



SOIL HEALTH

— INSTITUTE —

Enriching Soil, Enhancing Life



MEASURING AND ASSESSING SOIL HEALTH ACROSS NORTH AMERICA

Cristine Morgan, PhD

Chief Scientific Officer

Mission: safeguard and enhance the vitality and productivity of soil through scientific research and advancement

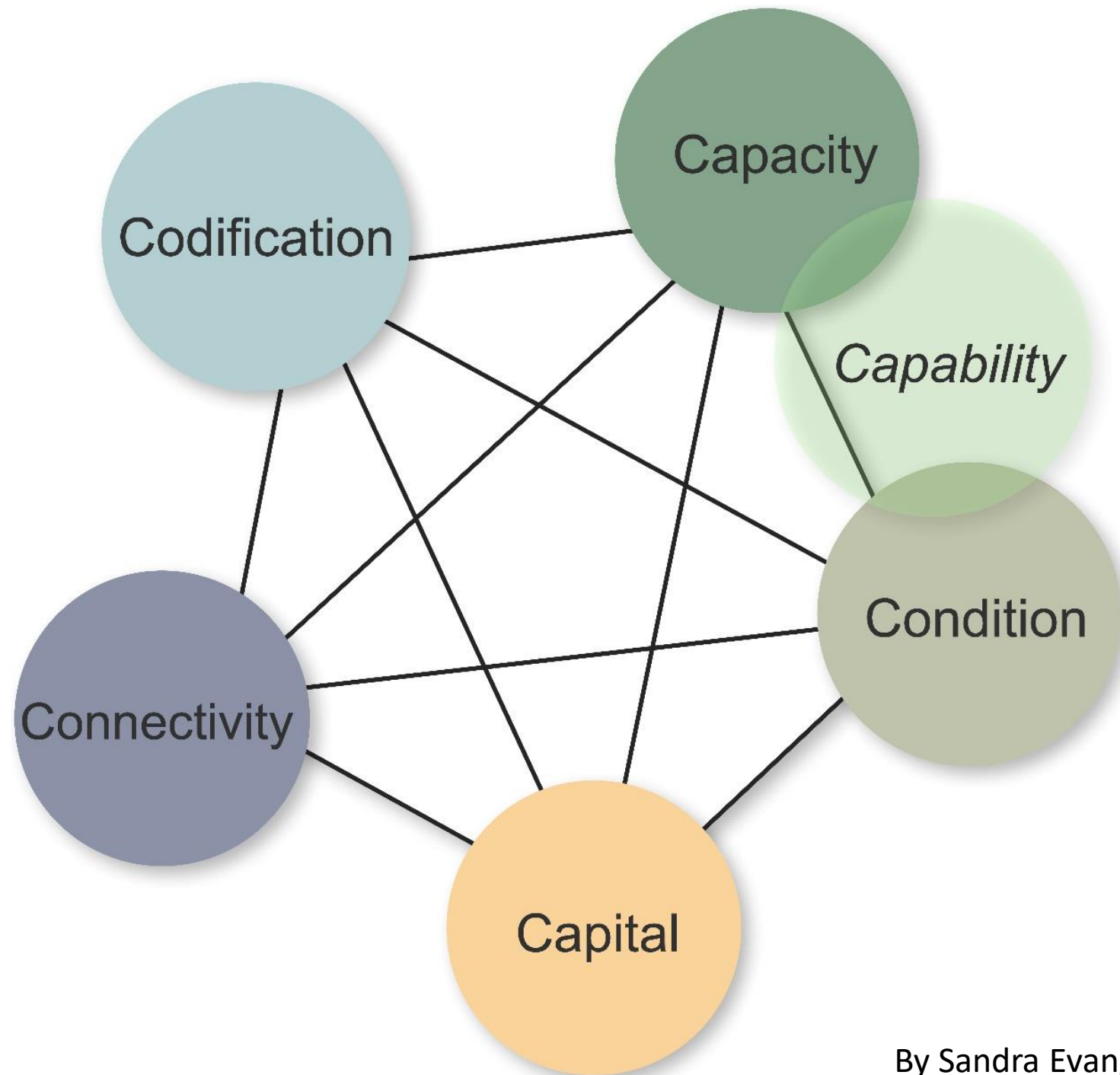


What is Soil Health?

Measure soil health to develop locally relevant resources for land managers & quantify impacts of soil health management systems



Soil Security



What are soil functions?

- Water infiltration and retention
- Filtering pollutants
- Decomposition of organic matter
- Carbon storage
- Nutrient cycling
- And more



What affects soil function?

Soil Forming Factors



Jason
Ackerson

[https://www.soils.org/
media-gallery/view/85](https://www.soils.org/media-gallery/view/85)

+

Soil Management



=

Soil Health Expression



Runoff collected on fields
managed with different practices.
Left to right = increasing levels of
soil health management systems

100

farms assessed in states where
71% of the corn and 67% of the
soybeans are grown in the U.S.

BACKGROUND AND SUMMARY OF FINDINGS ACROSS ALL 100 FARMS

97%

reported increased crop
resilience to extreme weather

85%

Net income increased for 85%
of farmers growing corn and
88% of farmers growing
soybean

67%

reported a higher yield than
their conventional system

\$24

Reduced the average cost to
grow corn by \$24/acre and
soybean by \$17/acre

\$52

Increased net farm income by
an average of \$52/acre for
corn and \$45/acre for soybean

