Soil Quality Assessment: Past, Present and Future

Douglas L. Karlen
National Soil Tilth Laboratory

Presentation Outline

What is soil quality assessment?

What approaches can be used?

Which approach should I use?

Where do I see assessment going?

What is Soil Quality Assessment?

The art and science of creating decision tools for sustainable land management

The process of quantifying:

"fitness for use" or

"capacity of a soil to function"

Assessment Requirements

- Tools must be:
  - *accurate*
  - *simple to use*
  - *meaningful*

And

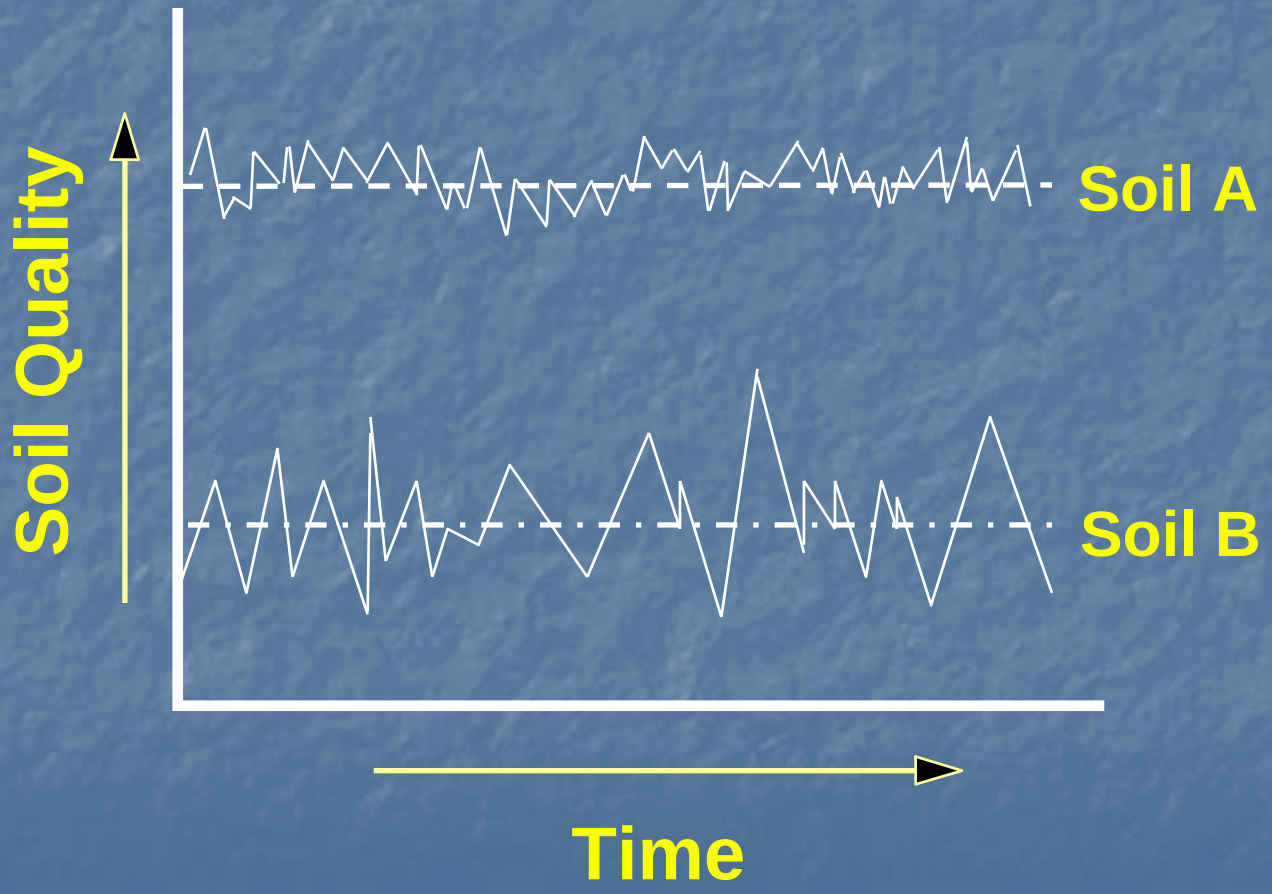
  - *Provide* site-specific standards & guidelines for interpreting soil quality indicators

