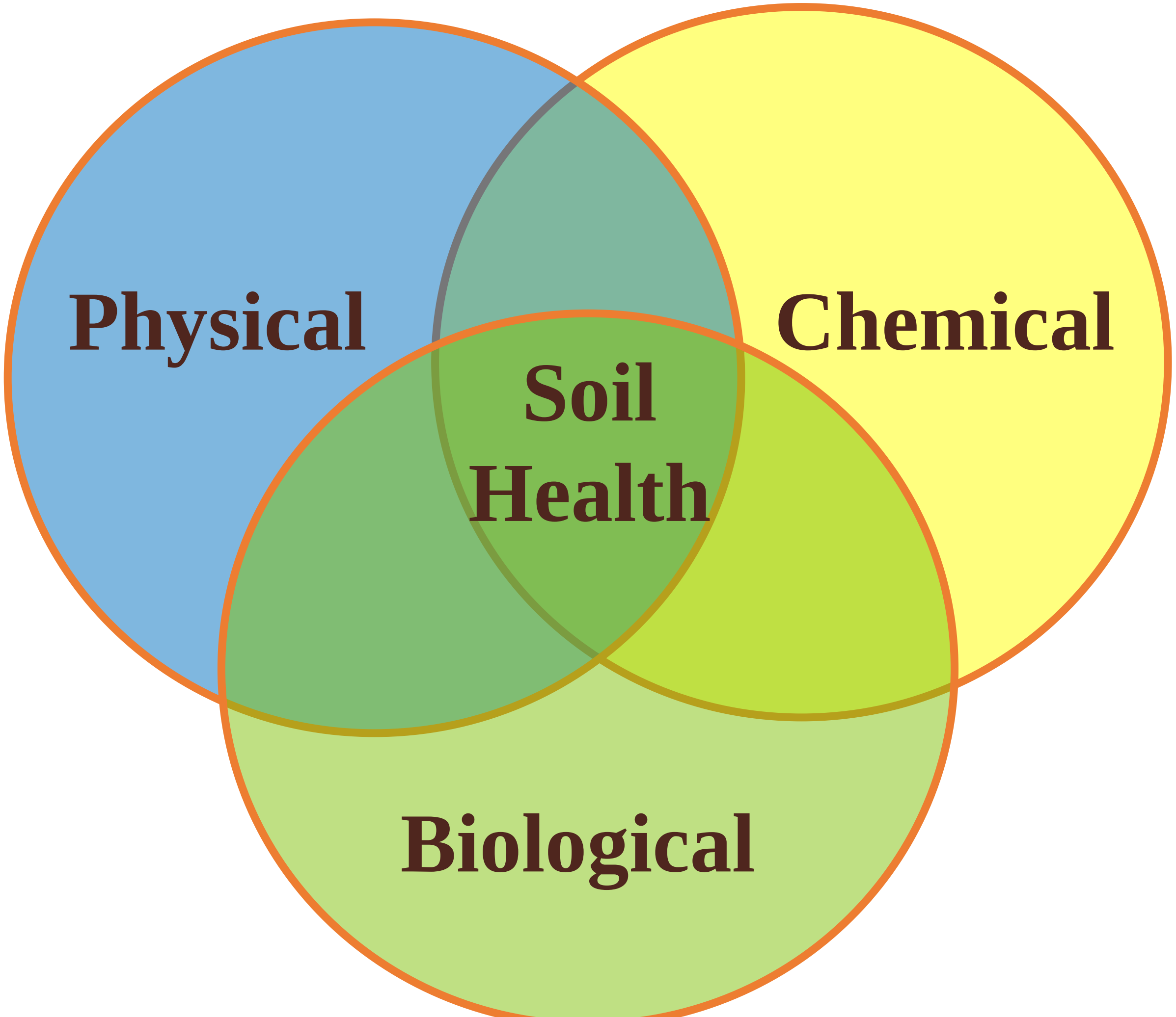
Soil Health: the continued capacity of the soil to function
as a vital living ecosystem that sustains plants, animals, and humans

An Aggregate is like a House

The interesting stuff (soil biota and their activities, water, air…) is happening in the "empty" spaces!



How do soils stop functioning optimally?