<https://soilhealthinstitute.org/economics/>

Partial Budget Analyses for over 170 farms

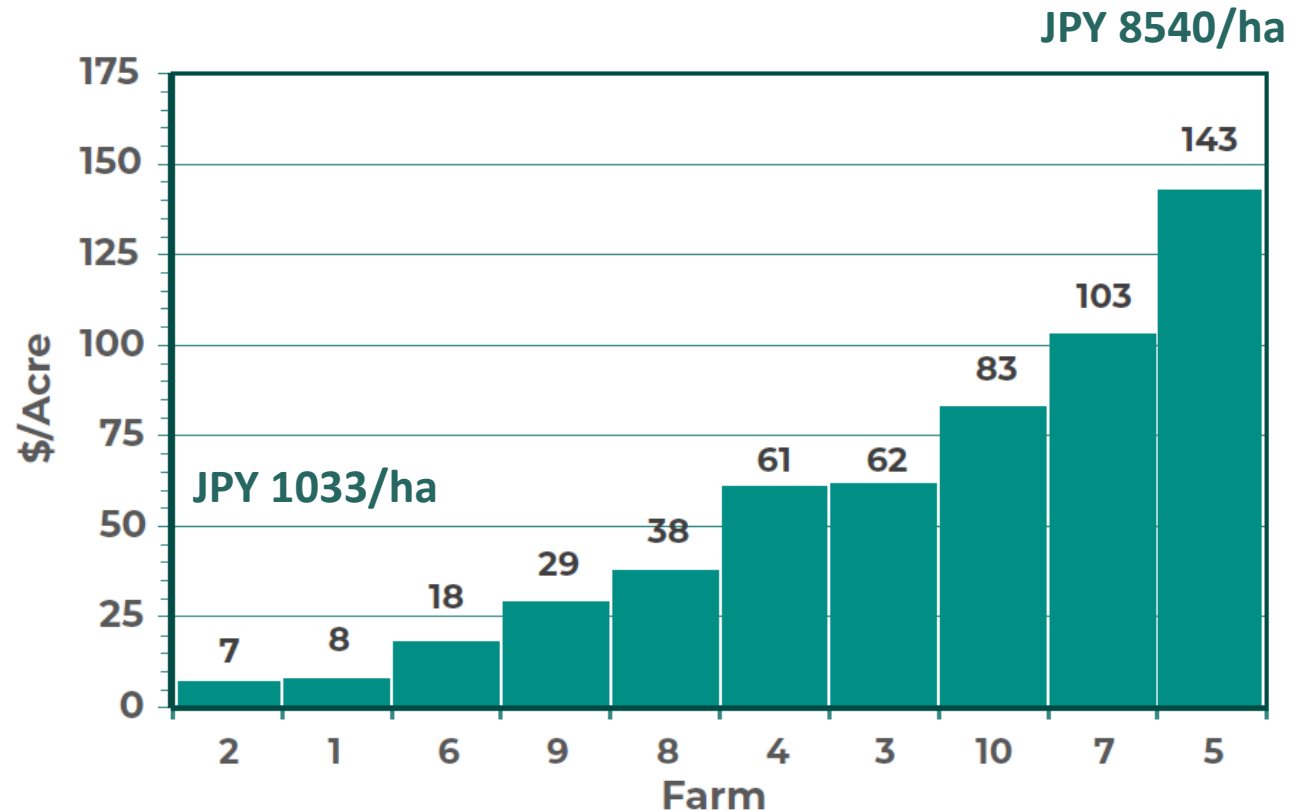
Expense Category	Wheat	
	Benefits	Costs
	Reduced Expense	Additional Expense
Seed	0.00	7.05
Fertilizer & Amendments	6.43	0.00
Pesticides	1.26	3.12
Fuel & Electricity	4.58	1.69
Labor & Services	9.63	4.93
Post-harvest Expenses	0.00	0.22
Equipment Ownership	18.91	9.22
Total Expense Change	40.81	26.23
	Additional Revenue	Reduced Revenue
Yield, bu./acre	0.80	0.00
Price Received ² , \$/lb.	5.50	5.50
Revenue Change	4.40	0.00
	Total Benefits	Total Costs
Total Change	45.21	26.23
Change in Net Farm Income	18.98	

Partial budget analysis of adopting a soil health management system

Average Improvement in Net Farm Income

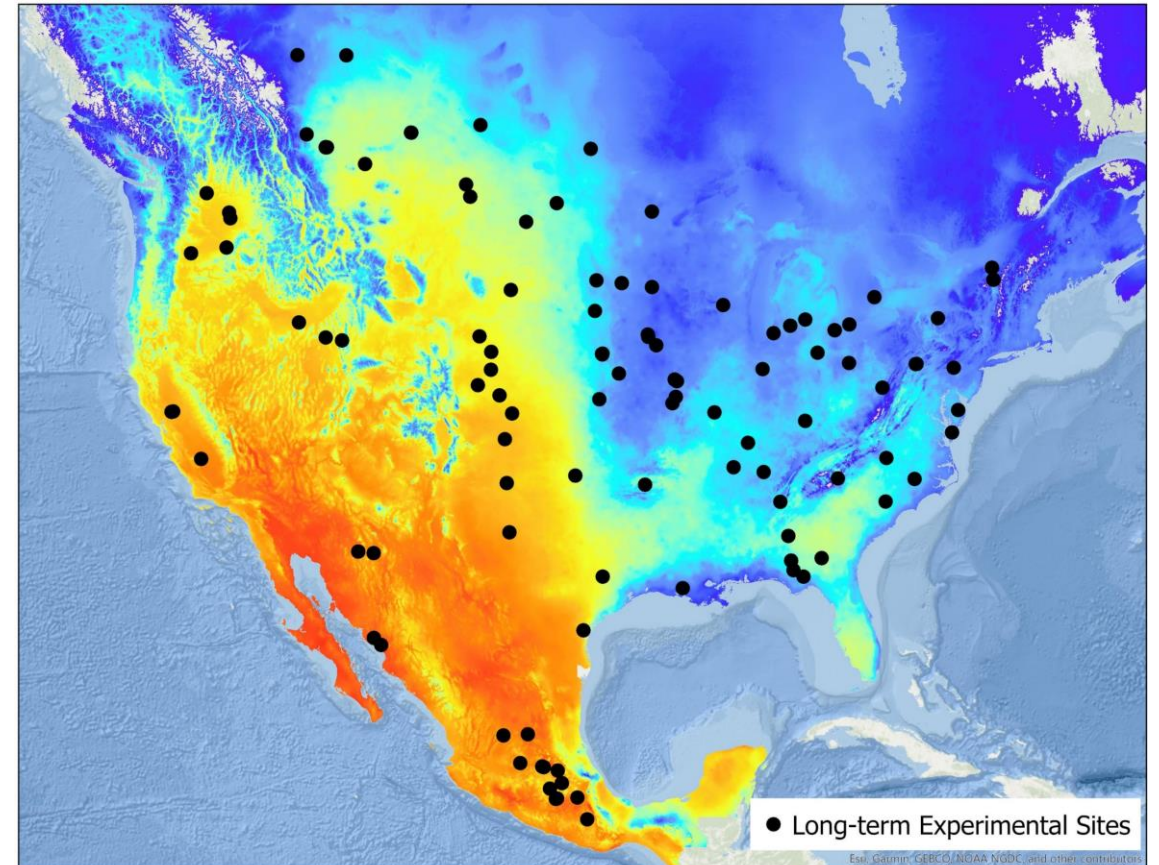
- **100 corn and soybean farms**
USD 50/ac JPY 2,990/ha
- **30 Soil Health Champions**
USD 65/ac JPY 3,880/ha
- **26 Cotton Farmers**
US 100/ac JPY 5,971/ha
- **18 Small Grains Farmers**
USD 19/ac JPY 60/ha

