**NCERA003: Soil and Landscape Assessment, Function, and Interpretation**

**Duration:** October 01, 2014 to September 30, 2019

**Administrative Advisor(s):** Ken Olson (ILLU) - Research

**NIFA Reps:** Nancy Cavallaro

Mervalin Morant

**Statement of Issue(s) and Justification:**

Justification for Continuation of NCERA-3 (NC\_TEMP003) Committee on Soil and Landscape Assessment, Function and Interpretation:

The National Cooperative Soil Survey (NCSS) includes federal, state, university and local partners with a public mandate for identification, inventory, use and management of soil resources. These partners include university pedologists from each agricultural experiment station (AES) in the nation; representatives from the USDA, Natural Resources Conservation Service (NRCS); USDI, Bureau of Land Management; USDA, Forest Service; Cooperative States Research, Education, and Extension Service (CSREES) and state and local agriculture and/or natural resource agencies. The NCERA-3 committee is an essential component for coordinating National Cooperative Soil Survey (NCSS) activities in the North Central Region (NCR). The NCERA-3 Committee members serve on a national advisory boards and committees to the NRCS. The boards and committees are charged with reviewing policies and making recommendations to improve procedures in the soil survey program, identifying and coordinating important soil and water research and education efforts, developing soil/water interpretive guidelines, and related activities.

Soil is the interface among solar radiation, nutrient dispersion, and water supplies, upon which most life on Earth depends. The NCERA-3 committee consists of pedologists from each North Central AES, representatives from the USDA, NRCS, CSREES, other universities, and an administrative advisor and this group is uniquely qualified to meet future needs for National priorities. Pedologists are soil scientists who study soils in their natural settings, with emphasis on soil classification, interpretations, and soil/water/geomorphic processes at scales from individual soil aggregates to landscapes. Critical soil-related environmental concerns, such as climate change and the terrestrial carbon cycle, are global in scale and are very much tied to the soil resource. Pedology is a relatively recent sub-discipline in soil science, which, itself, is a relatively young science. Much historical pedologic effort has focused on identifying and classifying soil, which is a multivariate continuum with spatial and temporal attributes linking both biotic and abiotic components. Any science must be based on a classification of the entity under study, and this effort has only recently been accomplished in soil science. The emphasis of pedologists is now shifting from classification and inventory to identifying and understanding the temporally and spatially variable processes and functions of soils and landscapes and relating this understanding to end-users.

The university representatives are responsible for coordinating research, teaching, and extension responsibilities with NCSS in their representative states. This committee coordinates and makes recommendations on designing, reviewing, and testing procedures and practices for developing soil survey information (SSI), which traditionally has included classifying, mapping and interpreting soils, and conducting research on important soil/water/landscape processes. Completion of most of the baseline soil mapping in the NCR has allowed participating scientists to focus on refining and adapting the assembled SSI to meet a spectrum of natural resource planning and management needs at a variety of spatial scales. In response to societal needs, the NRCS has appointed a national committee to identify key soil/water/landscape interpretations important to sustaining these finite resources. The NCERA-3 committee works directly with this group, the National Soil Interpretations and Advisory Group (NSIAG) as NRCS adjusts its historical mission and culture to meet new and important needs.

The SSI is the most detailed and comprehensive natural resource data, including tabular and spatial, available in the world. It is increasingly being used for a diverse array of applications that go well beyond its traditional use as a tool for agricultural planning and management. Most non-soil science SSI users have minimal knowledge of the SSI limitations, scale, and potentials. Educating collaborators and using modern technologies such as Geographic Information Systems (GIS) and remote sensing is extremely important. If broad societal concerns about overlapping issues such as resource sustainability, global climate change, soil quality, biodiversity, bioenergy and environmental protection are to be met, pedologists must play a key role. The SSI should therefore be formulated in a sufficiently robust and reliable manner to meet existing and emerging applications.

The NCSS is placing more emphasis on improving the scientific basis and extrapolative utility of soil interpretations especially for non-agricultural application, and developing improved systems for storage, retrieval, analysis, and display/dissemination of SSI. These areas of emphasis draw heavily on the scientific and technical expertise that university cooperators can provide to the NCSS.

Examples of committee members' activities:

1. Use GIS and other tools to organize and share existing SSI; to improve soil resource inventory; and to model soil/water/landscape processes for a variety of needs. The SSI tool may be used to inform allied disciplines about the soil resource and the soil-water-plant interface.
2. Address technical problems and concerns about data quality before data are reliably incorporated into automated systems, such as Web Soil Survey and decision support tools. Differences in scale, cartographic technology, landscape concepts, land use intensity, and classification systems have occurred over the 50 years the data have been collected. Use of automated technologies provides a means for improving the detail and quality of information contained in soil maps through application of spatial, analytical, and display techniques.
3. Develop new research methods and procedures for generating and using soils information at both smaller and larger scales of resolution than current used in SSI data collection. Methods would include geostatistics, surface modeling, LIDAR, image processing, landscape process modeling and visualization. Broadening the scope and scale of the research addressed would provide guidance on stakeholder needs related to updates, interpretations, and informational products, particularly priorities of the research community. More research and outreach emphasis will be placed on interdependent development of pedologicial interpretations that require on-site investigation at a scale of resolution finer than that obtainable in soil surveys. These include appropriate siting of independent sewage treatment systems, siting and construction of rain gardens, siting storm-water management infrastructure, and wetland delineation activities. Also developing a comprehensive, quantitative approach to soil health quantification and assessment by defining soil health in a holistic way that links soil health to whole soil profile and watershed attribute as well as identifies specific soil functions important to soil health and quantifying the physical, chemical and biological soil attributes responsible for the soil functions. The following step will be the development of interpretations and guidelines to assist land owners and land managers in making management decisions that will enhance soil health attributes, At a scale of resolution coarser than that obtainable in soil surveys would be focused on use of additional resource data (e.g., LIDAR, remotely sensed data or other GIS data layers) with soil survey data to enhance interpretations and recommendations. Multiple opportunities and needs for pedological research, education, and outreach around these types of interpretations exist and could be at least partially addressed on a regional basis, rather than being duplicated state by state.
4. Modernize the SSI (with emphasis on data needed for interpretations) using Major Land Resource Areas (MLRAs) as the focal point. The MLRAs are geographic in nature and cross county and state boundaries. NCERA-3 members interact with colleagues to access and provide crop, land use and climatic data in addition to soils information. The NCERA-3 members provide state-of-the-art SSI in a GIS format to: (i) maintain the integrity and accuracy of the original survey, (ii) eliminate duplication and waste in developing single use soil data bases, and (iii) facilitate the transfer of soil data layers between different computer systems across a variety of user clientele. NCERA-3 has advocated the need to characterize soils and to measure contaminated sediment in areas of the region that have been affected by flooding. Such information offers valuable guidance to remediation approaches and levee management decision-making. The USDA, NRCS soil survey leadership team has been encouraged to make updated soil surveys of all land affected by floodwaters.
5. Collect data for benchmark and/or extensive soils to support crop yield and biomass (including range, timber and bioenergy crops) estimates. Test models that better predict yield within the context of changing climate. Many states and counties use crop yield and biomass estimates in land appraisal and assessment work. These states and counties which use an income capitalization approach to land value have become leaders in use of digitized soil data for tax assessment. These crop yield and biomass data will also be useful in determining suitability and sustainability of soils for bioenergy production. NCERA-3 is addressing the plowing of long-term no-tillage fields and the wide-scale installation of tile drainage in the Northern Great Plains. The impact of using controlled drainage to reduce soil sodification, downstream flooding, and water quality risks and compare with ‘free-drainage’ systems will be determined. Management and soil amendment guidelines that optimize production on saline- and sodium-affected soils will be developed. Feedstock production systems within undulating landscapes typical of the North Central Region will be studied and result in a comprehensive carbon, energy, nitrogen, and productivity assessment.
6. Address environmental issues, including those related to sustainability, vadose zone and surface water quality and the soil component of the terrestrial carbon cycle. Multidisciplinary efforts to improve sampling and modeling designs that better represent soil distributions and processes are needed.
7. NCERA-3 meets annually to exchange pertinent research information. On alternate years it meets with all NCSS members in the NCR to identify and coordinate research needs that support soil survey. The meetings are an important forum through which research and extension initiatives are developed and the needs of society in general for soil and water information are identified and discussed. The university members on the committee are educating the next generation of soil scientists, and if society’s needs are to be met, future pedologists must have a wider range of skills and perspectives than their predecessors.

Three members of the NCERA-3 committee serve on the Regional Soil Taxonomy review committee which evaluates proposed modifications to Soil Taxonomy including those developed by international working committees. NCERA-3 members serve on the Soil Classification Field Guide Workgroup that is working within the National Cooperative Soil Survey to develop a simplified guide for soil classification. The guide is based on the 2010 edition of Keys to Soil Taxonomy and includes simplified keys for soil classification to the great group level. The intended audience is field soil scientists, university students, scientists in disciplines other than soil genesis and classification, and soil science practitioners. The guide will be extensively used for teaching classes in Introductory Soil Science and Soil Genesis and Classification at land grant and other research universities throughout the US.

Representatives from NCERA-3 serve on NCSS work planning boards and national committees. These various committee linkages provide a network for evaluating soil survey technology in terms of its suitability for use in solution of current and anticipated land use problems. SSI is a major mechanism for technology transfer of research findings developed at AES and other research facilities. Policies of NCSS are evaluated by the NCERA-3 with respect to their impact on land use.

In summary, NCERA-3 provides a forum for contributing to the scientific foundation that guides collection of SSI and its interpretation and extrapolation. It provides a mechanism for evaluating and refining NCSS directives to suit local and state needs. As numbers of soil scientists and supporting resources have declined, the importance of a regional committee has increased. As the need for truly collaborative multidisciplinary work is being recognized and encouraged, the science that focuses on the interface between the biotic and abiotic processes in the landscape (pedology) is impaired. Therefore, pedologists must develop new linkages with other disciplines (including sociologists, ecologists, economists, engineers, geologists, hydrologists and urban planners) that work in the soil landscape.