Inherent vs. Dynamic Soil Quality

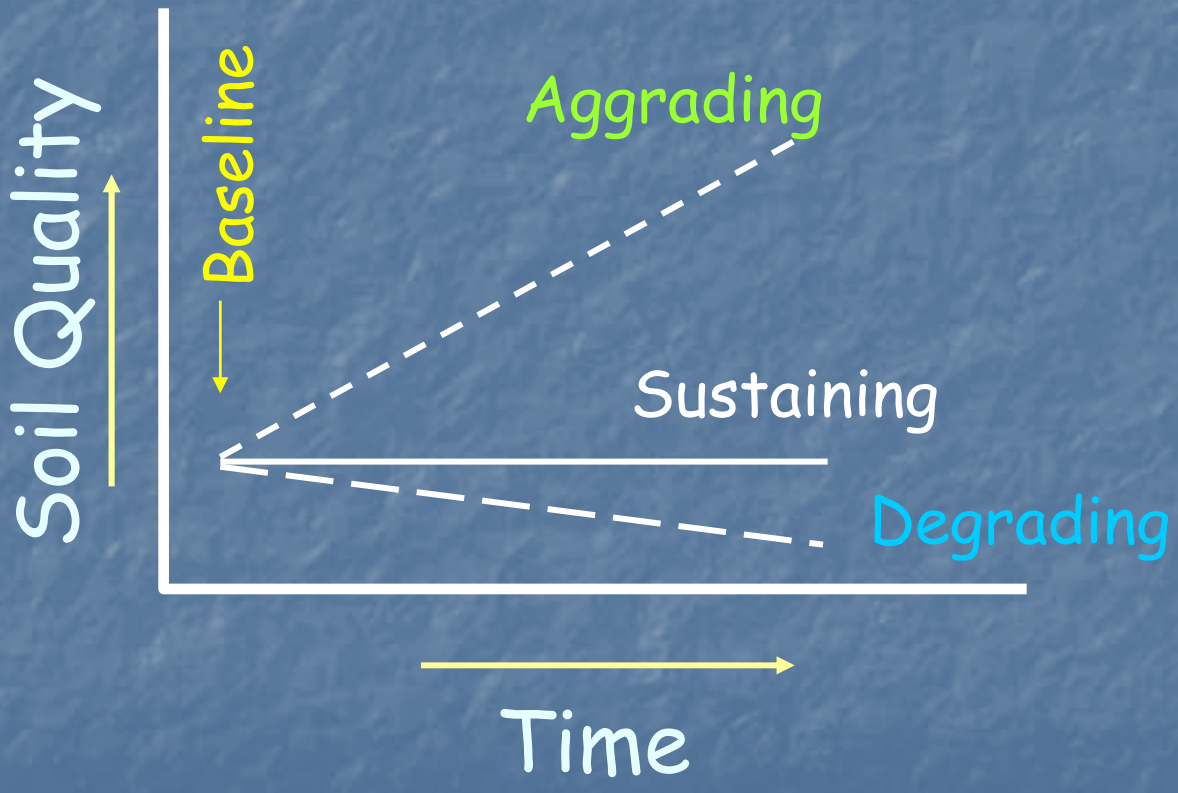
- **Inherent** - reflects basic soil forming factors
  - climate, parent material, time,
  - topography, and vegetation
- (Reflected in Land Capability Classifications)

- **Dynamic** - describes soil status or condition
  - reflects management decisions
  - current or past land uses
- (Reflects sustainability & conservation goals)