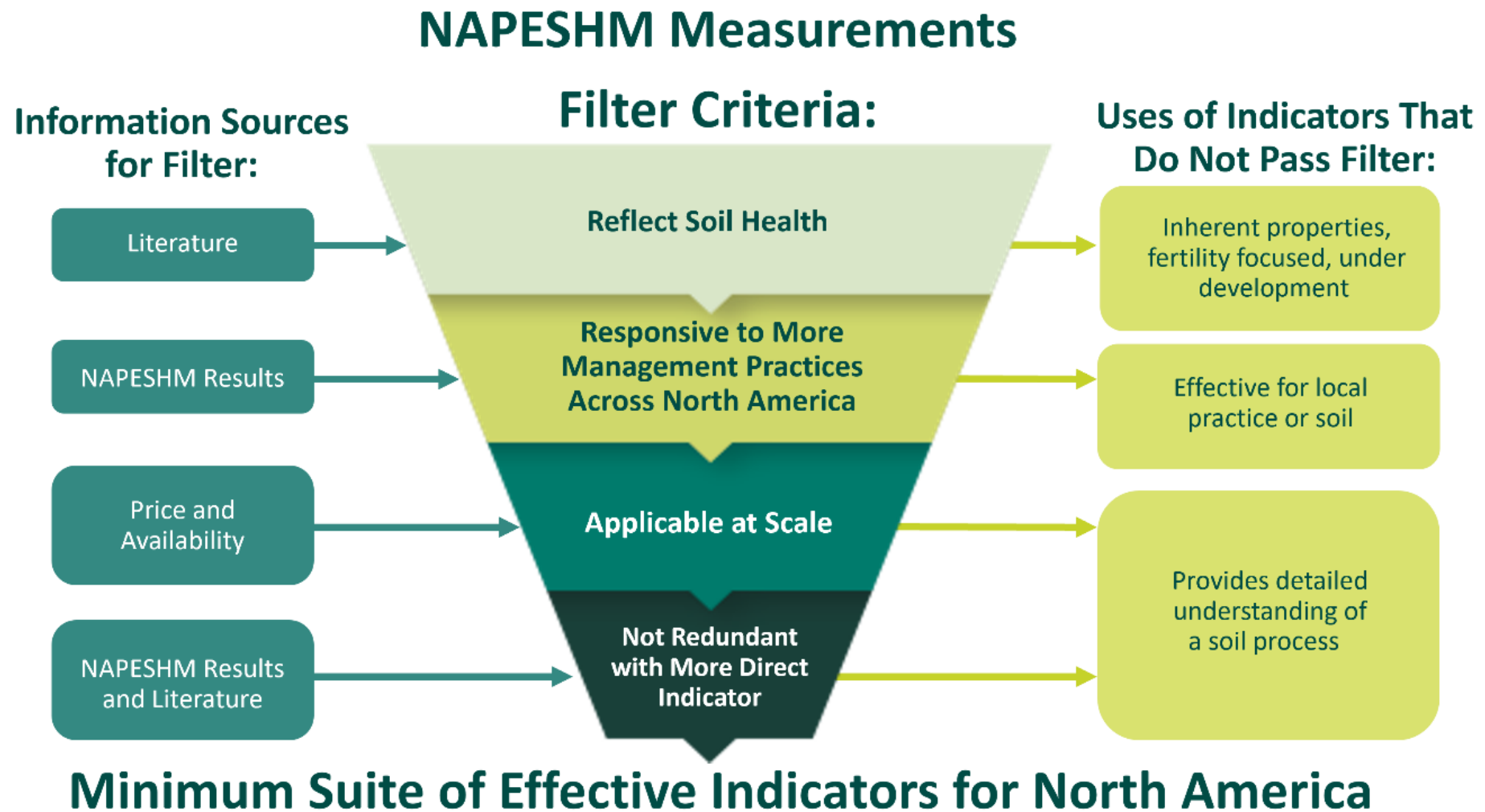
Mean change in net farm across many crops including grazing \$55/acre



North American Project to Evaluate Soil Health Measurements

- Identify most effective indicators of soil health
- 124 long term experimental sites
 - Paired treatments- tillage, cover crops, crop rotations
 - 0-15 cm depth
- Over 30 current & exploratory soil health measurements