**Objectives**

1 Coordinate activities and set priorities among the universities for the NCSS, with increasing emphasis on interpretations and data base availability.

2 Identify and prioritize common needs for soil and landscape research by Major Land Resource Areas to foster cooperative research projects and minimize duplication, with emphasis on important processes.

3 Prioritize research in pedology at both smaller and larger scales of resolution than obtainable in soil surveys. Focus and pool regional resources in areas, such as wetland delineations.

4 Develop the scientific foundation for databases needed for soil and landscape assessment and interpretation.

5 Engage in research, education and outreach activities regarding key soil processes and functions.

6 Initiate and strengthen partnerships with ancillary disciplines and sciences to inform users and the general public about the importance of the soil resource and its synergisms with water and living organisms.

**Procedures and activities**:

Objective 1

a. Participate in annual cooperative soil survey meetings at state, regional and national levels.

b. Maintain the NCERA-3 list-serve.

c. Designate NCERA-3 representation on NCSS committees and relay/evaluate national recommendations and initiatives to pertinent groups throughout the region.

d. Cooperate directly with NCSS advisory groups in identifying new uses of the soil survey and the soil data base.

Objective 2

a. Maintain communication with MLRA regional offices.

b. Advise and participate in MLRA research project development.

c. Direct research on soil landscape functions.

Objective 3

a. Focus research and outreach on interpretations at a scale of resolution finer than that obtainable in soil surveys.

b. Combine the use of additional resources on geographic and landscape information with soil survey data to enhance interpretations and recommendations at a scale of resolution coarser than that obtainable in soil survey

c. Improve the understanding of key decision-makers in land grant institutions and the NRCS about the relevance of soil map scale of resolution, pedology and landscape analysis.

d. Multiple opportunities and needs for pedological research, education, and outreach around these interpretations.

Objective 4

a. Incorporate existing AES and other universities soil characterization data into the national database in cooperation with National Soil Survey Center. These data includes soil sampling site location, soil classification, soil description (using pedon pc software program) and laboratory and field measured soil properties of each pedon (using lab data software program), and laboratory methods used.

b. Identify and characterize benchmark soils and landscapes with NCSS partners.

Objective 5

a. Participate in state, regional and national soil and land judging competitions.

b. Develop K-12 educational activities for soil processes and functions.

c. Provide training for certification and continuing educational programs for stakeholders.

d. Train the next generation of soil scientists.

e. Direct graduate research on soil landscape functions.

Objective 6

a. Contribute articles to NCSS newsletters and Soil Survey Horizons.

b. Contribute articles to journals in ancillary disciplines such as engineering, range, geosciences, forestry and ecological sciences.

c. Provide outreach activities through MLRA workshops, field days, seminars, etc.

**Expected Outcomes and Impacts:**

• NCSS programs and activities at the regional and national levels will continue to strengthen as a result of the leadership provided by the NCERA3 .

• Publications based on significant research related to soil landscape function within the 36 MLRAs in the NCR.

• AES and university characterization data will be incorporated into the National Soil Survey database and made available to a broader audience.

• Increased awareness of fundamental soil science processes and functions will result from workshops, training sessions, courses, and online training conducted for students, including K-12, .

• Improved understanding about the relevance of soil map scale of resolution, pedology, and landscape analysis by key decision-makers in land grant institutions and the NRCS.

• The next generation of soil scientists will be trained to meet the future needs of the NCSS and society.

• The understanding of pedology will be increased through articles in NCSS newsletters and Soil Survey Horizons.

• Increased awareness of soil and landscape functions through ancillary disciplines publications, seminars and workshops.

Project Participation:

Include a completed Appendix E form

**Educational Plan:**

Traditionally, much of the outreach education of this committee has been indirect, largely through publications from the Natural Resource Conservation Service (NRCS), formerly the Soil Conservation Service (SCS), and University Extension.

1. Produce educational soil interpretation materials for specific land uses, including agronomic and silviculture, on-site waste treatment and dispersal , wetland identification, soil erosion control and tillage management, and understanding the temporal and spatially variable attributes of soil systems. These guides will explain cause-and-effect dynamics as well as providing information for interpretations.
2. Produce web-based educational models that focus on soil-water dynamics, soil erosion, and the synergisms among soils, landforms and living organisms.
3. Develop educational materials for use in grades K-12 with the intention of making science more relevant and applicable, interesting and accessible to children and their teachers.
4. Continue to produce soil maps at a variety of scales and continue to provide information to ancillary agencies (NRCS and state groups such as Departments of Natural Resources and Departments of Conservation) for use in their educational outreach programs.

**Governance:**

Organization/Governance The committee will adopt the multi-state standard governance with the election of a chair, a chair-elect, and a secretary. All officers elected will serve two-year terms to provide continuity.