Downward Spiral of Soil Degradation

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

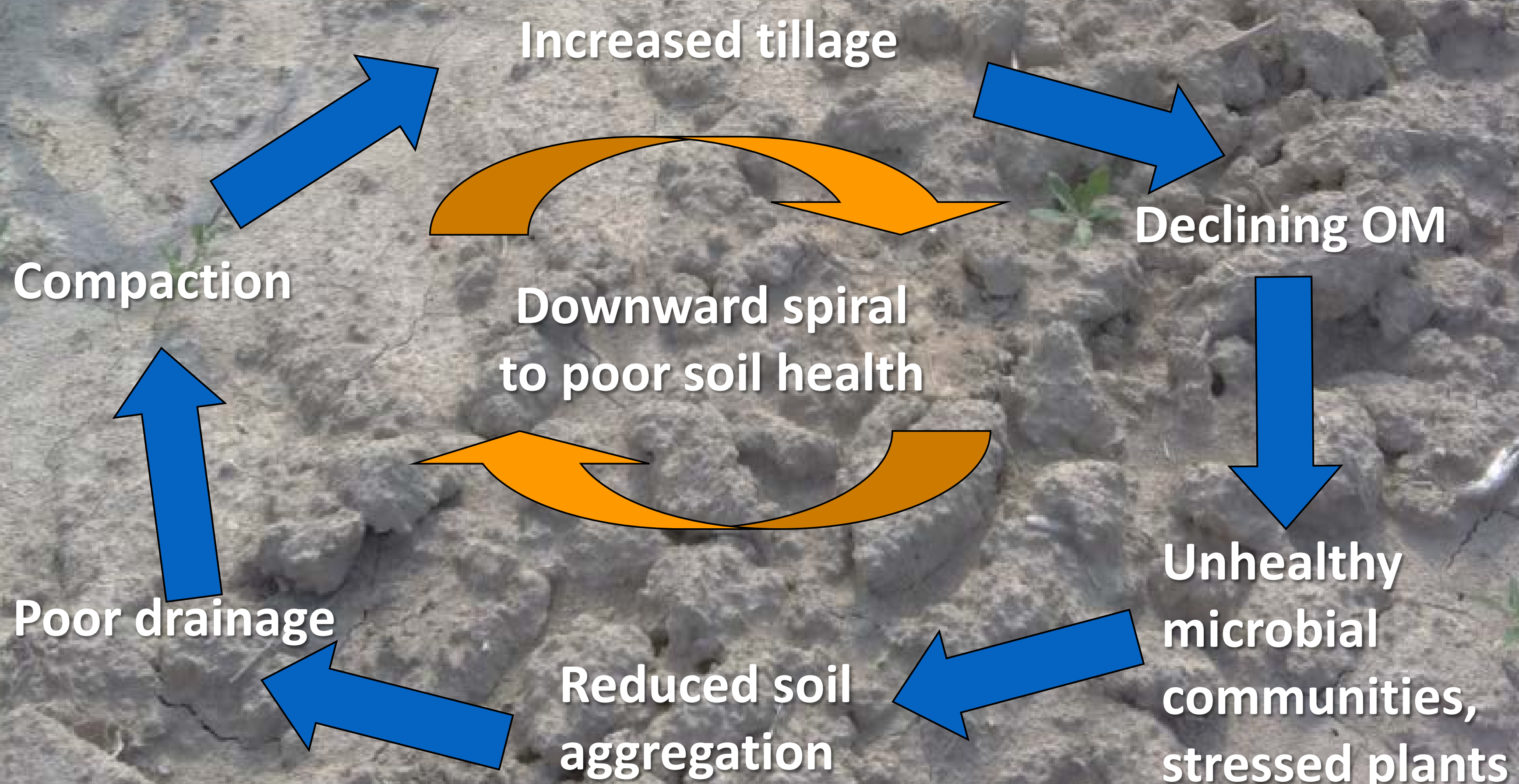
8. Crop yields decline

9. Hunger and malnutrition, especially if little access to inputs

Modified from *Building Soils for Better Crops*

Note: soils also degrade without tillage, through overgrazing, compaction, etc

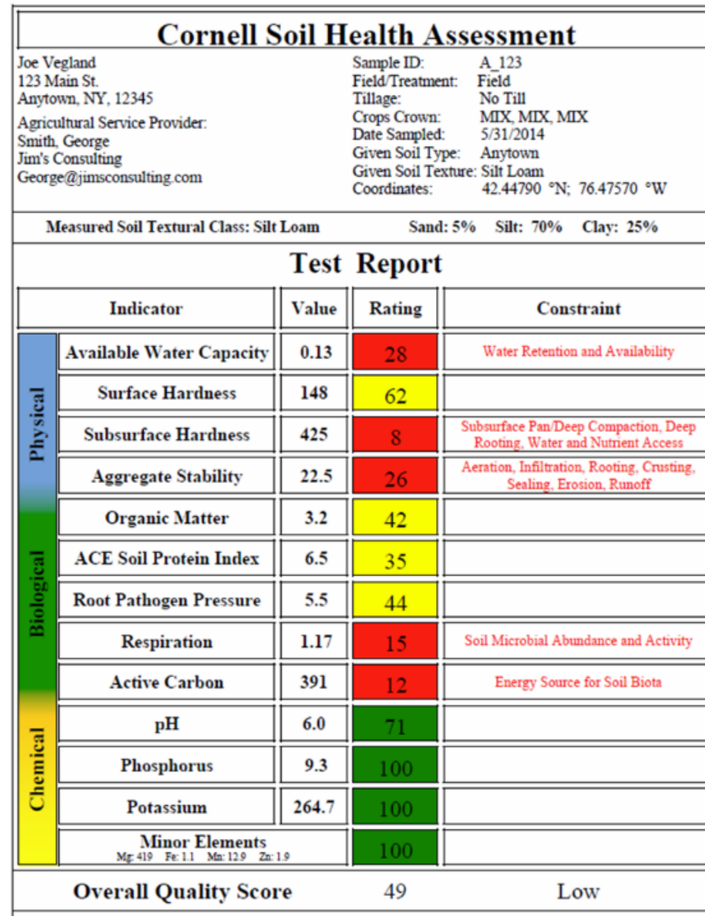
Tillage Addiction: Downward Spiral in Soil Health



Modified from *Building Soils for Better Crops*

Soil Health Assessment

- Why assess soil health?
- The Cornell Soil Health Assessment
    - The report at a glance
    - Indicators measured
    - What do they mean?
    - Managing identified constraints
- Framework for Soil Health Management Planning and Implementation



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

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- Why assess soil health?
- The Cornell Soil Health Assessment
  - The report at a glance
  - Indicators measured
  - What do they mean?
  - Comments on managing identified constraints
- Lessons from Research and Case Examples

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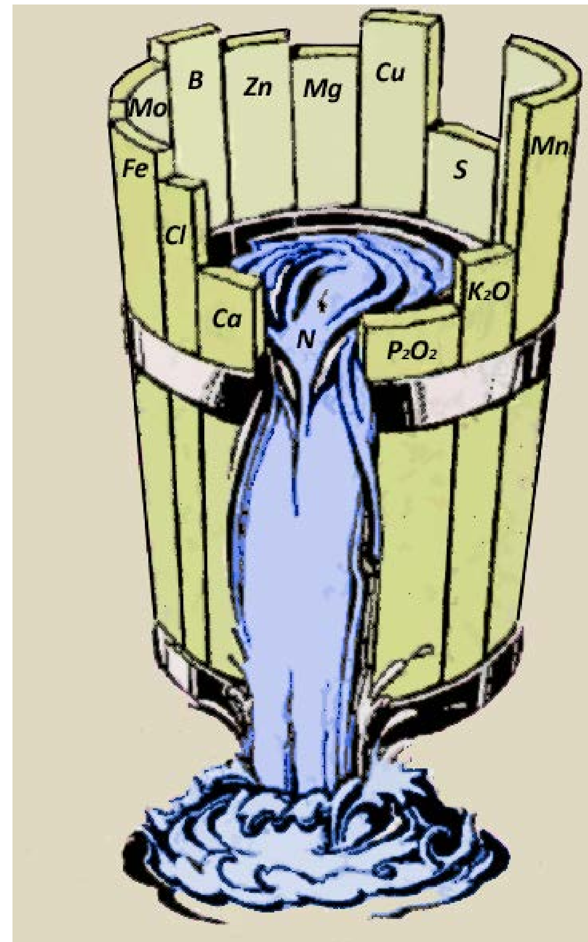
Moving Beyond Standard Soil Nutrient Testing & Management

- Nutrient testing and management foundational to agricultural success
- IDs nutrient deficiency/excess
- Next critically important step: apply principle to assess constraints in essential biological and physical functioning

→ Soil Testing should mean Soil Health Testing!



Reasons for Soil Health Testing

- **Understand constraints** beyond nutrient limitations and excesses
- **Target management practices** to alleviate those constraints
- **Measure** soil improvement or degradation from management
- **Facilitate applied research**
- **Improve awareness** of Soil Health (not just plant nutrition)
- **Enable valuation** of farmland
- **Enable assessment** of farming system risk

Assessing Soil Health using Indicators

A soil health indicator is a measurement of a soil property that provides information about the status of specific important soil processes

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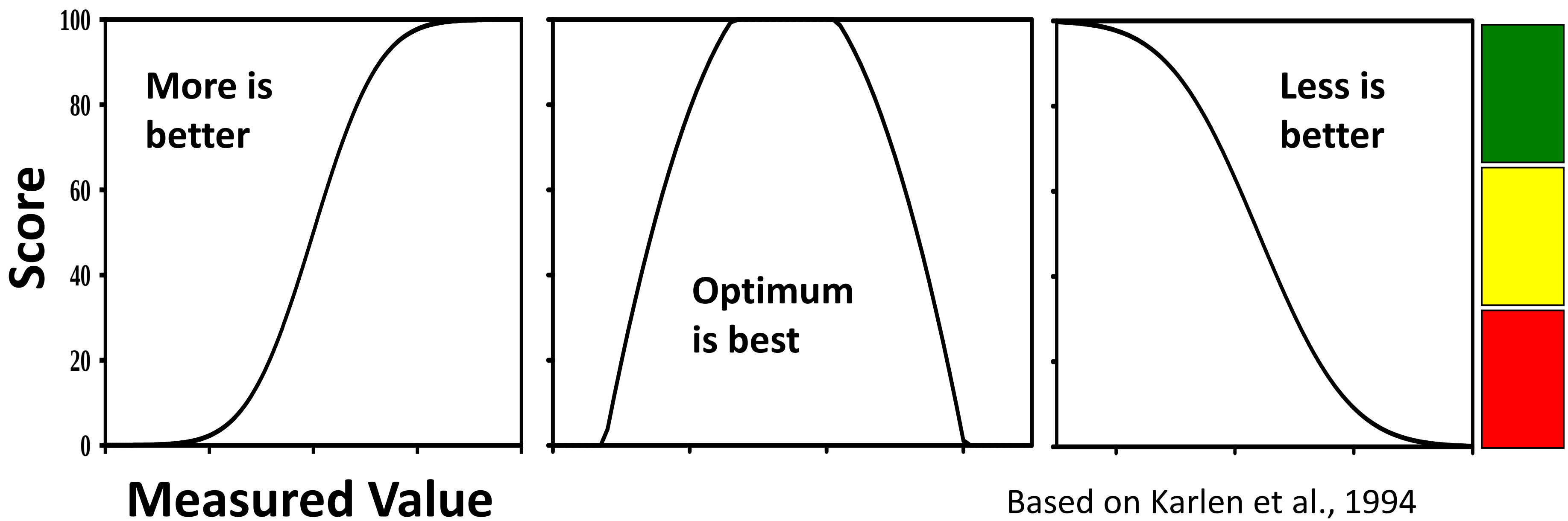
Summary Page of Cornell Soil Health Assessment Report

- Integrative
- Assesses Physical, Chemical, and Biological Functioning
- Process Oriented
- Indicators and Interpretation
- Scoring Functions
- Overall score
- Targeted Management Suggestions

