UF | IFAS Extension UNIVERSITY of FLORIDA

UF/IFAS PEER REVIEWED

AE573

https://doi.org/10.32473/edis-AE573-2022

Florida's Agricultural Carbon Economy as Climate Action: The Potential Role of Farmers and Ranchers[1]

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Introduction

Climate change, one of the biggest challenges facing society, is leading to unexpected changes in weather patterns. Many countries and people are trying to slow or stop global warming by reducing greenhouse gas (GHG) emissions. There are many ways to decrease the amount of GHGs entering the atmosphere, such as using energy-saving devices, renewable energy sources, and fuel-efficient vehicles. Farms and woodlands are critical places where we can help to slow global warming. When carbon is stored in soil, put there by plants through photosynthesis, it prevents the return of carbon dioxide (CO_2), one of the major GHGs, to the atmosphere. Certain management practices can store more carbon in soil, thus mitigating climate change. A carbon credit is a way to reward such management activities. Creating and trading carbon credits are expected to incentivize agricultural and natural resources management practices that can more efficiently sequester carbon. Increased carbon sequestration can benefit farmers by improving soil health and crop production. Understanding the science, mechanisms, and policy behind the carbon cycle and trading will help Florida's agriculture and natural resource sectors better prepare for the carbon economy.

This article introduces concepts related to carbon sequestration, credits, and markets to help Extension agents, farmers, and concerned residents to better understand how agriculture can help to mitigate climate change, and thus become a part of Florida's carbon economy. For more information on landowners' contributions to carbon sequestration in forestry, see https://edis.ifas.ufl.edu/publication/FR453. This article is a part of a larger body of work initiated by the UF/IFAS Climate and Carbon Extension Educators (C^2E^2) that informs a general audience about climate issues and mitigation strategies.

Carbon Sequestration as Climate Action

Carbon sequestration is the process of capturing (or removing) CO_2 from the atmosphere and storing it so that it will not contribute to global warming. Plants and trees take up CO_2 from the atmosphere through photosynthesis, and carbon is stored in the plants. Fresh and decaying plant matter deliver carbon to the soil, where it is then sequestered as soil organic carbon. Decomposition releases some of this sequestered carbon back into the atmosphere,

1. This document is AE573, one of a series of the Department of Agricultural and Biological Engineering, UF/IFAS Extension. Original publication date May 2022. Visit the EDIS website at https://edis.ifas.ufl.edu for the currently supported version of this publication.

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but some of it remains in the soil. Soil carbon sequestration improves soil quality because organic matter retains water and nutrients essential for plant growth and microorganisms in the soil. The soil carbon pool is a major global reservoir of carbon. The role of agricultural soils in carbon sequestration has been overlooked in the past.

Climate action is defined as "stepped-up efforts to reduce greenhouse gas emissions and strengthen resilience and adaptive capacity to climate-induced impacts" (United Nations n.d.). Examples include reducing energy use, protecting green spaces, and cutting consumption and waste of resources. Soil carbon sequestration can be a great climate action in agriculture. Good farming practices can efficiently capture CO_2 by promoting plant growth. Management practices, such as conservation crop rotation, riparian forest buffer, no-till farming, and nutrient management, can conserve soil and water resources, increase resource use efficiency, and reduce GHG emissions.

Agricultural Practices for Carbon Sequestration

The soil carbon pool is susceptible to changes in the environment and management practices applied to the soil. Soil cultivation tends to facilitate the emission of GHGs stored in the soil carbon pool into the atmosphere, and soil misuse (or inappropriate management practices) can accelerate the GHG emissions (Lal 1999; Batjes and Bridges 1994). For example, before 1970, more atmosphere CO_2 came from soil cultivation and deforestation than from fossil fuel combustion (Bloodworth and Uri 2016). Agricultural management practices, including tillage systems, cover crops, nutrient fertilizer management, mowing, grazing, manure application, crop residue, and leguminous crops, can facilitate carbon sequestration. There is some site- and soil-specific information about carbon sequestration rates, but such data are still very limited. Some studies used simulation models to see how soil carbon sequestration processes and rates respond to agricultural management practices (Shaffer et al. 2001; Li 2018).

The amount of carbon sequestered by a practice will depend on the duration of use, biophysical characteristics of the soil, and other field management practices in use. One online tool, COMET Planner (http://comet-planner.com/), was developed by USDA to help estimate the amount of GHGs reduced by implementing specific conservation practices. Users can select the county of a farm of interest and a conservation practice of interest from the COMET Planner website. Once the acreage of the farm is entered in a text box, the COMET Planner will calculate the amount of GHGs, including CO_2, nitrous oxide (N_2O), and methane (CH_4), that can be removed (sequestered) from the atmosphere by implementing the practice.

Conservation practices sequester CO_2 from the atmosphere in different ways. For example, planting cover crops increases the amount of plant residue left on fields, therefore increasing soil organic carbon. The amount of residue left from cover crops is related to soil characteristics and climate. For example, a study conducted by Li (2018) showed that winter cover crops in Florida could produce a relatively large amount of residue because of the fertile soil and warm winters, compared to those of other areas in the United States, including California and Iowa. The study showed a net benefit of planting winter cover crops in mineral soils of up to 5,264 lb of carbon per acre per year (or C/ac/year), and in organic soils, a net benefit of up to 22,840 lb C/ac/year.

