Cornell University

Soil Carbon Management & Greenhouse Gas Mitigation Opportunities

Information Sheet #6 – OVERVIEW

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Fast Facts

- **Impacts**: Soil carbon management can store (sequester) carbon in soil organic matter, which can reduce carbon dioxide in the atmosphere and improve soil health.
- **An imperative to act:** Improved soil carbon management increases soil health, increases grower profits and reduces carbon dioxide emissions to the atmosphere, reducing climate change.
- **An opportunity for proactive change**: Reducing tillage and adding crop residues to soil both increase soil carbon storage (**sequestration**), increase soil health, improve profitability, and reduce greenhouse gas emissions.
- **A concern for implementation:** Reduced tillage and especially no-till can increase soil carbon, but subsequent tillage can release this carbon back to the atmosphere.

Introduction

Soil carbon (closely related to soil organic matter) is beneficial for soil health for many reasons, including improved water infiltration, improved water retention, reduced erosion, improved tilth, and improved biological activity. Increasing the amount of carbon stored in soils has multiple agricultural and environmental benefits, including improved yields, increased resistance to drought and flooding, improved water quality, and reduced carbon dioxide (CO_2) in the atmosphere. This Information Sheet focuses on how farms can reduce CO_2 emissions using soil health best management practices (BMPs). However, it should be noted that it takes decades to build up (sequester) soil carbon but only months or a few years to lose the sequestered carbon due to tillage and other soil disturbing practices.

Environmental Concerns

Reducing GHG emissions is important to reduce the extent and impacts of climate change. Improving soil carbon management can provide cost-effective GHG mitigation opportunities.

Adequate soil organic carbon is important for soil health (the capacity of a soil to function), and has a direct impact on crop production and an indirect impact on water quality. Unhealthy soils with less soil carbon are more likely to erode and have a higher potential for runoff during storm events. Soil erosion can carry sediments, nutrients and pesticides to surface water bodies degrading water quality. Healthy soils are able to absorb and supply water, retain nutrients, suppress pests and weeds, and produce high crop yields.

Summary of Regulation of GHG Emissions and GHG Markets

Emissions of GHGs from soil are not regulated. However, there may be opportunities for soil carbon management activities to qualify for GHG mitigation credits (also called carbon credits or carbon offsets) from various carbon markets. For example, the Climate Action Reserve, the American Carbon Registry, and the Voluntary Carbon Standard have defined quantifiable management practices that are qualify for carbon (or GHG) markets (Tonitto et al. 2016). Carbon markets in the USA include the former Chicago Carbon Exchange, the Climate Action Reserve, and the Regional Greenhouse Gas Initiative (Tonitto et al. 2016, Fahey et al. 2010). While such programs may provide opportunities for payments for soil carbon sequestration, the requirements may be very stringent and the costs of compliance high (Fahey et al. 2010, Tonitto et al. 2016).

Goal

This Information Sheet is intended to help technicians and educators work with landowners to help them better understand and navigate methods for reducing GHG emissions from soil through soil carbon management.

Summary of Potential GHG Mitigation Practices

Description of Strategy	Opportunities	Considerations
Reduce tillage	Increases soil carbon and soil health when practiced over many years.	Soil carbon can be lost quickly if tillage is later increased making it difficult to qualify as 'permanent' mitigation of GHG.
Add crop residues	Increases soil carbon, especially combined with reduced tillage. Improves soil health, including tilth.	Excess residues on the soil surface can keep soil too cool and wet in spring, and can interfere with planting or early crop growth.
Add manure, compost, or biochar	Increases soil carbon, especially combined with reduced tillage. Improves soil health, including tilth.	Transporting these materials from off the farm can be difficult and costly. Biochar is expensive to produce and there is little to no commercial experience with it in New York.
Add cover crops or double crops	Having crops cover the soil and build additional root systems for more of the year increases soil health and soil carbon.	Cover crops require time and money to manage. Double crops increases total yield, but may reduce yields of the primary crop.
Convert land from annual to perennial crops	Perennial crops, pasture, and tree root systems sequester soil carbon, use nutrients more efficiently, reduce erosion, and reduce GHG emissions.	It may be difficult to find appropriate markets for some perennial crops.

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