USDA-NRCS Soil Monitoring Network:

Concept and Design

Larry T. West
Soil Scientist
Contractor NSSC
(Old Retired Fart)
National scale network of sites sampled and analyzed periodically to track changes in soil properties
Need for the Data

► Quantification of soil property changes related to
  ▪ Agricultural (and silvacultural) management
  ▪ Conservation practices
  ▪ Climate change

► Enhancement of soil information used for
  conservation assessment and planning

► Validation data for simulation models such as APEX and Century

► Reliable and spatially distributed soil and management data for evaluation of the effects of conservation practices on soil health, soil erosion, C sequestration, greenhouse gas mitigation, and similar resource issues

► Improvement of modeled resource trends to inform NRCS program initiatives and farm policy analysis
History

► Not unique concept
  ▪ Soil monitoring programs active in several countries

► 2005? – Pilot study
  ▪ Agreement (RID, RIAD?) with CSU
  ▪ Validate Century model
    ▶ Reduce error in SOC stock predictions
  ▪ 44 sites sampled and analyzed
    ▶ CEAP sites – extensive management data

► 2008-2012 – Discussions of expansion to nationwide program

► 2012-2013 – Agreement with CSU for expanded pilot with involvement of SSD
  ▪ 8 states – 15 sites per state

► Today – Discussions to establish nationwide monitoring program
Network Design

► Design should depend on
  ▪ Objectives
  ▪ Sound science
  ▪ Availability of resources
    ► Money
    ► Time
    ► People

► 4 areas to consider
  ▪ Number and distribution of sites
  ▪ Monitoring period and return frequency
  ▪ Sampling protocols
  ▪ Data collected – field and lab

► Interaction of these 4 determine feasibility

The devil is in the details
Monitoring Period and Return Frequency

► Current concept of monitoring period is 100 years
  ▪ Slow but important changes
  ▪ A lot can happen in 100 years
  ▪ If sample design will not accommodate a long period, it cannot happen

► 5-10 year return frequency
  ▪ Shorter interval for sites expected to change rapidly
Number and Distribution of Sites

- Distribution
  - Random
  - Landscape
  - Integration with other monitoring programs
    - NRI, CEAP, NEON, LTER, LTAR, …
    - Research sites vs farm fields
- Land cover/land use
  - All or selected?
  - Management data are critical
- Sample stratification
  - MLRA
  - Soil (grouping)
  - Management system
- Level of statistical reliability
  - Strata X Reps = a lot of sites
  - 5,100 sites ~ 14 sites per MLRA
Site Protocols

► Site data collected
  ▪ Landscape
  ▪ Vegetation
  ▪ Management

► Pedons described and sampled per site
  ▪ Single
  ▪ Multiple
    ▶ Distribution

► Sample collection
  ▪ Max depth
  ▪ Fixed depth intervals or by horizon
  ▪ Composited samples

700 sites/y X 3 pedons X 5 horizons = 10,500 samples/y
Data

Field

- Infiltration rate
- Ksat for major horizons
- Surface and crust properties

Lab (all or selected layers)

Traditional

- Particle size distribution
- Bulk density
- Rock/gravel content
- pH
- Total C and N
- CEC
- Extractable cations
- KCl extractable Al
- Electrical conductivity
- Saturated paste extract
- Inorganic C (if present)

Soil Health/SOC related

- POM (particulate organic matter)
- Soil litter C mass
- Surface litter C mass
- Carbon dioxide evolution – Solvita test
- Extracellular enzymes
- Permanganate oxidizable (active) C
- Aggregate stablility
One size fits all?
Data Disposition

► Publically available database
  ▪ Must be user friendly

► In house analysis
  ▪ Summaries applicable to
    ► Soil survey enhancement
    ► Resource assessment
    ► Conservation planning
    ► Program evaluation

► Not trivial tasks
  ▪ Committed staff will be needed

Data rich and information poor?
Near-Term Plan (F 2015)

- Resample 44 sites sampled in 2006-2007
  - All CEAP sites
- Evaluate property changes over 8-9 years
- Input for network decisions
  - Utility of data
  - Design changes to meet Agency and Division objectives
Summary

- National soil monitoring network could supply data to improve resource assessments and conservation programs.
- Network design should reflect project objectives and resources available.
- Back-end data storage, delivery, and analysis must be part of project design and be part of resource allocations.