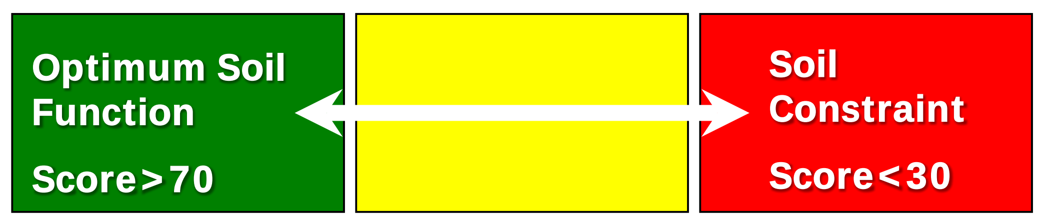
Indicator interpretation

3 types of Scoring Functions interpret how constrained soil processes are:



Based on Karlen et al., 1994

- Adjusted by texture
- Not yet adjusted for different US regions, nor for production systems



For each indicator, report provides interpretation and management prioritization

Aggregate Stability is a measure of how well soil aggregates or crumbs hold together under rainfall or other rapid wetting stresses. Measured by the fraction of dried aggregates that disintegrate under a controlled, simulated rainfall event similar in energy delivery to a hard spring rain, the value is presented as a percent, and scored against a distribution observed in regional soils with similar textural characteristics. A physical characteristic of soil, Aggregate Stability is a good indicator of soil biological and physical health. Good aggregate stability helps prevent crusting, runoff, and erosion, and facilitates aeration, infiltration, and water storage, along with improving seed germination and root and microbial health. Aggregate stability is influenced by microbial activity, as aggregates are largely held together by microbial colonies and exudates, and is impacted by management practices, particularly tillage, cover cropping, and fresh organic matter additions.

Your measured Aggregate Stability value is **22.5%**, corresponding with a score of **26**. This score is in the **Low** range, relative to regional soils with similar texture. **Aggregate Stability should be given a high priority in management decisions based on this assessment, as it is likely to be an important constraint to proper soil functioning and sustainability of management at this time.** Please refer to the management suggestions table at the end of this document.

Management Suggestions for Physical and Biological Constraints		
Constraint	**Short Term Management Suggestions**	**Long Term Management Suggestions**
Availabe Water Capacity Low	• 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
Surface Hardness High	• 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
Subsurface Hardness High	• 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
Aggregate Stability Low	• 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 and mycorrhizal hosts
Organic Matter Low	• 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
Soil Protein Index Low	• Add N-rich organic matter (low C:N source like manure, high N well-finished compost) • Incorporate young, green, cover crop biomass • Plant legumes and grass-legume mixtures • Inoculate legume seed with Rhizobia & check for nodulation	• Reduce tillage • Rotate with forage legume sod crop • Cover crop and add fresh manure • Keep pH at 6.2-6.5 (helps N fixation) • Monitor C:N ratio of inputs
Root Pathogen Pressure High	• Use disease-suppressive cover crops • Plant on ridges/raised beds • Monitor irrigation • Biofumigate	• Use disease-suppressive cover crops • Increase diversity of crop rotation • Sterilize seed and equipment • Improve drainage/monitor irrigation
Respiration Low	• Maintain plant cover throughout season • Add fresh organic materials • Add manure, green manure • Consider reducing biocide usage	• Reduce tillage/mechanical cultivation • Increase rotational diversity • Maintain plant cover throughout season • Cover crop with symbiotic host plants
Active Carbon Low	• 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

Constrained and Suboptimal indicators are flagged in report management table

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- Available Water Capacity
- Surface Hardness and Subsurface Hardness
- Aggregate Stability

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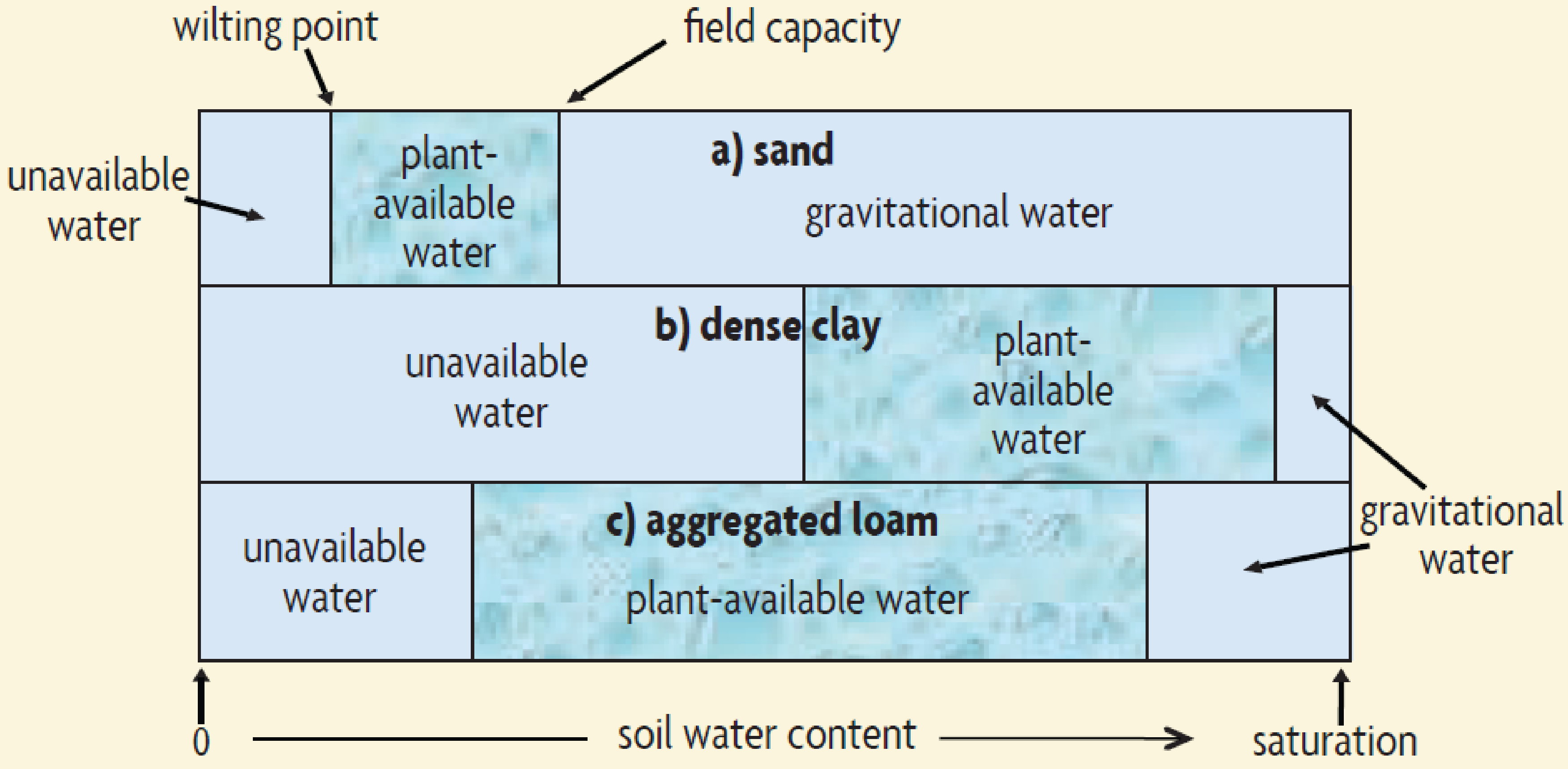
Available Water Capacity

- Measures plant available water per amount of soil
- Between field capacity and wilting point
- Critical to improve in droughty soils
- Influenced by aggregation, texture, organic matter

Water storage depends on texture, organic matter, and aggregation



Magdoff & van Es, 2009

Plant use of water stored in soil…

Must have:

- Plant available water
- Actively growing roots
- Access by roots to soil volume where water is stored
- Access is expanded by key biota (mycorrhizal fungi)

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Surface Hardness

- Measures compaction 0-6”
- Affects infiltration, erosion
- Influences plant available water (infiltration, volume)
- Influences nutrient access, plant stress, disease
- Critical to improve, esp in hill side soils
- Influenced by aggregation and organic matter