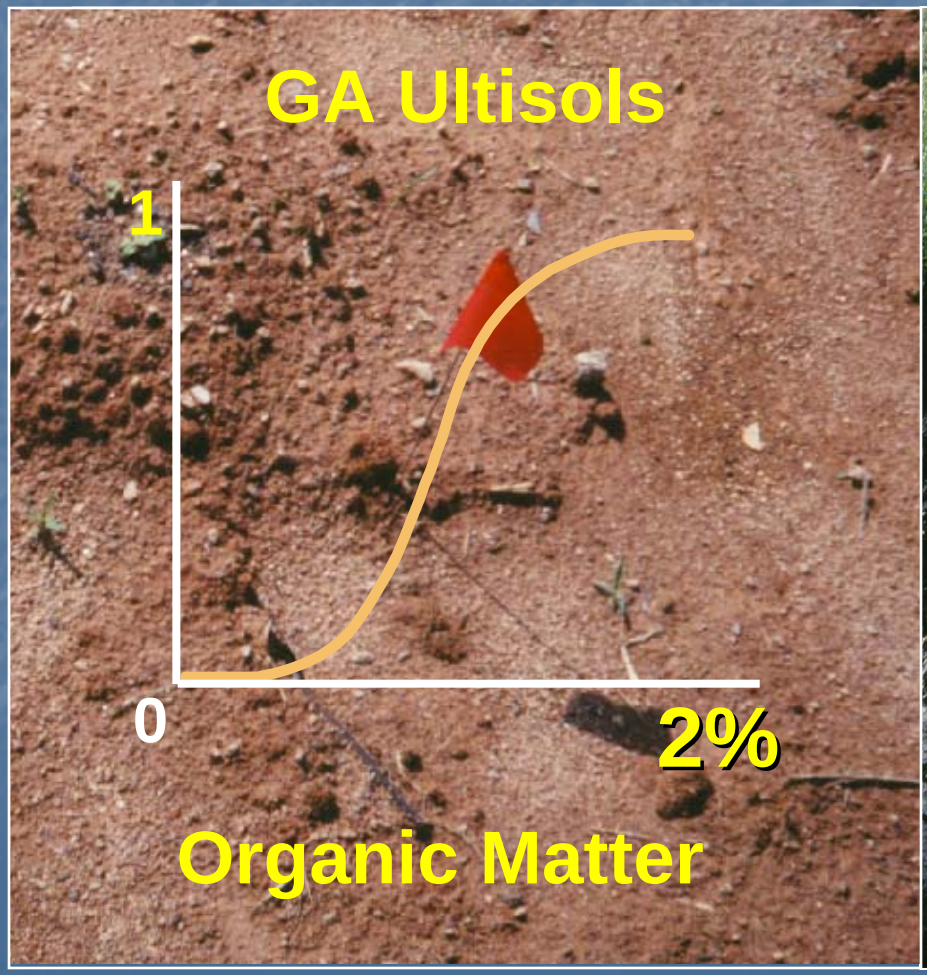
Inherent Soil Quality

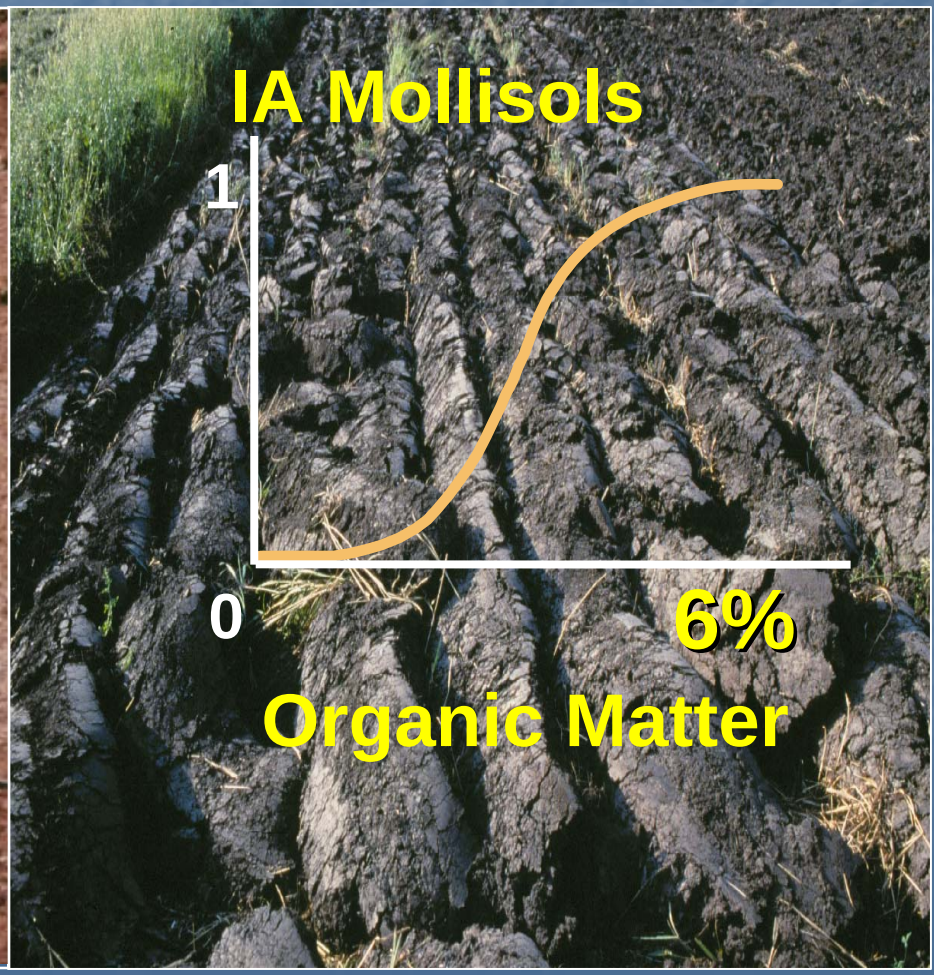


Dynamic Soil Quality



Soil Organic Matter





What Approaches Can Be Used?

Scorecards


Soil Pits


Test Kit

Indexes such as:

AEPAT – AgroEcosystem Performance Assessment Tool

SCI – Soil conditioning Index

SMAF – Soil Management Assessment Framework

Which Approach Should I Use?

Scorecards – to build basic awareness of soils and to document efforts to improve them

Soil Pits & Test kits – for education and building awareness of spatial & temporal variability

Indices –to identify most limiting factors, quantify outcomes not effort, and to help set priorities for conservation investment

What Are Indices Assessing?

Critical Soil Functions – or ability of soil to:

- Sustain biological productivity
- Regulate and partition soil water
- Store and cycle nutrients
- Function as a filter and buffer

What Indices Are Available?

- AEPAT – AgroEcosystem Performance Assessment Tool
- SCI – Soil Conditioning Index
- Cornell Soil Health Test
- SMAF – Soil Management Assessment Framework

AEPAT

- Measured indicators assigned to various functions
  - e.g. food/feed production & nutrient cycling
- Functions weighted by user
- Function scores combined into index
- Used to compare management practices such as wheat-fallow & continuous no-till

Soil Conditioning Index (SCI)

- NRCS adopted tool for predicting soil organic matter trends
- SCI = [OM*0.4]+[FO*0.4]+[ER*0.2]
- Incorporated into RUSLE2 & is one factor used by NRCS to evaluate EQIP & CSP applications

Cornell Soil Health Test

- Implemented in 2007 by Dr. Harold van Es
- Uses biological, chemical, & physical indicators
  - Sensitive, relevant to critical functions, consistent & reproducible, easy to sample, and economical
- Purpose – education about soil health, targeting management practices, monitoring for NRCS programs, and to increase land value

