Dynamic Soil Properties (DSPs) in Soil Survey Updates: Meeting Needs for a New Paradigm

DSP Leadership Team
DSP Technical Team
DSP Course Cadre
SSS Meeting, Columbia, SC
March 30, 2010
Current situation: Soil survey databases do not reflect the effects of management (in most cases). DSPs seek to change that.
Topics for Discussion

- DSP 3 Main Objectives
- Methods
  - Comparison Studies
  - Benchmark Soils
  - Stratification methods
- Uses
- How do similar studies relate to DSPs?

http://soils.usda.gov/technical/soil_change/
Objective 1. Account for soil change over the human time scale

Centuries, decades and less

- Decades to centuries - the recovery time scale
- Decades - the management time scale

Richter and Markowitz, 2001

Understanding Soil Change

Tugel et al., 2005
Differences in Resistance and Resilience

Soil Function vs. Time (years)

Soil with high resistance

Soil with low resistance and high resilience

Soil with low resistance and low resilience

(Seybold et al., 1999)
**Objective 2.** Improve accuracy of databases (and provide reference values for dynamic soil properties).

<table>
<thead>
<tr>
<th>Soil</th>
<th>Database estimate</th>
<th>Grassland-measured</th>
<th>Cultivated-measured</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aksarben</td>
<td>2-4 %</td>
<td>6.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Monona</td>
<td>2-4 %</td>
<td>3.6</td>
<td>2.9</td>
</tr>
</tbody>
</table>

This example is important for: C-sequestration, pesticide & nutrient applications

(Grossman, unpublished)
Management impact on soil properties for a current DSP Project in TX

C. Stiles, Amarillo  FSL DSP Project data, 2010
Objective 3. Develop interpretations of management effects on soil function.

- The importance of soil change is its affect on function.

- The consequences of change depend on its reversibility.  
  (Arnold et al., 1990)
Using the interpretations

- Decision makers can use interpretations of recovery potential to target restorable lands.
- Policy makers can use interpretations of reversibility to develop programs to avoid irreversible change.
- Interpretations of potential can be used to respond to threats and plan for optimum soil quality management.
  - Global warming, biofuels, bioterrorism, invasive weeds, water pollution, etc.
Methods for Inventory of Dynamic Soil Properties

From the Soil Change Guide:

- Comparison Studies
- One Benchmark map unit component phase
- Stratify by land use, management, history
  - For Range and Woodland: ESD
  - For Pasture: dominant grass or forage suitability(?)
  - For cropland: Quick Comparison Tool and CHIT
Example State and Transition Model

Post oak/flowering dogwood/tick trefoil-goldenrod. Multi-story. Canopy: 30-90%

Hot summer burn and/or long-term grazing

Burn, Site prep & Planting / Seeding. No grazing or limited controlled grazing

Post oak/buckbrush (or similar) Lacks mid-story. Understory single species woody dominated Canopy: open 30-90%

Harvest, site prep, seeding

Pasture (improved) Non-native grass sod

Abandonment for 20+ yr with recruitment of woody natives

Westoby, et. al., 1989
Stringham et.al., 2001

Post oak/blackjack oak/little bluestem ESD, Missouri
### Quick Cropland Comparison Tool

**Five questions, match pattern:**

<table>
<thead>
<tr>
<th>Crop System Attribute</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tillage (&gt;4” depth)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>High residue crop</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Cover crop or perennials</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Manure application</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Organic pest management</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
Crop History Information Tool (CHIT)

- MS Excel tool to enter cropping history
- Three major areas
  - Rotation & Field Operations
  - Residues and Manure
  - Irrigation
- Score for each section and total
- Will explore relationships between scores
Methods, Data, and Uses Review

Stratification Theory

State and Transition models or Crop and pasture tools

Comparison study for DSP Sampling

DSP point data set

Planning

Action

Interpretation and reference data set for soil quality, function, and health

Soil maps and attribute data

Reference data to interpret monitoring results

Project Outline and Work Plan

Sampling and Lab Work

Adapted from Soil Change Guide, 2008
Similar or Related Projects: What if a project does not fit?

- The Guide could need revision, if prescribed methods don’t work in particular system
- Results may inform knowledge gaps, i.e.,
  - spatial variability
  - indicators to use
  - functional relationships, or
  - extrapolation to other similar soils or management
  - Resistance and resilience
- How could it become a DSP project? Should it?
Summary

1. Soil change on the human time scale is a new type of project for soil survey updates.

2. Methods are outlined in the Soil Change Guide and some are still under development.

3. Data will help planners improve practice designs, show the benefits of conservation systems, and identify lands at risk of irreversible change.
More information

Soil Change Guide
available online at:
http://soils.usda.gov/technical/soil_change/

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Questions and Discussion