Compaction = Loss of Large Pores

Need to know WHERE and WHY

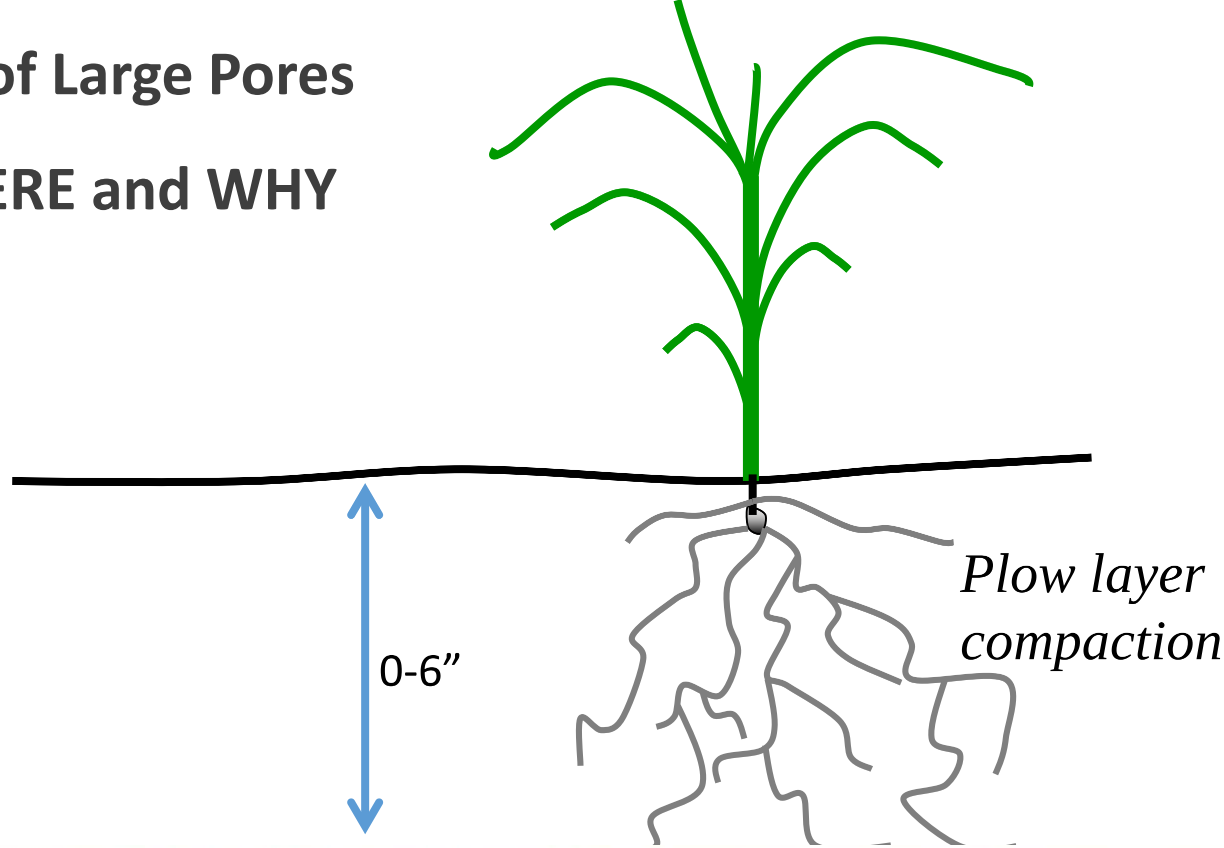


Photo by D. Degolyer


Photos from *Building Soils for Better Crops*

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<u>Subsurface Hardness</u>

- Measures compaction 6-18”
- Affects drainage, erosion
- Influences plant available water (deep soil volume)
- Influences nutrient access, plant stress, disease
- Critical to maintain plant-accessible subsoils for deep rooted plants, for *drought resilience*
- Influenced by soil type, texture, aggregation, and organic matter, traffic, disturbance

Compaction = Loss of Large Pores

Need to know WHERE and WHY

3. Subsoil compaction

6”-18”

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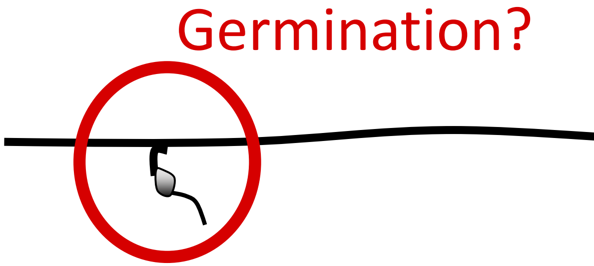
Aggregate Stability

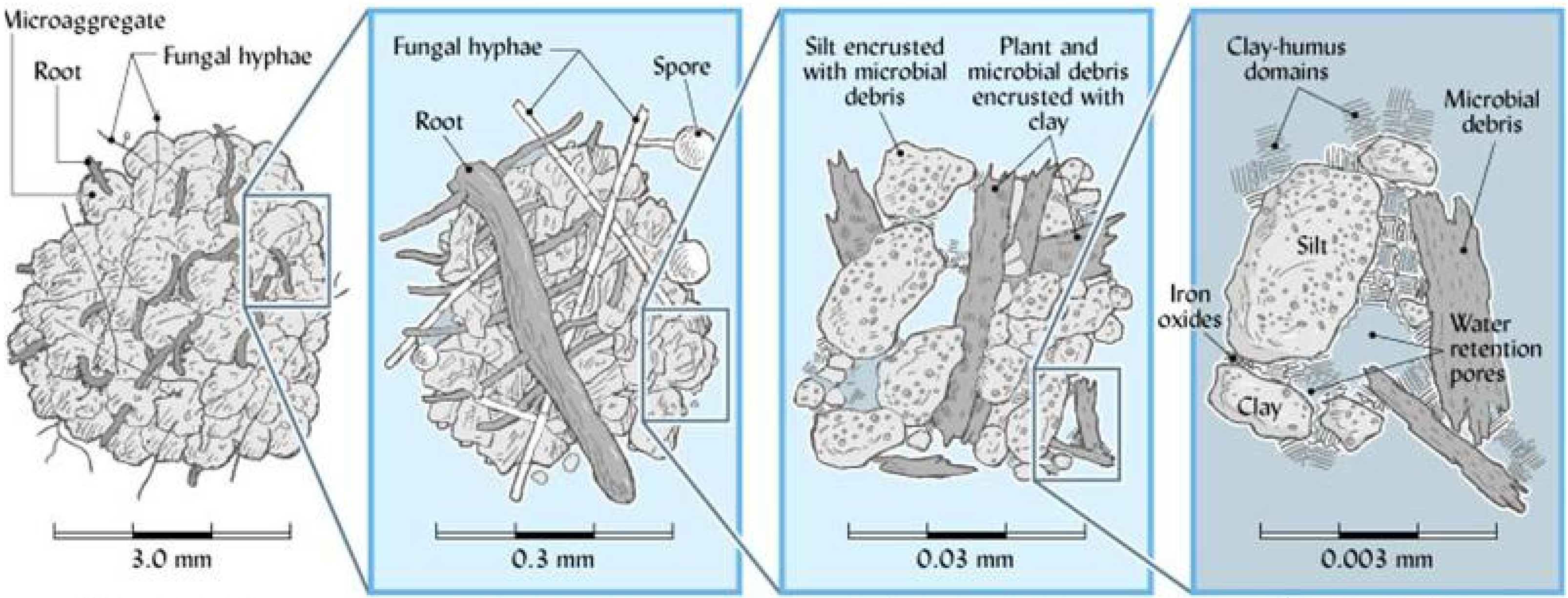
- Measures strength of aggregates against precipitation impact
- Affects
  - Water infiltration, movement and storage
  - Erosion, crusting
  - Aeration
  - Organic matter protection and biotic activity
- Influenced by OM, biota (bacteria, fungi, etc), management (residue, tillage), sodicity
- Biological activity is critical
  - mycorrhizal fungi, decomposers (bacteria, fungi, other fauna), cyanobacteria, algae


Germination?