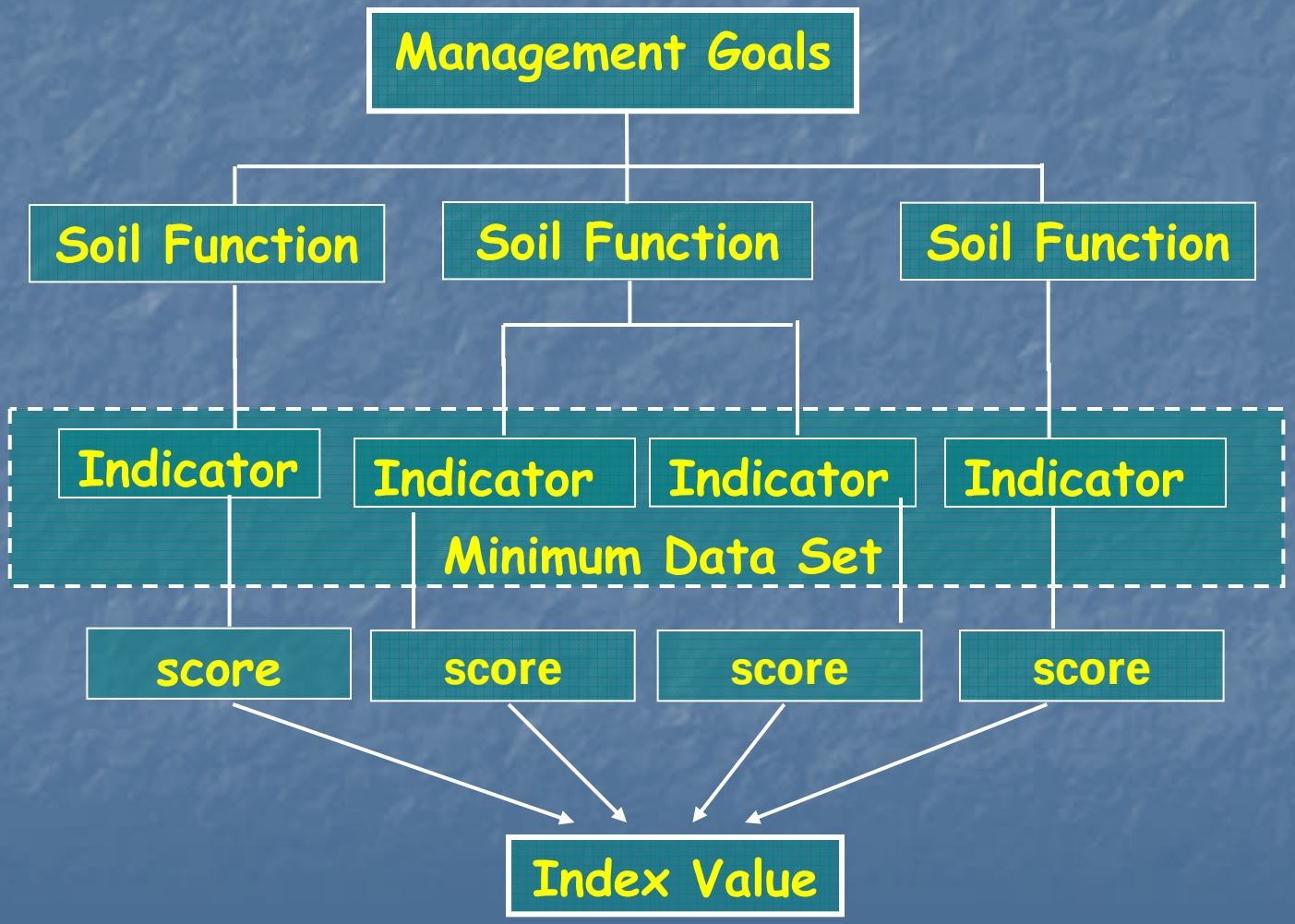
SMAF

- Developed first as Excel spreadsheet & used to evaluate sustainability throughout U.S.
- Currently being made available on CD & web
- Uses multiple indicators – goal is to have one or more representing biological, chemical, and physical properties & processes