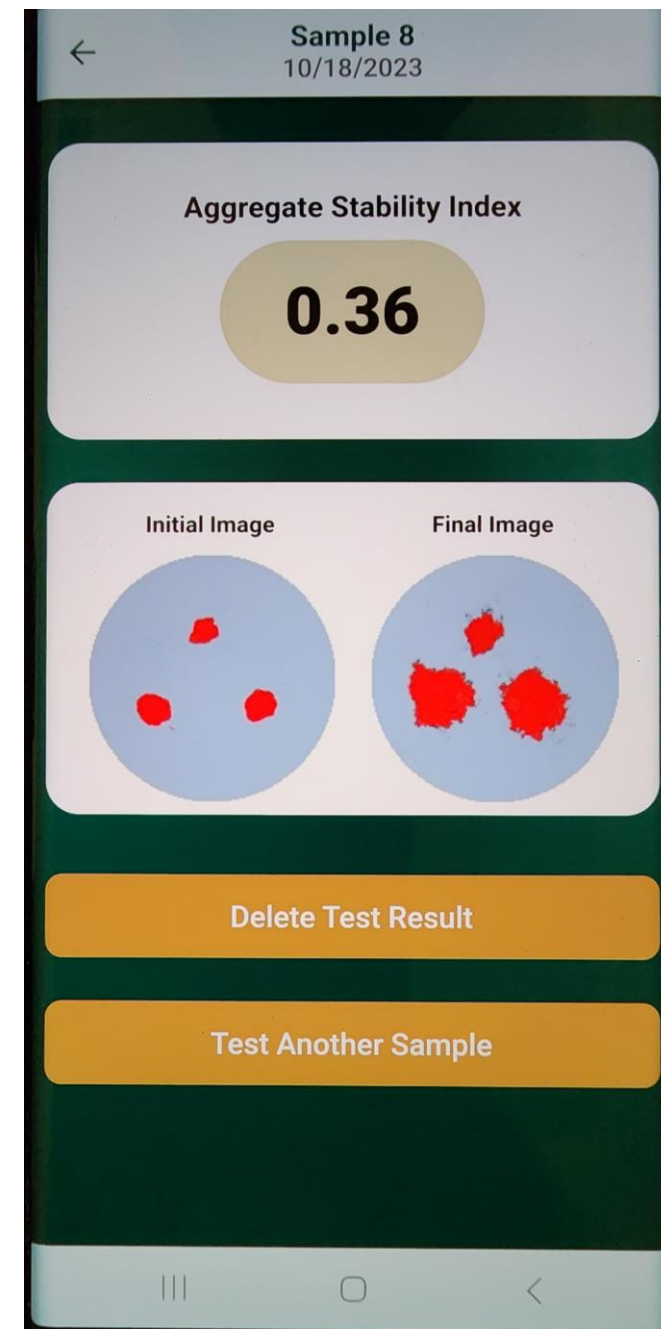
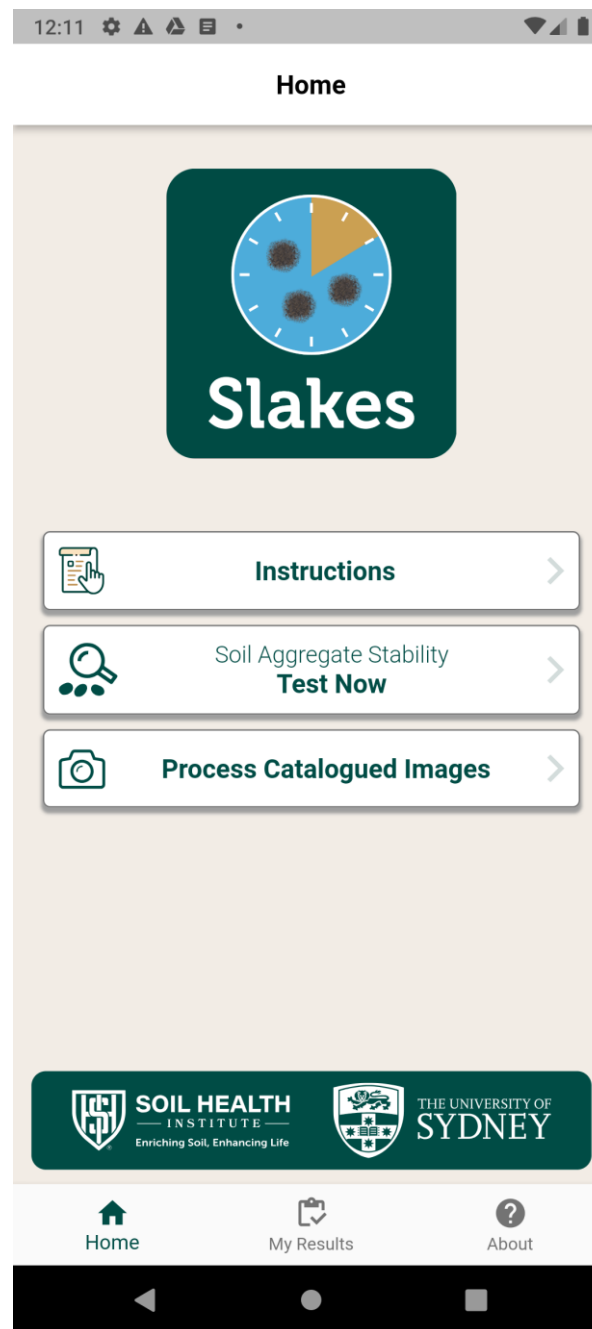




Accessibility of measurement:

Slakes Smart Phone App:

Wet Aggregate Stability



Selected Soil Health Indicators

A minimum suite of soil health indicators for North American agriculture

Dianna K. Bagnall¹  , Elizabeth L. Rieke¹, Cristine L.S. Morgan, Daniel L. Liptzin, Shannon B. Cappellazzi, C. Wayne Honeycutt