Photos by B. Moebius-Clune


Photo by D. DeGolyer

Building Aggregates means improving biological functioning through physical and biological methods



Macroaggregate
- Roots
- Hyphae

(a)

Microaggregate
- Root hairs
- Hyphae
- Polysaccharides

(b)

Submicroaggregate
- Mineral grains encrusted with plant and microbial debris
- Plant debris coated with clay

(c)

Primary particles of silt, clay and humus
- Clay and clay-humus domains

(d)

Brady and Weil, 2002

Reduce tillage, increase fresh organic matter availability to decomposers, improve environment for plants and soil organisms

Biological Indicators

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Biological	Root Pathogen Pressure	5.5	44	
Biological	Respiration	1.17	15	Soil Microbial Abundance and Activity
Biological	Active Carbon	391	12	Energy Source for Soil Biota
Chemical	pH	6.0	71	
Chemical	Phosphorus	9.3	100	
Chemical	Potassium	264.7	100	
Chemical	Minor Elements Mg: 419 Fe: 1.1 Mn: 12.9 Zn: 1.9		100	
	Overall Quality Score		49	Low

- Organic Matter Content
- Protein Content
- Root Pathogen Pressure
- Respiration
- Active Carbon

Biological Indicators

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
Physical	Surface Hardness	148	62	
Physical	Subsurface Hardness	425	8	Subsurface Pan/Deep Compaction, Deep Rooting, Water and Nutrient Access
Physical	Aggregate Stability	22.5	26	Aeration, Infiltration, Rooting, Crusting, Sealing, Erosion, Runoff
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	Overall Quality Score		49	Low

Organic Matter Content

- Measures organic material lost on ignition
- Affects exchange capacity and nutrient storage (exchangeable and bonded)
- Affects aggregation, water holding capacity, hardness

Biological Indicators

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

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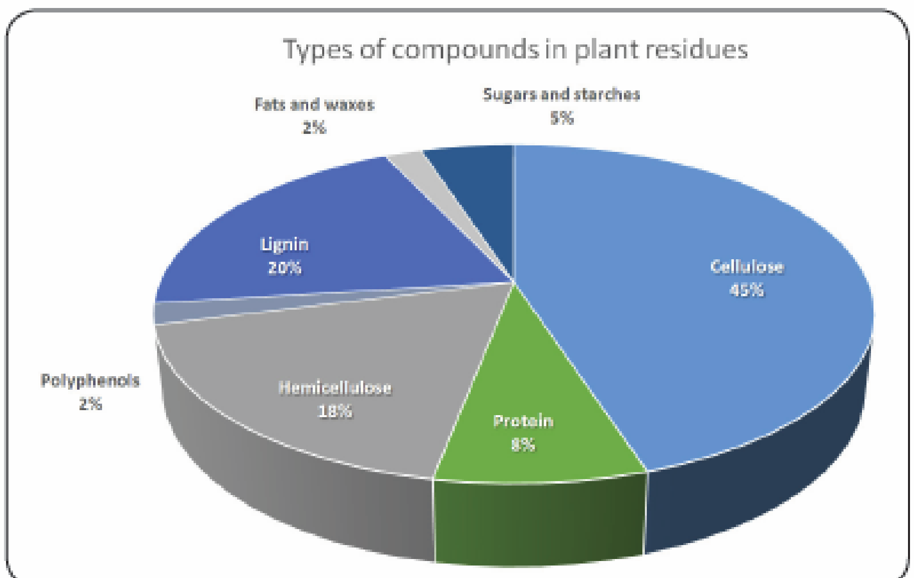
Protein Content

- Measures organic N pool
  - Mineralizable polymer-N (C and N)
  - Influences N cycling and availability to plants
- Proteins come from: plant residues, root turnover, microbial biomass N, organic matter amendments

OM Composition

Biomass from:

- Plant Tissues
- Fungi
- Bacteria
- Animals



(Modified from Brady and Weil 2002, Figure 12.2)

Composed of:

- Cellulose
- Chitin
- Proteins
- Carbohydrates
- Lipids
- Nucleic Acids
- Salts

Biological Indicators

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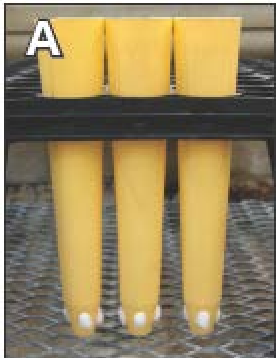
Root Pathogen Pressure

- Pathogen presence
- Disease suppressiveness of the microbial community

Root Pathogen Pressure Bioassay

Beans (*Phaseolus vulgaris*) planted in fresh soil, grown in greenhouse, rated for disease



Beans grown in greenhouse for 6 weeks

Bean roots are washed

Root rot severity is rated
(1= healthy to 9 = almost dead)

Biological Indicators

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

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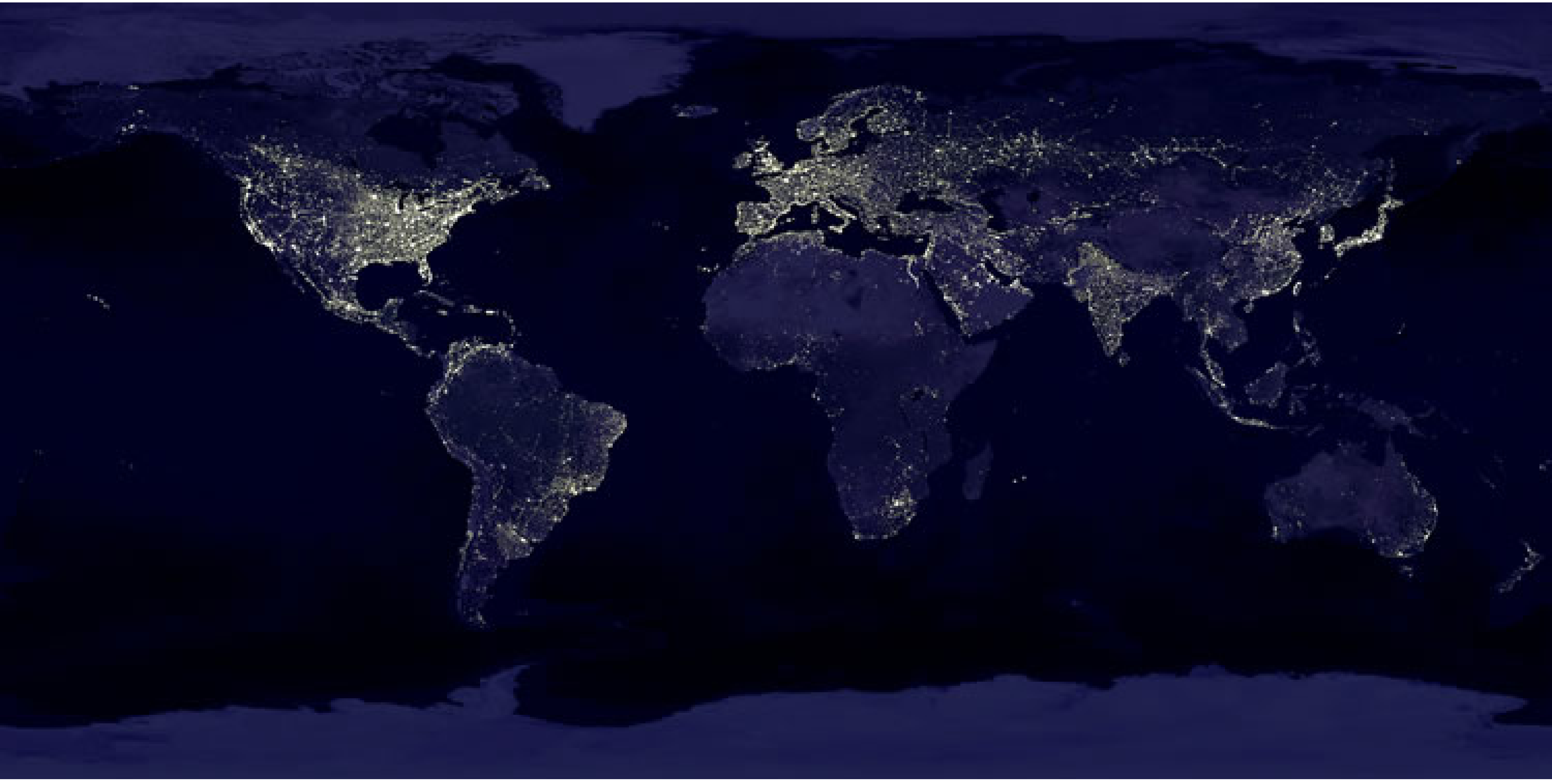
Respiration

Measures biological activity, which controls

- Decomposition
- Biological nutrient mineralization and immobilization
- Aggregation
- Plant-microbe interactions

