17. Carbon Sequestration In Forest Soils Disturbed By Coal Mining And Urban Land Use In Ohio

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Abstract:
Undisturbed forest ecosystems are important global carbon (C) sinks as they sequester large amounts of C in vegetation, detritus and soil. The process of C sequestration, in particular, implies that the C pool increases through absorption of atmospheric carbon dioxide (CO2) by plant photosynthesis and subsequent transfer into vegetation, detritus and soil pools, and that the pool of organic compounds with long C residence time increases over time. However, mining activities and urbanization alter this natural process by disturbing vegetation and soil. Specifically, surface mining for coal drastically reduces soil organic carbon (SOC) due to reduced litter inputs and accelerated C losses by soil erosion, surface soil removal and increased mineralization. Judicious reclamation practices are required to restore the SOC pool after mining operations cease. Urbanization may also drastically reduce SOC but vegetated urban land uses such as urban forests may sequester C.

We studied the SOC storage in six coal mine sites in southeastern Ohio reclaimed to forest land use in 1956, 1962, 1969, 1973, 1982 and 1994, and in eight urban forest parks and a relatively undisturbed forest in Columbus, Ohio. The SOC pool in soils reclaimed prior to the 1977 Surface Mining Control and Reclamation Act (SMCRA) ranged from 15.7 to 78.1 Mg C ha-1 in 0-15 cm and from 8.8 to 45.9 Mg C ha-1 in 15-30 cm. In the soils reclaimed according to SMCRA regulations, 13.5 to 51.2 Mg C ha-1 were stored in 0-15 cm, and 5.1 to 21.5 Mg C ha-1 in 15-30 cm. However, coal C contribution severely affected the determination of SOC sequestration in reclaimed coal mine soils. The urban forest soils were deeper developed than the reclaimed mine soil profiles, and stored between 82.4 and 94.2 Mg C ha-1 in 0-30 cm, and between 115.3 and 135.1 Mg C ha-1 in 30-100 cm. Thus, urban forest soils stored more SOC to 100 cm depth than rural forest soils. However, similar to the reclaimed coal mine soils increasing C/N ratios with depth in some urban forest soil profiles indicated that coal C and/or anthropogenic organic compounds impaired the determination of SOC sequestration.

About 2% of the land area in Ohio has been surface mined for coal, and about 8.5% of the land area is currently under urban land use. More land area and soils will be disturbed in the future as coal will continue to be the primary energy source for electricity generation, and the growth of urban areas is projected to continue. Thus, the knowledge about reclamation practices and urban land uses which sequester SOC helps to reduce detrimental effects of mining activities and urbanization on terrestrial C sequestration.

Keywords: Carbon Sequestration, Coal Mine Reclamation, Urban Forests, Soil Profiles
Topic: C. Urban soils and ecosystem services
Sub-topic: C4. Biogeochemical cycling in the urban ecosystem
Presentation type: Oral

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