SMAF - continued

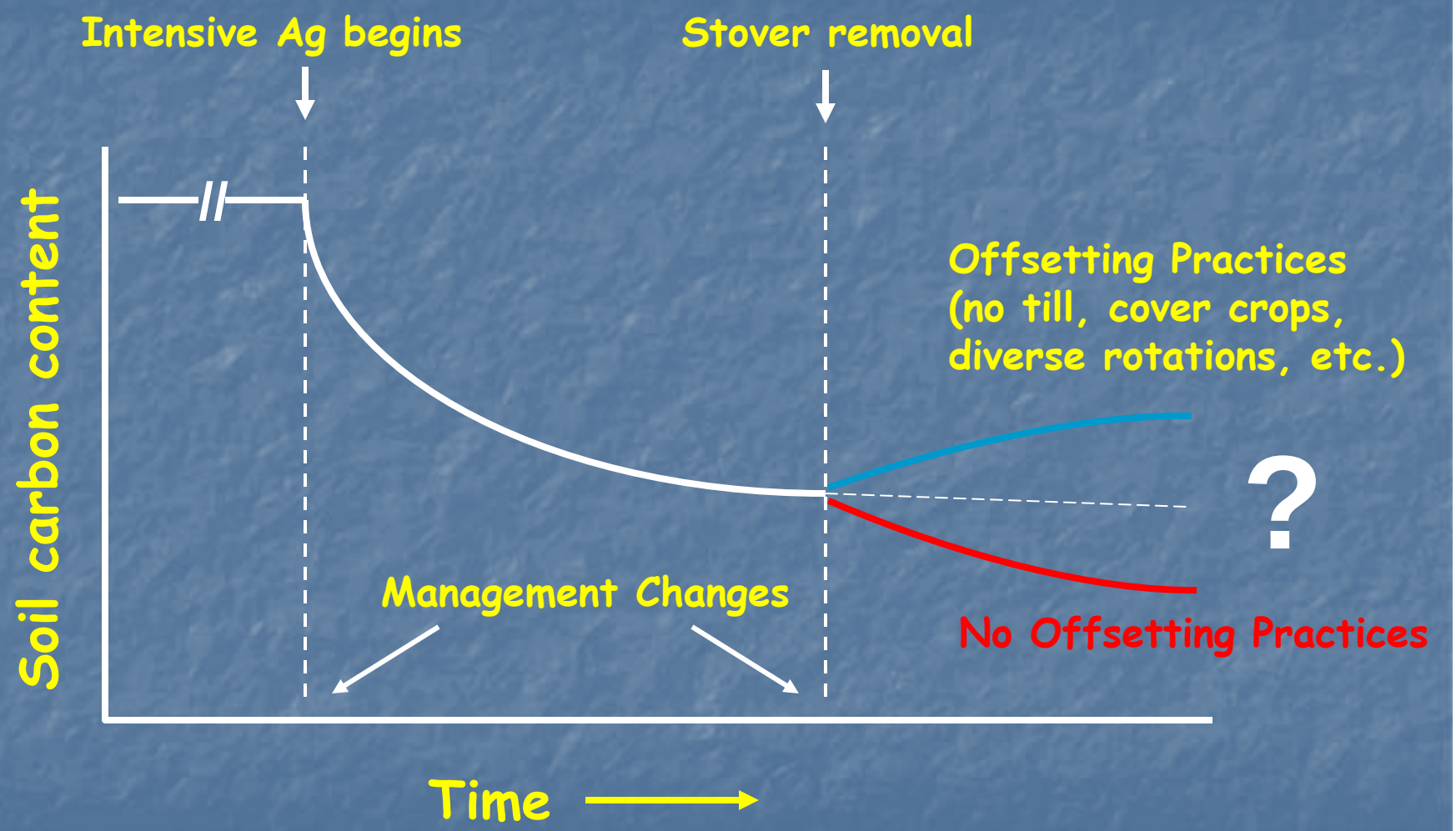
- Current scored indicators include:
  - pH, P, EC, TOC, MBC, PMN, Agg Stability, Bulk density (D_b), AWC, SAR, qCO_2
- Scoring curve designs
  - More is better, more is worse, mid-point optimum
- Overall index or individual indicators used to evaluate management effects