Microbial Activity: Respiration

Integrates Abundance and Metabolic Activity



Biological Indicators

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	Overall Quality Score		49	Low

Active Carbon

- Measures labile carbon pool
- Energy source for microbial community
- Likely an early indicator of total organic matter gain or loss

Chemical Indicators

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

Test Report

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Chemical	Minor Elements (Mg: 419 Fe: 1.1 Mn: 12.9 Zn: 1.9)		100	
	Overall Quality Score		49	Low

- pH
  - Exchange capacity
  - Nutrient availability
  - Toxicity
- P
  - Deficiency
  - Excess – mostly lost through erosion
- K
  - Leaches in sandy soils
- Minor elements
  - Deficiency or toxicity

In a nutshell: Soil Health Assessment Identifies Constraints

→ Ties each Indicator to Function of Soil Processes, which can be explicitly managed

Physical Indicators	Soil Processes
Available Water Capacity	Water that plant can use; drought resistance, prevent leaching
Surface Hardness	Penetration resistance 0”- 6”; aeration, surface rooting, infiltration, germination, prevent runoff & erosion
Subsurface Hardness	Penetration resistance 6” - 18”; deep rooting, drought resistance, water movement and drainage, extreme precipitation resilience
Aggregate Stability	Resistance to falling apart during rainfall; aeration, infiltration, germination, prevent runoff & erosion
Biological Indicators	**Soil Processes**
Organic Matter	Water and nutrient storage/release, long-term energy storage, C sequestration
ACE Soil Protein Index	N containing fraction of organic matter, N release
Root Pathogen Pressure	Disease suppressiveness of microbial community for vegetables
Respiration	Microbial activity, nutrient release
Active Carbon	Carbon easily available as short-term microbial food source

Chemical Indicators: Standard Soil Test Analysis included, add-ons for heavy metals and salinity available

Cornell Soil Health Testing Services

More information and up-to-date soil health testing at:

http://soilhealth.cals.cornell.edu/

- **Sample submission**
- **Manual**
- **Blog**
- **New manual in progress**

Other resources:

Soil Health Assessment

- Why assess soil health?
- The Cornell Soil Health Assessment
  - The report at a glance
  - Indicators measured
  - What do they mean?
  - Managing identified constraints
- Framework for Soil Health Management Planning and Implementation

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
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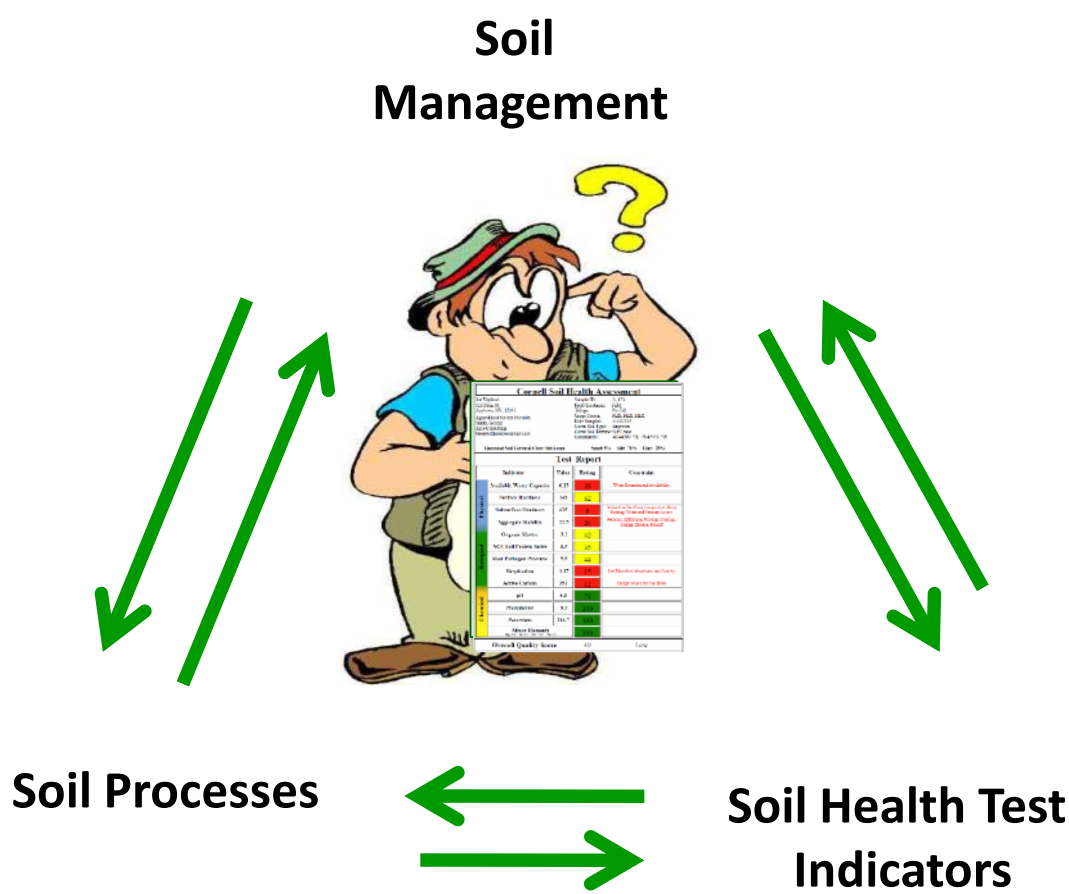
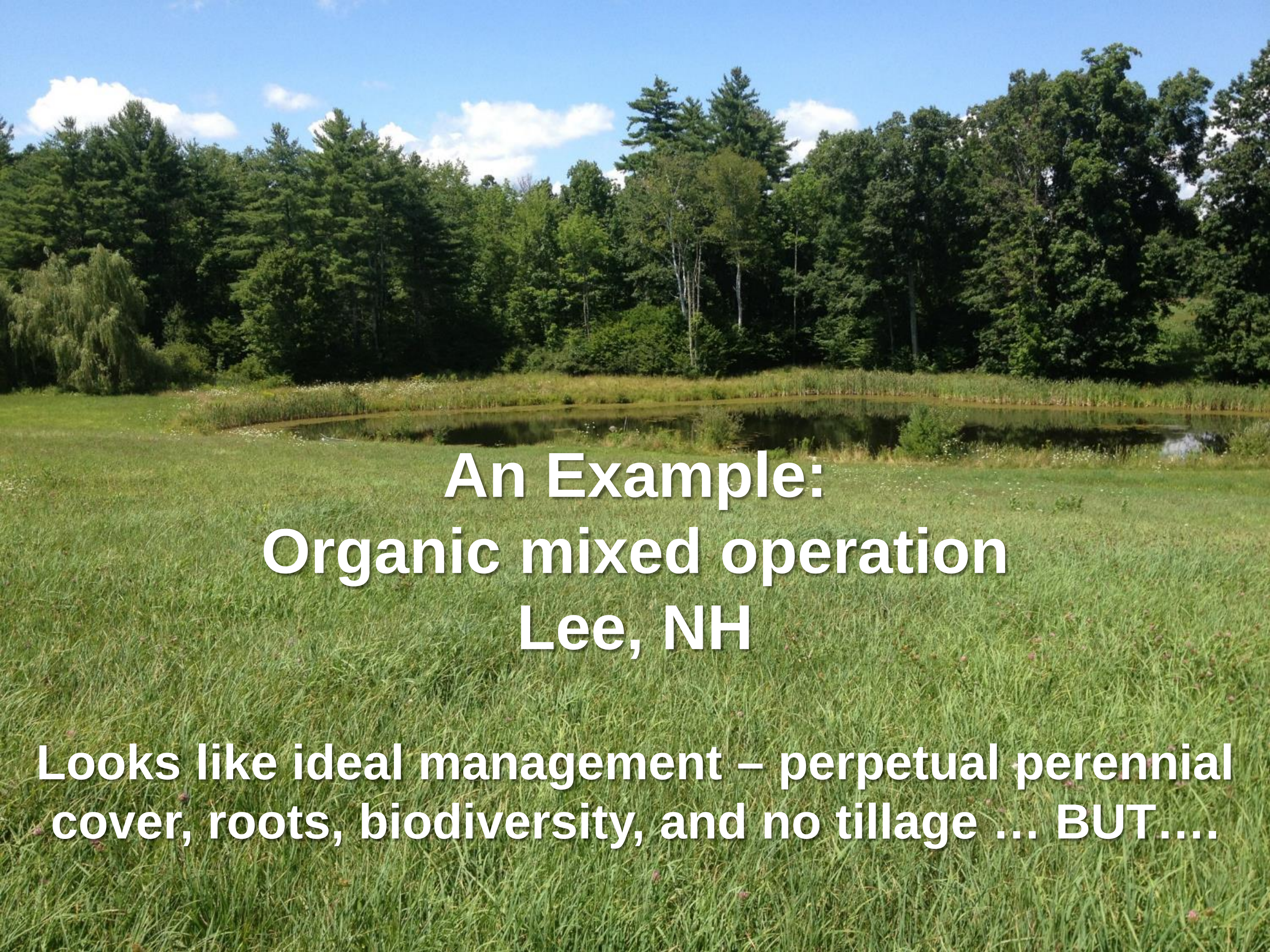
Overall Quality Score 49 Low

How do I use soil test information?



