Soil Carbon Sequestration & Greenhouse Gas Mitigation

Symposium: Soil Carbon Sequestration and Greenhouse Gas Mitigation

Agriculture can help minimize the effects of greenhouse gases (GHG) on the environment both by increasing C storage and reducing GHG emissions. With increasing national and international concerns about climate change, there is an ever-growing need for relevant research information by decision-makers and managers of land and water resources. The broad range of research papers in this special section were part of the Soil Carbon Sequestration and Greenhouse Gas Mitigation Symposium, held jointly by the Soil Science Society of America and the Geological Society of America in Houston, TX in October of 2008.

Land-use practices, such as cultivation, livestock grazing, manure management, and fertilization have strongly contributed to the release of carbon dioxide (CO₂) into the atmosphere as well as by increasing emissions of other GHGs, such as nitrous oxide (N₂O) and methane (CH₄). In the past, the dominant driver of CO₂ emission was the conversion of grasslands and forests to crop and pasture lands, resulting in the depletion of soil organic C. In terms of total GHG emissions for the USA, the primary GHG emitted by human activities is CO₂ (85% of total of all GHG emissions; EPA 2008). The largest source of CO₂ and of overall GHG emissions has been from fossil fuel combustion (94% of the total CO₂ emissions). However, about 14% of total U.S. CO₂ emissions are offset by the large amount of C sequestered by land use, land use change, and forestry in the USA. Agricultural activities in the USA (livestock, crops, grasslands, energy use, forestry, and urban trees; USDA 2008) are a net sink that offsets over 4% of all U.S. (CO₂, N₂O, CH₄, and other) GHG emissions.

The net CO₂ sequestration from land use and land-use change increased from ~738 Tg CO₂ equivalence in 1990 to ~884 Tg CO₂ equivalence in 2006. The C sequestration in mineral soils was largely due to the conversion of cropland to permanent pastures and hay production, reduction in summer fallow in semiarid areas, increased adoption of conservation tillage practices, and increased application of organic fertilizers (i.e., manure and sewage sludge) to agricultural lands (EPA 2008). In addition, much of the total increase was due to accumulation in forest C stocks, particularly in aboveground and belowground tree biomass.

Several recent studies have indicated that farm, ranch, and forest lands can provide substantially more GHG mitigation by adjusting the type and intensity of agricultural production. Additional agricultural mitigation would be relatively cost effective when compared with mitigation options in other sectors. The EPA (2008) estimates that 10 to 25% of current U.S. GHG emissions could be offset through a combination of actions in forestry and agriculture, including: land conversions, reduced tillage, afforestation, improved forest management, improved nutrient management, manure management, and bioenergy production.