

Enriching Soil, Enhancing Life

AN ACTION PLAN FOR SOIL HEALTH



SOIL HEALTH
INSTITUTE

UNIFY ■ RESTORE ■ PROTECT

RESEARCH

What we don't know

MEASUREMENT & ASSESSMENT

What the current status is

ECONOMIC ANALYSES

What the costs, risks, and benefits are

COMMUNICATIONS & EDUCATION

Getting the word out

POLICY

A cornerstone for decision making

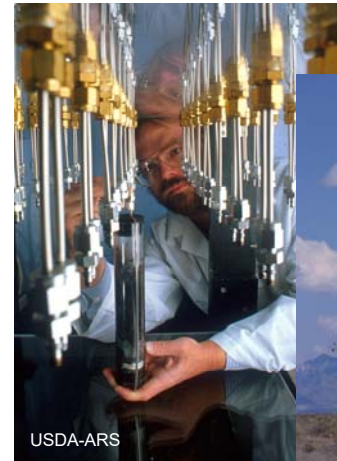
The National Soil Health Assessment

- Two needs must be met.
 - Selection of **specific measurements** of soil physical, chemical, and biological properties having known relationships to land management practices and soil health.
 - Creation of a **sampling design and protocols** that can be deployed in procedurally and statistically rigorous ways that will enable valid conclusions to be drawn from the data.



MEASUREMENT & ASSESSMENT - Determining the current situation – What is the best way to quantify soil health?

- What measurements are available to us now?
 - Physical – texture, structure, water infiltration...
 - Chemical – nutrient concentrations, pH, CEC...
 - Biological – soil respiration, nutrient transformations....
 - *Who decides which are best?*
 - Is a particular measurement useful everywhere?
 - Scale?



Characterization of soil health measurement “Tiers”

- Tier 1:
 - An effective indicator of soil health
 - Defined regionally and by soil groupings across the nation
 - Thresholds are known to indicate (at minimum) “Poor”, “Adequate”, and “Good” that are outcome based (yield, environmental goals, etc.)
 - Specific management strategies can be suggested to improve soil functioning.
- Tier 2:
 - An effective indicator of soil health
 - Known to be related to improvements or degradation of soil
 - Potential ranges may be known in some regions but not nationally
 - Research is needed to establish thresholds to meet a relative standard of a healthy soil in various regions
 - There is some knowledge of management practices that can change measured values and the soil processes that affect observed measurement results.
 - Further development of a Tier 2 indicator may bring it into Tier 1.
- Tier 3:
 - An indicator that has potential to add significant information about soil health in specific locations or on large scales
 - Specific relationships among measured values, soil processes, and effects of land management are not fully understood.
 - Promising enough to warrant research on these relationships, as well as development of SOPs for production laboratory implementation and interpretation, in support of eventually developing them to meet Tier 1 criteria.



SHI's survey on Tier 1 Indicators

- Sent to 179 recipients - anyone who attended at least one:
 - A Soil Renaissance “Research” working group meeting
 - A Soil Renaissance “Measurements” working group meeting
 - The first SHI annual meeting (July 2016 in Louisville)
 - (Survey may have been forwarded to others)
- List of proposed Tier 1 indicators was derived from meeting report-outs and published in the SHI Action Plan.
- Respondents rated each proposed Tier 1 indicator
 - 1 (not worth the effort and resources) to
 - 10 (essential to measuring and understanding soil health)



Tier 1 Survey Results - 48 responses

INDICATOR	Min	Max	Median	Mode	Mean	
Organic carbon	1	10	9	10	8.5	Nearly universal agreement
pH	1	10	9	10	7.9	
Water-stable aggregation	1	10	9	10	7.8	
Crop yield	1	10	8	10	6.9	Very strong agreement
Soil texture	1	10	8	8	6.7	
Soil penetration resistance	1	10	7	8	6.4	Clear consensus
Cation Exchange Capacity	1	10	7	8	6.3	
Electrical conductivity	1	10	7	8	6.2	
Potassium	1	10	7	8	6.0	
Short-term carbon mineralization	1	10	7	7	6.9	
Nitrogen mineralization rate	1	10	7	7	6.8	Moderate to weak consensus
Visual rating of erosion	1	10	7	7	6.8	
Nitrogen	1	10	7	6	6.3	
% Base saturation	1	10	6	8	6.0	Meh
Phosphorus	1	10	6	5	6.3	
Bulk density	1	10	6	5	6.0	
Micronutrients	1	10	5	5	5.5	

Specific Tier 1 measures endorsed by SHI include:

- organic carbon
- pH
- water-stable aggregation
- crop yield
- texture
- penetration resistance
- cation exchange capacity
- electrical conductivity
- nitrogen
- phosphorus
- potassium
- carbon mineralization
- nitrogen mineralization
- erosion rating
- base saturation
- bulk density
- available water holding capacity
- infiltration rate
- micronutrients



SHI's research priorities for soil carbon

- Methods that
 - give meaningful data for different soils
 - meet accuracy and precision standards across laboratories
 - allow data to be harmonized
 - are low in cost and permit many samples
 - allow detection of spatial and temporal trends at different scales
 - have demonstrable functional (process) relationships to management practices
 - lead to quantitatively predictable outcomes, guiding actions
 - X% increase in C or C mineralization rate provides Y change in benefit
- Determining the achievable limits to C sequestration in different soils