SH Management Planning Process Overview

1. Determine farm background and management history Compile background info: history by management unit, farm operation type, equipment, access to resources, situational opportunities or limitations.
2. Set goals and sample for soil health Determine number and distribution of soil health samples needed according to operation background and goals.
3. For each management unit: identify and explain constraints, prioritize Soil Health Report identifies constraints, guides prioritization. Explain results based on background, and adjust priorities.
4. Identify feasible management options Management suggestions table available as part of Soil Health Report, or online with NRCS practice linkages
5. Create short and long term Soil Health Management Plan Integrate agronomic science of 2-4 with grower realities of 1 to create a specific short-term schedule of management practices for each management unit and an overall long-term strategy
6. Implement, monitor, and adapt Implement and document management practices. Monitor progress, repeat testing, and evaluate outcomes. Adapt plan based on experience and data over time.


An Example:
Organic mixed operation
Lee, NH
Looks like ideal management – perpetual perennial cover, roots, biodiversity, and no tillage … BUT….

SH Management Planning Process Overview

1. Determine farm background and management history

Sloped hay field, sometimes grazed – especially recently, pond below field is full of algae (P excess); growth mediocre. Visible erosion, runoff during rain. Diverse inventory of field equipment, grower inclined to experiment with anything. Organic mixed operation.

2. Set goals and sample for soil health

Improve soil health, productivity, on-farm nutrient and carbon cycling, and long-term sustainability, and regain use of the pond for recreational purpose

3. Constraints

Nutrient Management Planning has been critical in identifying chemical constraints:
P and K are low, pH marginal

… but the pond is showing clear signs of P pollution!

What is going on here?

CHEMICAL	pH (see Nutrient Analysis Report)	6.1	67	
	Extractable Phosphorus (see Nutrient Analysis Report)	3.1	44	
	Extractable Potassium (see Nutrient Analysis Report)	37.8	33	
	Minor Elements (see Nutrient Analysis Report)		100	
	OVERALL QUALITY SCORE (OUT OF 100):		62.0	Medium

Soil Textural Class:==> silt loam

SAND (%): 45.6 *SILT (%): 52.5* *CLAY (%): 1.9*

3. Constraints

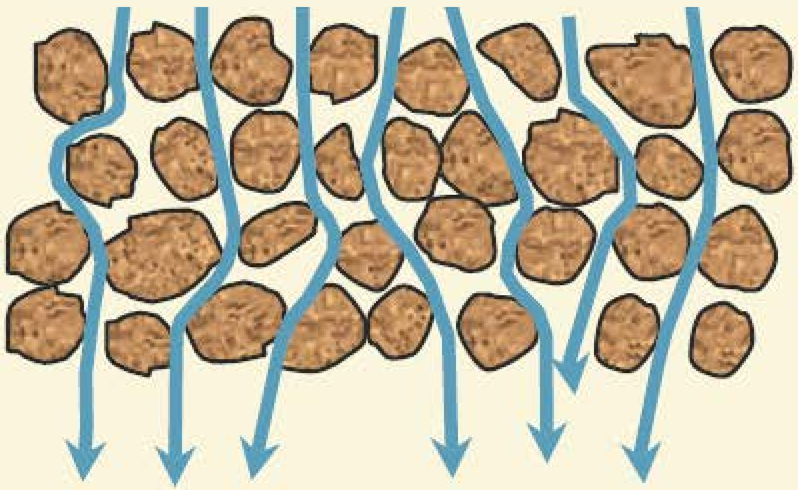
	Indicators	Value	Rating	Constraint
PHYSICAL	Aggregate Stability (%)	83.6	99	
	Available Water Capacity (m/m)	0.17	59	
	Surface Hardness (psi)	233	24	rooting, water transmission
	Subsurface Hardness (psi)	325	36	
BIOLOGICAL	Organic Matter (%)	5.3	91	
	Active Carbon (ppm) [Permanganate Oxidizable]	566	40	
	Potentially Mineralizable Nitrogen (μgN/ gdwsoil/week)	17.2	100	
	Root Health Rating (1-9)	5.0	50	
CHEMICAL	pH (see Nutrient Analysis Report)	6.1	67	
	Extractable Phosphorus (see Nutrient Analysis Report)	3.1	44	
	Extractable Potassium (see Nutrient Analysis Report)	37.8	33	
	Minor Elements (see Nutrient Analysis Report)		100	
	OVERALL QUALITY SCORE (OUT OF 100):		62.0	Medium

Soil Textural Class:==> silt loam

SAND (%): 45.6 *SILT (%): 52.5* *CLAY (%): 1.9*

Management must address explicit physical and then biological & chemical processes

Usually Pastures have better infiltration



a) aggregated soil

But this one is compacted, causing runoff

b) compacted/ soil, large pores lost despite good aggregate stability

Figure 5.6. Left: Corn root in a compacted soil cannot access water and nutrients from most of the soil volume. Right: Dense rooting allows for full exploration of soil water and nutrients.

Observed: significant runoff during rain events

NRCS Natural Resources Conservation Service

Interpreting Soil Health Ass
NH-590 Quick Ref

4. Identify feasible management options

Test Results	Suggested Management Practices		
	Short Term	Long Term	
Physical Concerns			
Low Aggregate	• Incorporate fresh organic materials • Use shallow-rooted cover/rotation crops	• Reduce tillage • Use a surface mulch Rotate with sod crops	(328) Conse (329) Resid (484) Mulch (528) Presc
Lo Water Capacity	• Add compost or biochar • Incorporate high biomass cover crop	Reduce tillage • Rotate with sod crops • Incorporate high biomass cover crop	(328) Conse (329) Resid (317) Comp (512) Forag
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) Conse (345) Resid (484) Mulch (512) Forag
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 (329) Resid (345) Resid (340) Cover
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) Conse (329) Resid (317) Comp (512) Forag
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) Conse (329) Resid (345) Resid (512) Forag
Low	• Add N-rich organic matter (low C:N source like manure or well-finished compost)	• Reduce tillage • Rotate with forage legume sod crop	(328) Conse (329) Resid

SH Management Planning Process Overview

1. Determine farm background and management history

Sloped hay field, sometimes grazed – especially recently, pond below field is full of algae (P excess); growth mediocre. Visible erosion, runoff during rain. Diverse inventory of field equipment, grower inclined to experiment with anything. Organic mixed operation.

2. Set goals and sample for soil health

Improve soil health, productivity, on-farm nutrient and carbon cycling, and long-term sustainability, and regaining use of the pond for recreational purpose

3. For each management unit: identify and explain constraints, prioritize

Biggest constraint: Surface compaction causing loss of P inputs to pond, while soil P is low.
Also: Subsurface compaction, low active carbon; K, P, and pH below optimal

4. Identify feasible management options

Need mechanical disturbance first: Surface mechanical disturbance, deep ripping/subsoiling along contours. Then fresh organic inputs, wood ash and/or manure additions, interseed additional crops for vigorous and diverse rooting.