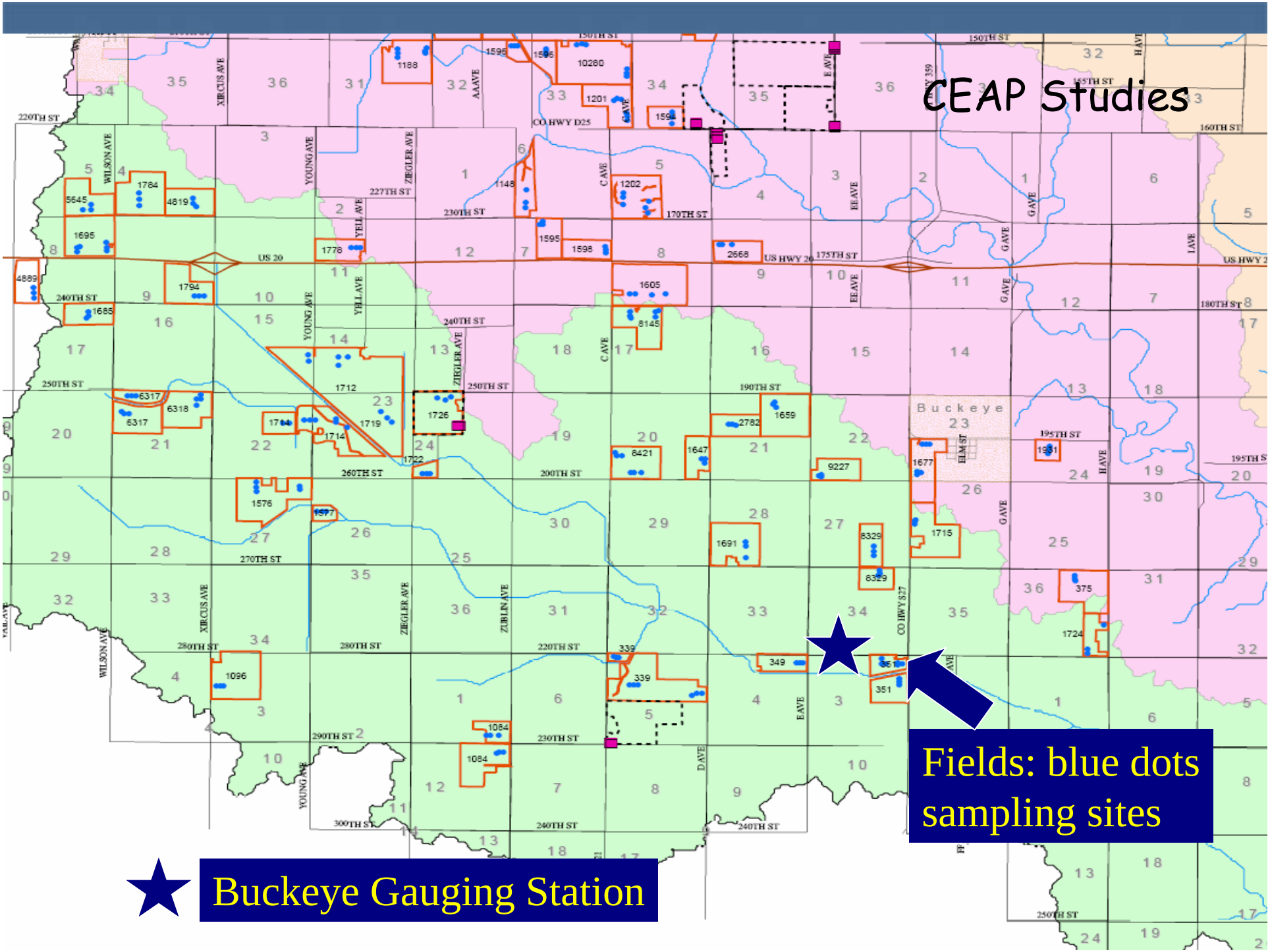
How Does SMAF Work?



What's the Future?