1. Soil Organic Carbon Concentration

2. Carbon Mineralization Potential

3. Aggregate Stability via Slaking Image Analysis

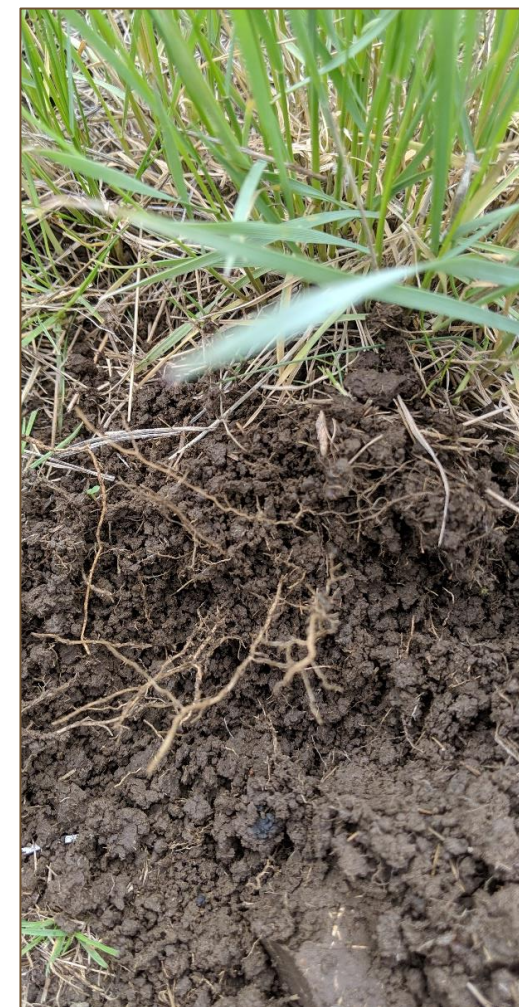
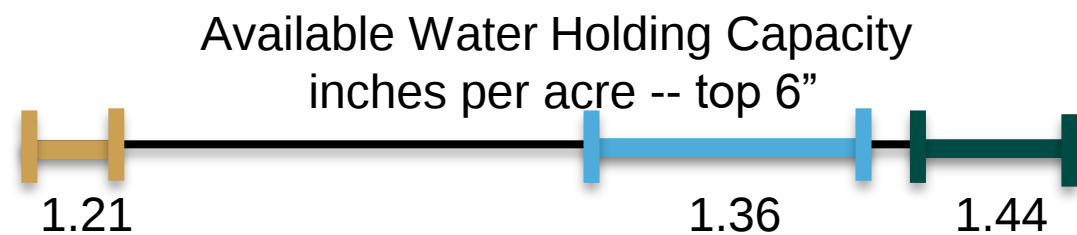
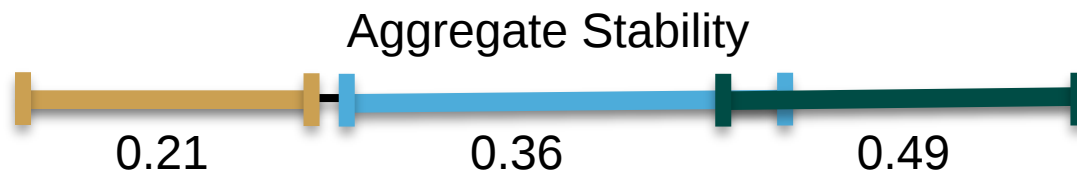
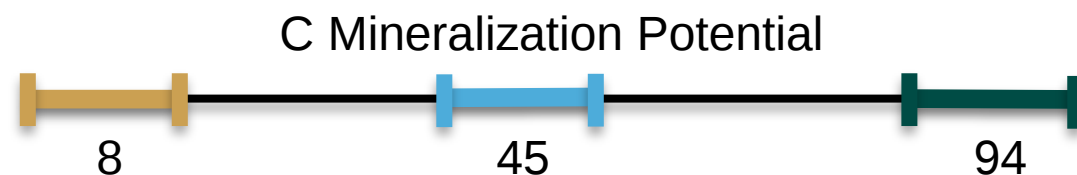
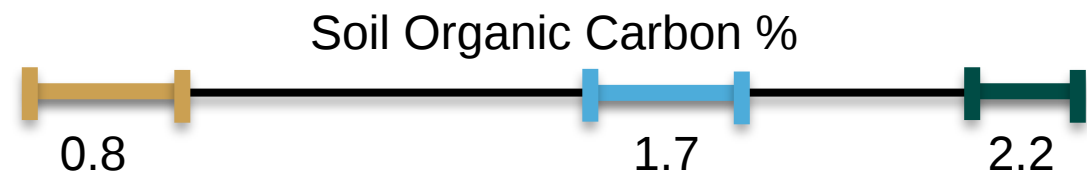
4. *Predicted Available Water Holding Capacity*

