Disturbance of Soil Organic Matter and Nitrogen Dynamics: Implications for Soil and Water Quality

Background:

The deterioration of soil quality can lead to dramatic and long-term changes in terrestrial ecosystems, but little is currently known about what thresholds may exist that prolong or prohibit the recovery of soil quality following ecosystem disturbance. This project is ongoing at Fort Benning, Georgia, within the framework of the SERDP Ecosystem Management Project (SEMP) to evaluate the short- and long-term effects of land use change and terrestrial ecosystem disturbance on two key measures of soil quality: soil organic matter (i.e., soil carbon) and soil nitrogen dynamics.

Objective:

The overall objectives of this study are to: (1) describe how soil carbon and nitrogen dynamics are affected by current land use activities and disturbance regimes, (2) evaluate the potential for short- and long-term recovery of soil quality in disturbed environments, (3) use existing GIS resources for analysis of spatial patterns of soil carbon and nitrogen, and (4) predict the effect of site disturbance and/or land use change on nonpoint sources of nitrogen pollution.

Approach:

The research project will assess the potential impact of military activities, ecosystem disturbance, and land use change on soil quality and terrestrial nonpoint sources of nitrogen to surface receiving waters. Soil carbon and soil nitrogen dynamics have been compared at sites with different disturbance histories. We have also measured soil carbon and nitrogen stocks in ecosystems along gradients of disturbance and land use change for the purpose of mapping key measures of soil quality using a geographic information system. Measurements of soil carbon and nitrogen dynamics have been undertaken at multiple field sites. Simple models of soil carbon and nitrogen dynamics are being used to predict the potential recovery of soil organic matter, soil carbon sequestration, and potential terrestrial sources of nitrogen to aquatic ecosystems following soil disturbance. These models are useful for establishing thresholds to ecosystem recovery.

Benefits:

This research will help site managers predict the impacts of various land uses on two key determinants of soil quality at Fort Benning. It will also contribute to a better general understanding of soil organic matter and soil nitrogen dynamics in different land use/land cover categories, the effects of soil disturbance on organic matter and soil nitrogen dynamics, and how land management decisions may impact soil quality and the potential for recovery of degraded lands.

Technical Progress:

Soil carbon and nitrogen are indicators that can be used by military land managers to identify incipient changes in soil quality or to rank training areas on the basis of soil quality. Soil C:N ratios, as well as soil carbon concentrations and stocks, are also sensitive indicators of recovery at sites where ecosystem disturbance is being reversed through establishment of perennial vegetation. Land cover has a significant effect on key measures of soil quality, including: soil bulk density, soil nitrogen availability, soil carbon and nitrogen stocks, and properties and chemistry of the soil organic matter horizons. Characterization of land cover can help military land managers assess the impacts of management practices and the consequences of land use change for soil attributes linked to the maintenance and/or recovery of soil quality. Simple mathematical models, based on soil nitrogen availability, have been used to explore nutrient thresholds to recovery for some desired future ecosystem conditions at Fort Benning. This work indicates that issues specific to restoration and/or management of ecosystems can be aided by the identification of thresholds related to soil carbon and nitrogen dynamics.

For more information, visit the SEMP website
http://www.denix.osd.mil/SEMP

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Conservation
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