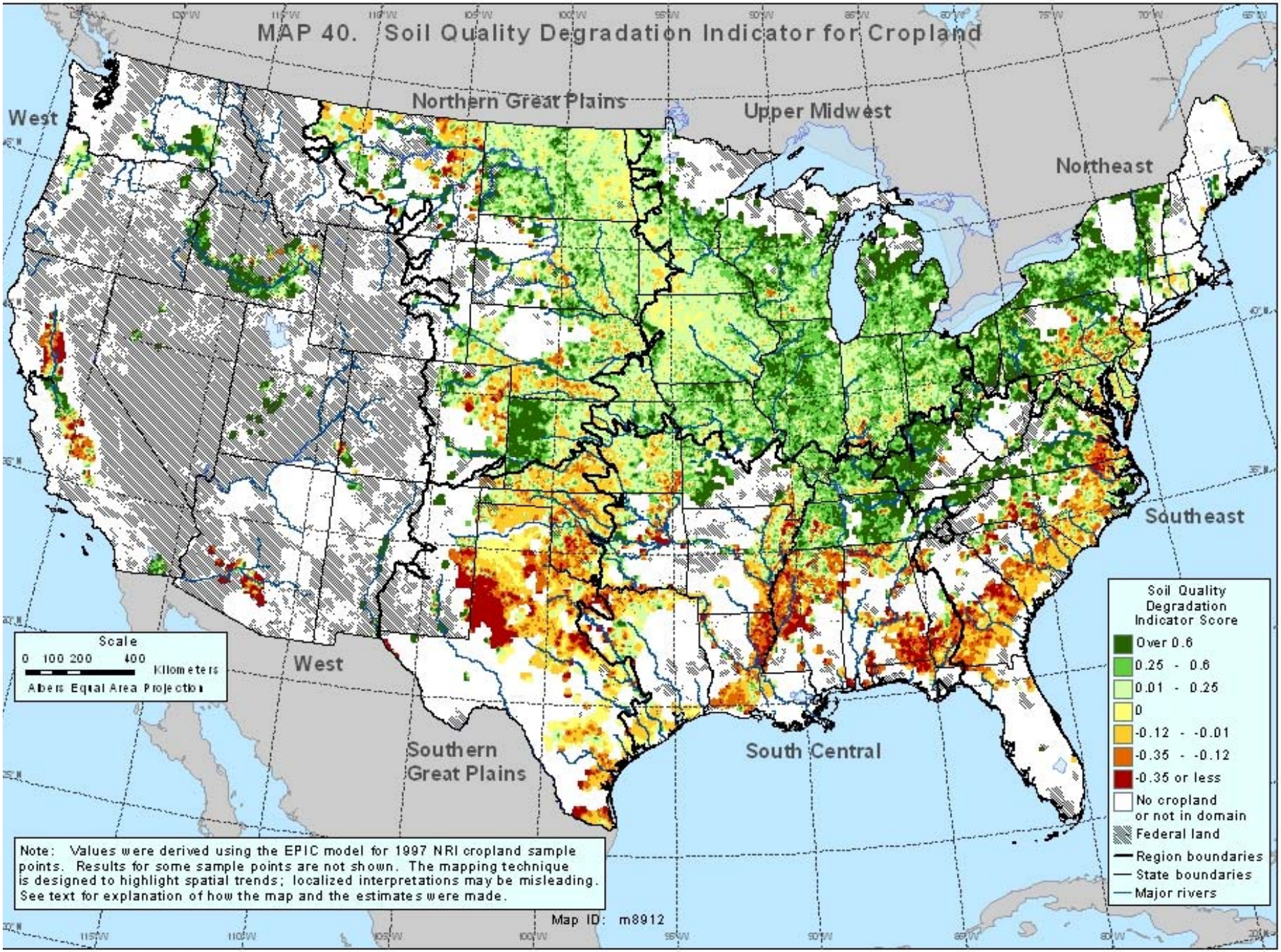
Monitoring Stover Removal Effects




CEAP Studies
Fields: blue dots sampling sites
Buckeye Gauging Station

Landscape Effects on Soil Quality

	SMAF SQI Values	
Landscape Group	Neppel Study	ISA Study
Hilltop	82	78
Sideslope	88	77
Toeslope	89	78
Depression	94	89


MAP 40. Soil Quality Degradation Indicator for Cropland
West
Northern Great Plains
Upper Midwest
Northeast
Southeast
West
Southern Great Plains
South Central
Scale
0 100 200 400
Kilometers
Albers Equal Area Projection
Soil Quality Degradation Indicator Score
Over 0.6
0.25 - 0.6
0.01 - 0.25
0
-0.12 - -0.01
-0.35 - -0.12
-0.35 or less
No cropland or not in domain
Federal land
Region boundaries
State boundaries
Major rivers
Note: Values were derived using the EPIC model for 1997 NRI cropland sample points. Results for some sample points are not shown. The mapping technique is designed to highlight spatial trends; localized interpretations may be misleading. See text for explanation of how the map and the estimates were made.
Map ID: m8912

Summary & Conclusions

- Soil quality assessment is here to stay
- Assessments provide information on overall sustainability of agricultural systems
- Meaningful measurements can be made and interpreted
- Value added opportunities are available