Bagnall, D.K., Morgan, C.L.S., Cope, M., ... Honeycutt, C.W., 2022. Carbon sensitive pedotransfer functions for plant available water. Soil Sci. Soc. Am. J. <https://doi.org/10.1002/saj2.20395>

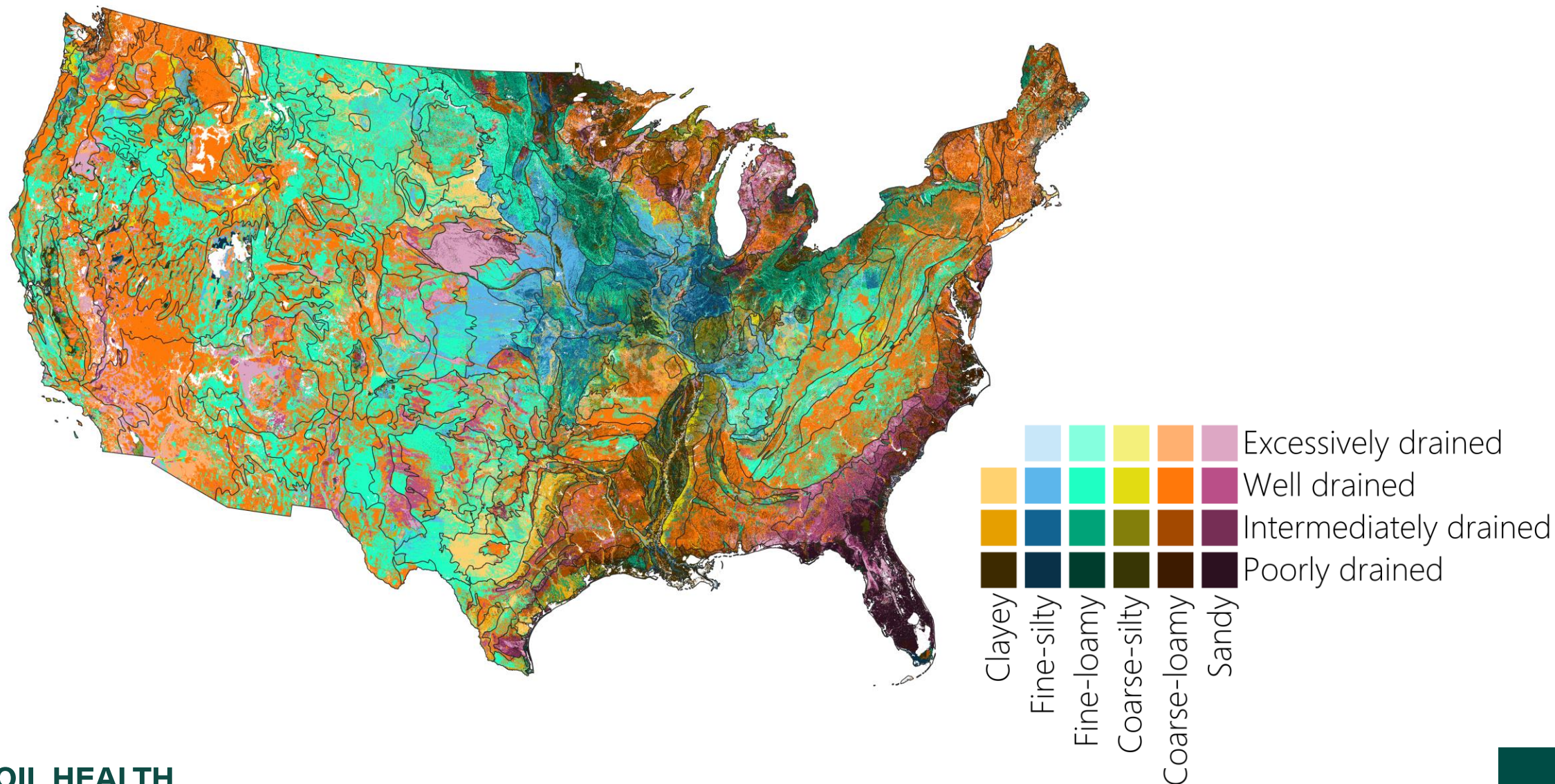


Management Systems

Baseline Soil Health Reference



Soil health sampling groups for the conterminous US