5. Create short and long term Soil Health Management Plan

6. Implement, monitor, and adapt

5. & 6. Plan and Implementation

September 2012: Ripped with Yeoman's Plow

addresses subsurface compaction

Photos: Bianca Moebius-Clune

September 2012: Aerator addresses surface compaction

Photos: Bianca Moebius-Clune

October 2013:
Spread wood ash
(addresses K, some P, pH)

Photos: Bianca Moebius-Clune

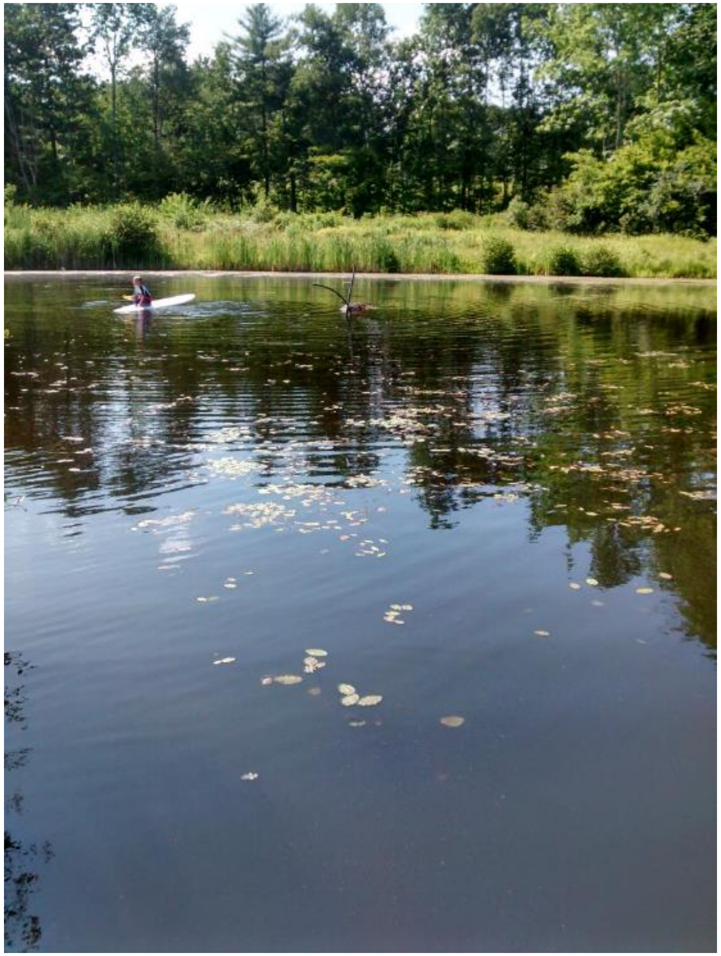
Oct 2013:
Seed cover crop mix/forage of hairy vetch, winter rye, wheat, barley. Single pass 3” rotovator & no-till drill.

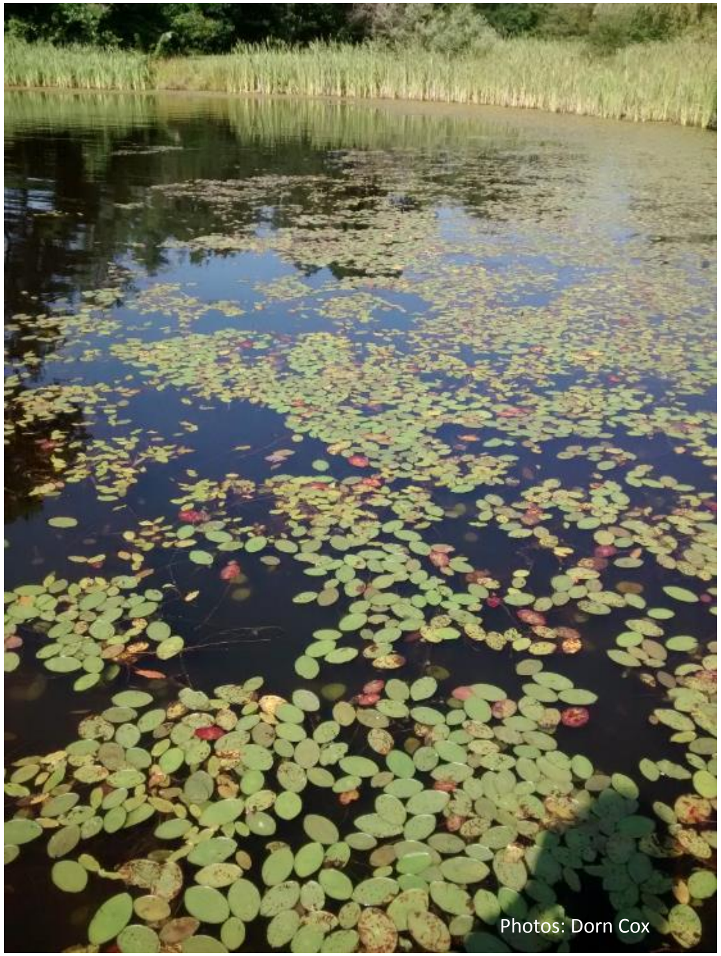
increased active C, decreased surface compaction, increased infiltration

Photos: Dorn Cox

Results: Vigorous growth

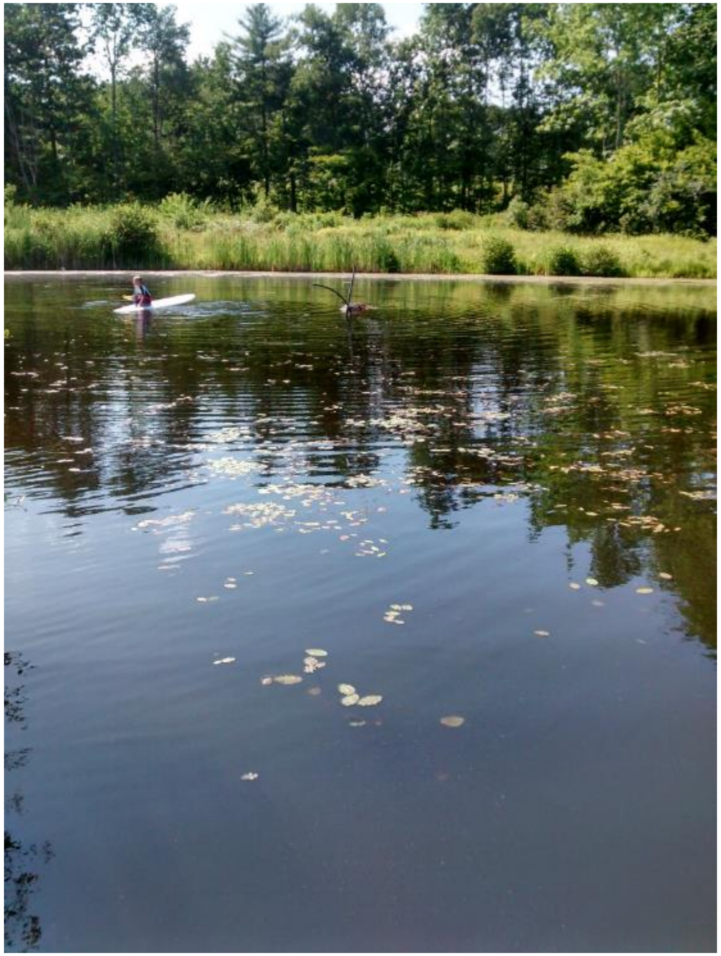
Results: Pond eutrophication cleared





Recreational use resumed in 2013, improved in 2014

Lessons demonstrated



- Nutrient constraints interact with physical and biological constraints to create water quality issues
- Prescribed BMPs have limitations
- Use systems indicators as feedback for adaptive management
- Need comprehensive Soil Health Management Planning, and adaptive implementation for progress in soil and water conservation

Moebius-Clune, B, Dorn Cox, 2014. Implementation of a Soil Health Management Plan resolves pond eutrophication at Tuckaway Farm, NH. What's Cropping Up? Vol. 24. No. 5, pp 49-53

Key Points to Remember

- Basic concepts apply everywhere
- Indicators provide information about how well processes are working
- Indicators relevant in most systems, but ratings are not yet regionally adjusted, relative importance will differ
- Differences in regions, climates, soil types, production systems, and producer inclination → application of info must be adjusted
- General management guidelines apply in principle but must be adapted to each location
- **User must understand concepts well to apply to each situation as appropriate!**




Questions and Discussion

bianca.moebius-clune@wdc.usda.gov