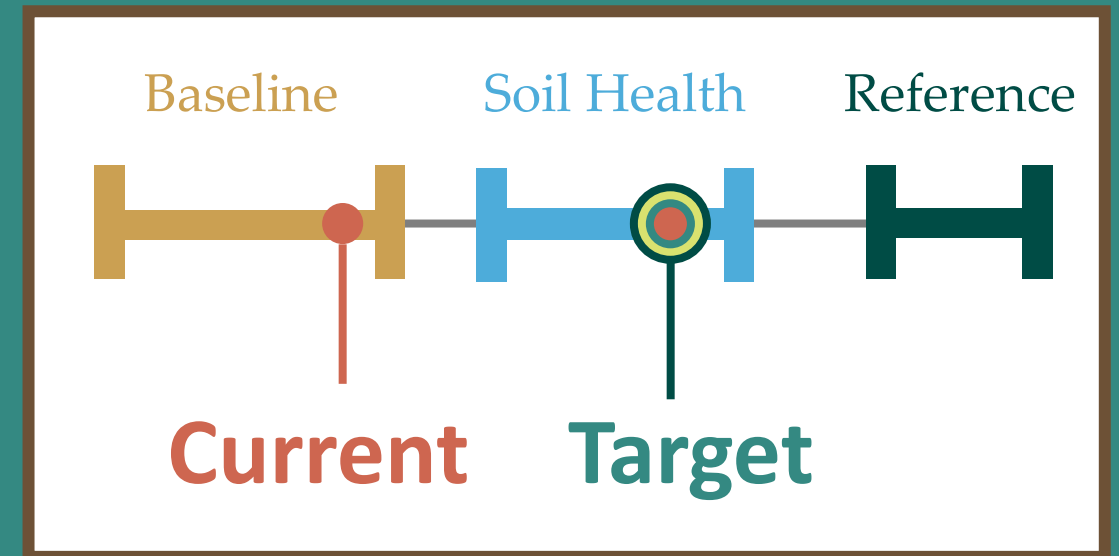


Benchmarking Soil Health

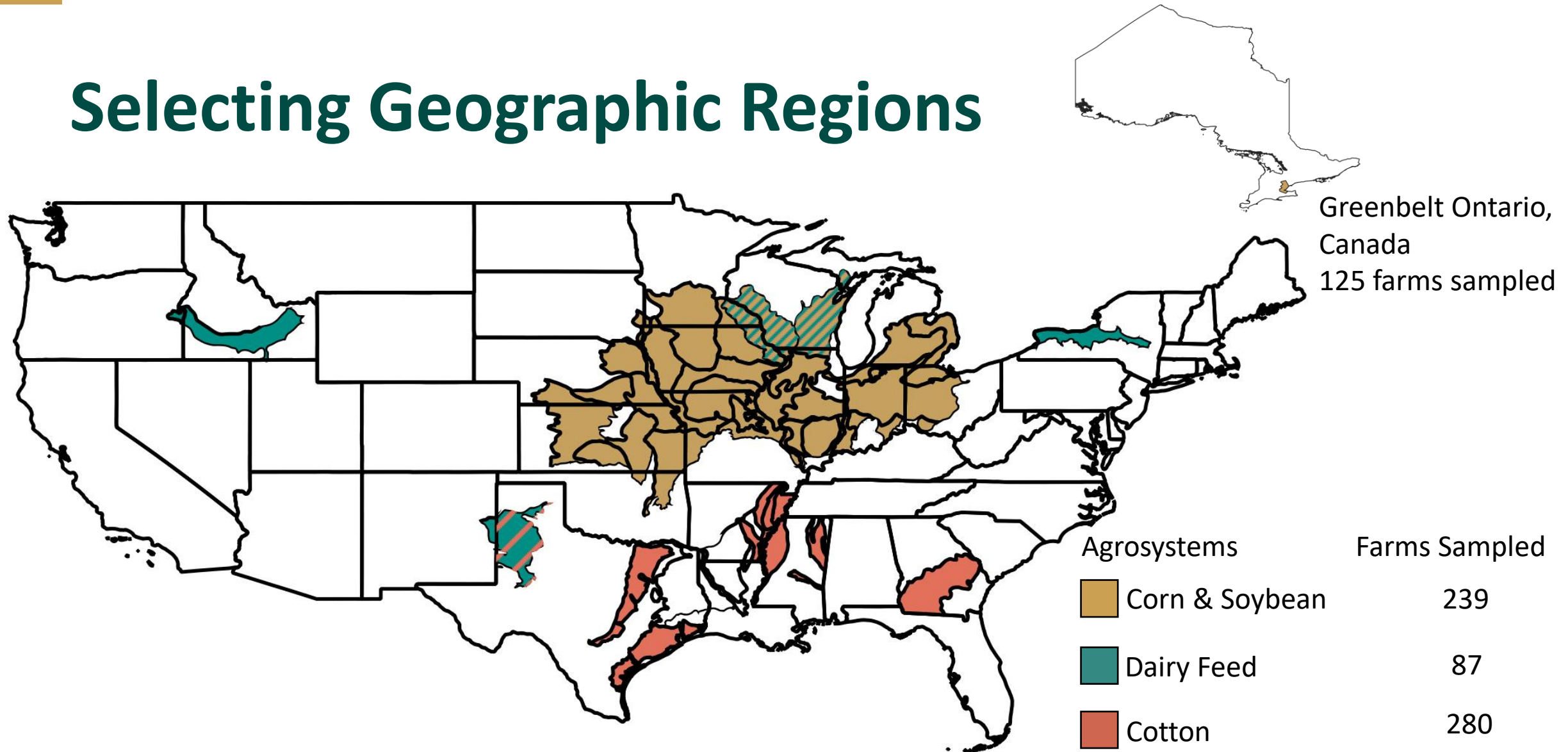


SOIL HEALTH BENCHMARKS

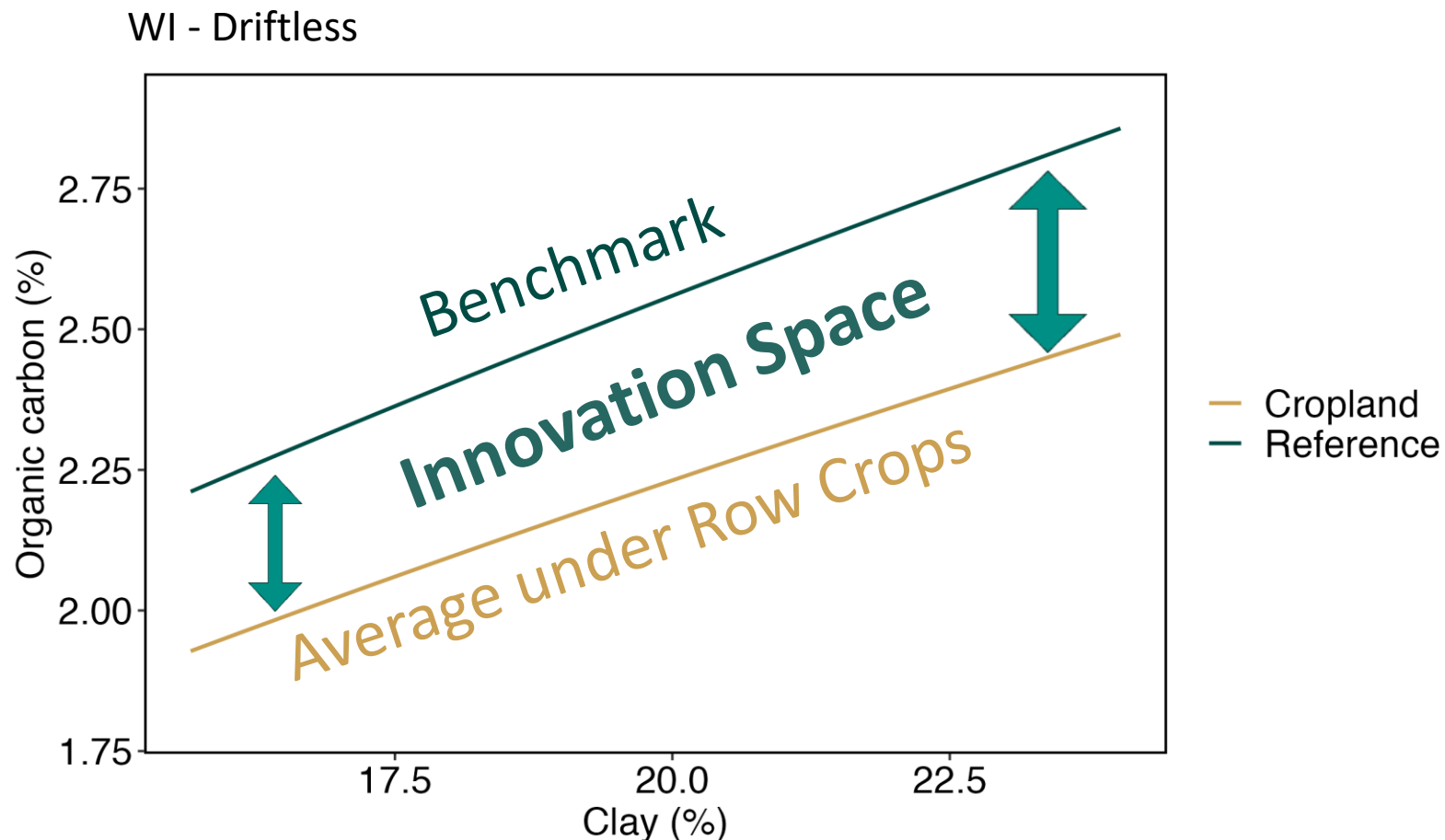
An interpretable, scalable, locally relevant method for evaluating and monitoring soil health. Targets are set by farmers and their advisors for individualized goals.



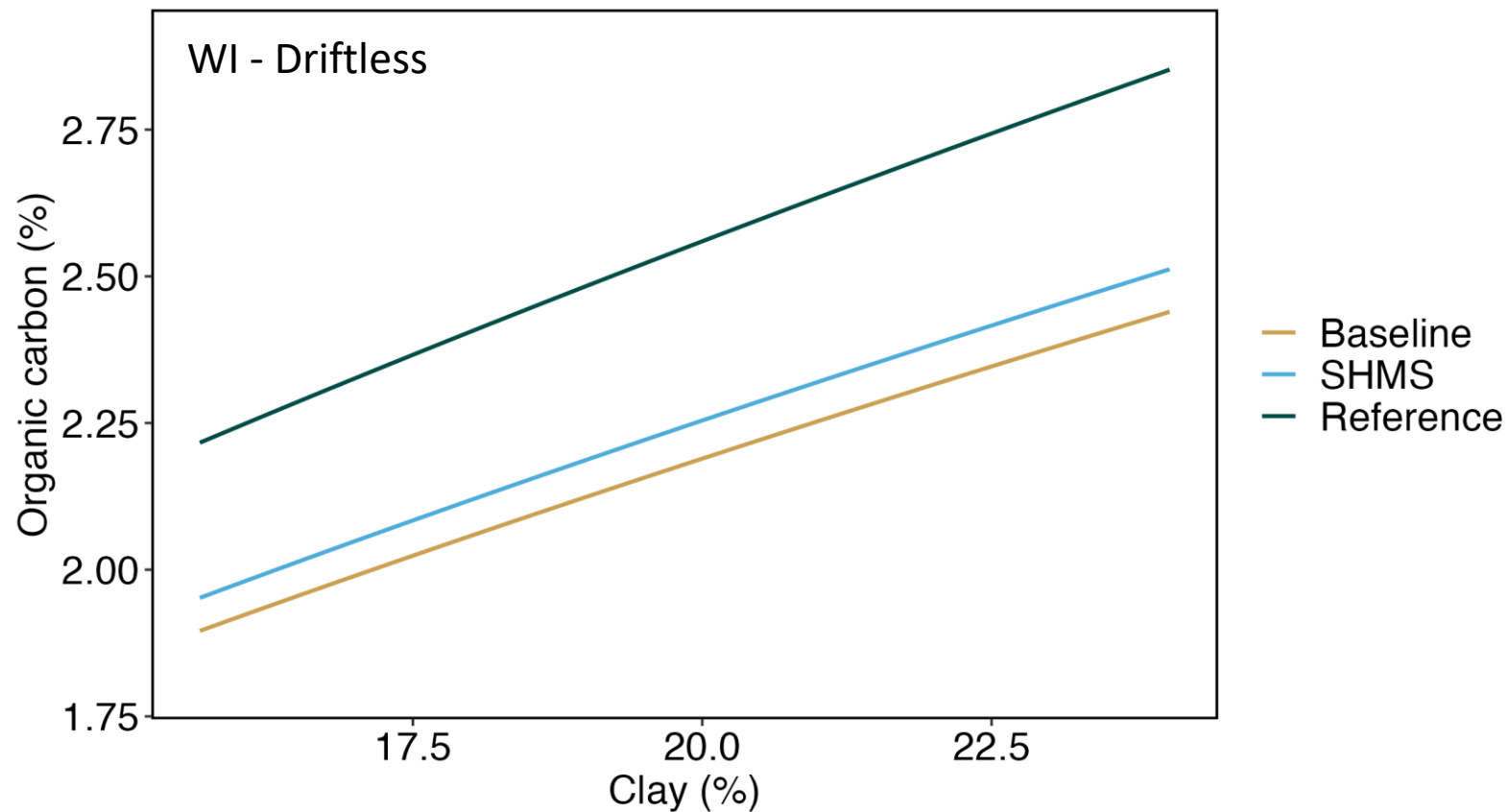
Selecting Geographic Regions



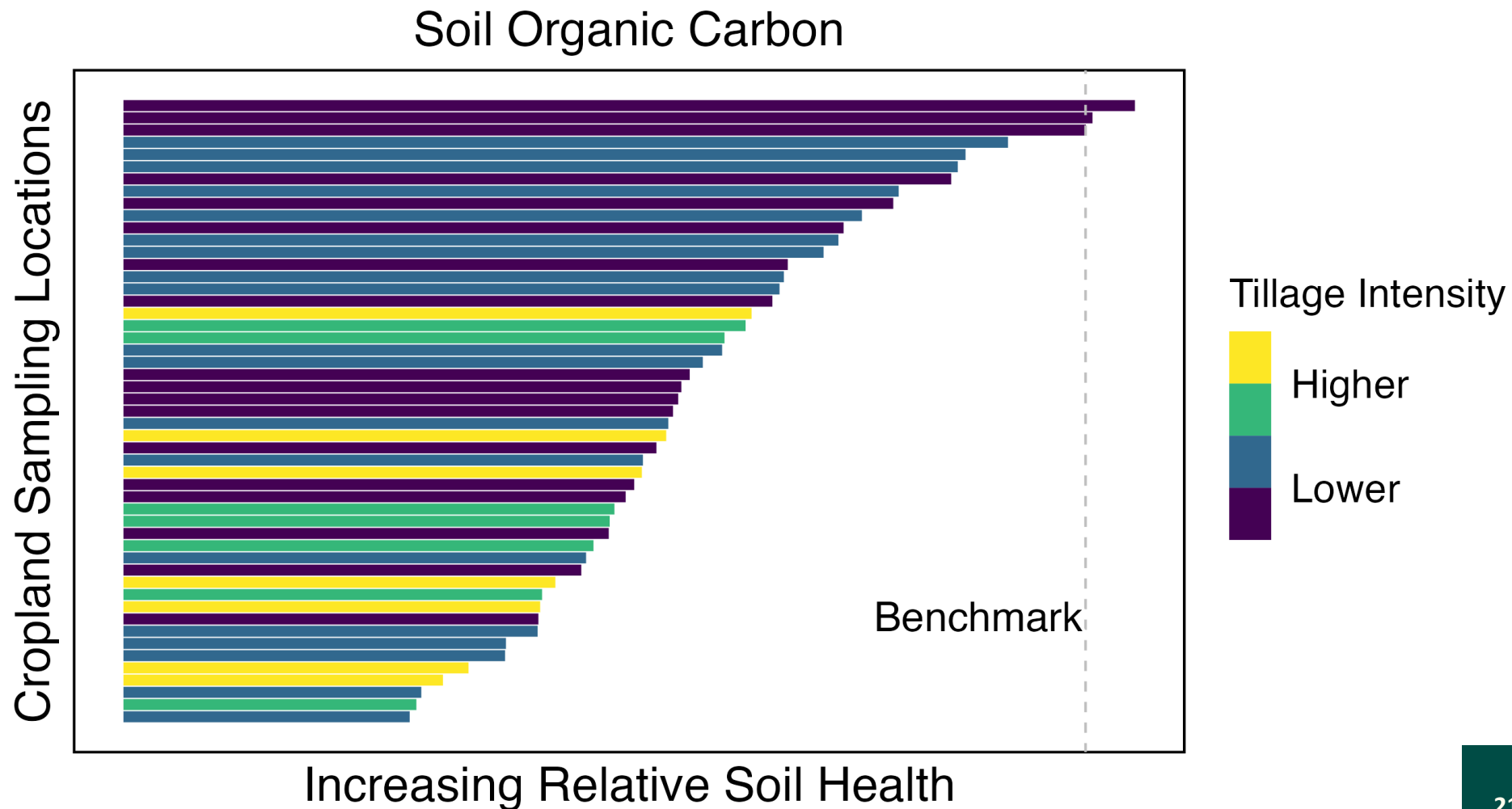
Regional Interpretation of Management Effects



Regional Effects of Management

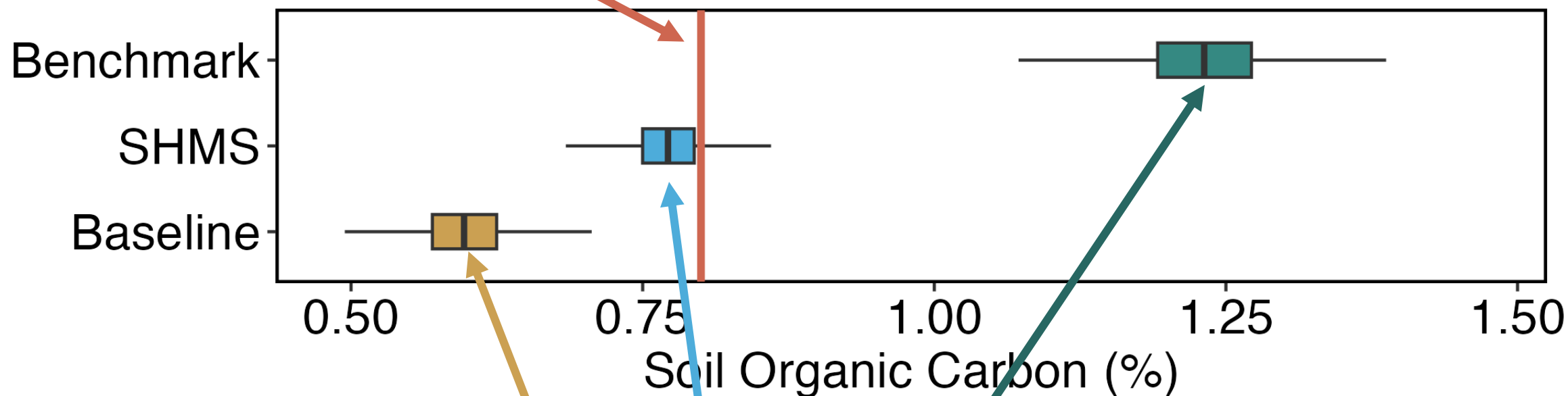


Progress Achieved at the Regional Scale (Georgia)



Farmer-Facing Reporting

Sample with 80% sand
and 0.8% SOC



Expected values of SOC for soils
with 80% sand in same region

Summary

- ✓ Soil health management systems can help our most productive soils become more profitable
- ✓ We can measure and monitor soil health affordably (3 accessible measurements)
- ✓ Achievable soil health varies by soil type, climate, and cropping system
- ✓ Reporting to individual farmer is different than reporting to other stakeholders (policy, consumer product groups, commoditization)
- ✓ If you treasure it measure it



CMORGAN@SOILHEALTHINSTITUTE.ORG