Carbon Credits and Carbon Offsets

A carbon credit represents the right to emit a certain amount of CO_2 or GHG equivalent. It is a unit of exchange that companies and individuals can use to offset their GHG emissions. One carbon credit is equivalent to one metric ton (1,000 kg or 2,205 lb) of GHG removed from the atmosphere. For example, if you hold one carbon credit, you can emit one metric ton of CO_2 into the atmosphere without having a net impact on climate. You can sell the carbon credit to an individual or company. Buying a carbon credit means that you gain ownership of one metric ton of CO_2 removed from the atmosphere or prevented from entering the atmosphere by implementing a management practice.

There are several types of GHGs, including CO_2, N_2O, CH_4, and water vapor. They have different abilities to trap heat and increase the Earth's global average temperature. For simplicity, the total amount of GHG is usually measured in terms of CO_2 equivalents (denoted by CO_2e). For example, in terms of how much warming is caused, one metric ton of nitrous oxide (NOx) is equivalent to 295 metric tons of CO_2 and thus is expressed as 295 metric ton CO_2e. In addition, one metric ton of methane (CH_4) is equal to 25 metric tons of CO_2 and denoted by 25 metric ton CO_2e (https://sustainability.duke.edu/offsets/about/faq).

A carbon offset means an activity that compensates for the emission of GHGs by removing or preventing the same amount of GHGs from entering the atmosphere. Carbon offsetting lets you earn ownership of one carbon credit.

There are many ways to create a carbon credit or offset: by planting trees and plants that absorb CO_2 from the atmosphere as they grow; by implementing management practices that capture and store (sequester) GHGs in soils instead of letting them enter the atmosphere; and by improving energy efficiency to reduce energy use and lower associated GHG emissions (https://sustainability.duke.edu/offsets/about/faq).

Carbon Markets and Trade

Farmers and ranchers can generate soil carbon credits by adopting conservation practices that result in quantifiable carbon sequestration. Carbon credits are designed to be purchased by carbon emitters to offset their emissions so that they can keep their overall emissions below certain thresholds or reduce their overall carbon footprint (Plastina 2021). Carbon credits are exchanged through carbon markets. Like other commodities, carbon credit prices are primarily driven by supply and demand. Contracts between those who generate credits and those who pay for them will vary by company buying the credits and program. Payments are typically made on a per metric ton of carbon stored basis. The carbon storage potential may be estimated with field samples or biophysical models run before or calculated throughout the contract. Factors such as soil biophysical characteristics, management practices, and local climate will determine how much carbon can be stored over time and may therefore affect program eligibility or total payment.

Carbon markets in the US are voluntary, and there is no universal price for the carbon stored on agricultural lands. These are private and not statewide or federal programs, so payments will vary by the company, private donor, or foundations buying the credits. The current market is not mature and is difficult to characterize as carbon credit programs have different rules, incentives, and penalties (Plastina 2021). Additionally, because this market and the programs are new, they will likely evolve with time. Payments for carbon credits will depend on the program specifics: some companies will offer a graduated payment to the farmer; some will pay farmers upfront, while others will pay them later. These payments could be cash, cryptocurrency, or credits toward purchases (Sellers et al. 2021). While there is no universal price for carbon credits, available information on current voluntary programs shows that incentives might range from $10 to $20 per metric ton of CO_2e (Myers 2021). Interested parties will need to contact the programs for payment details and processes.

Most programs do not pay growers for previously implemented practices. Payments are for carbon storage resulting from newly adopted conservation practices (Plastina 2021). Eligible practices for carbon credit programs are typically additional (i.e., farmers would not have adopted them if they were not enrolled in the carbon trading program). Farmers cannot enroll the same acres with the same practice in more than one carbon trading program (although they may enroll in other conservation programs not related to carbon or ecosystem markets after they enroll in a carbon trading program). Therefore, carbon credit programs do not prohibit farmers from collecting payments from other incentive programs offered by the USDA or other organizations. However, farmers must enroll in a carbon trading program before other conservation incentive programs. Few programs allow enrollment based on practices already adopted, and those that do, limit the time the practices can be used before enrollment (e.g., 3–5 years or fewer).

Programs are typically long (e.g., 10 or more years). There could be penalties for the farmer (or contract holder) if the land is rented or sold during the contract and the tenant or purchaser does not follow the agreed-upon sequestration practices (Sellers et al. 2021). Temporary contract breaches could result in delayed or lowered payments, while permanent breaches could require the farmer to return carbon credit payments (Plastina 2021).

Currently, there are two major companies that verify carbon sequestration practices and projects: Verra and Gold Standard. The information they provide is used by companies that buy credits to determine the viability of projects. Some companies cover program costs, while others might keep a portion of the carbon credit to cover some fees, or require payment directly from the farmer. Some typical fees are administrative costs, soil sampling, and third-party verification. Other fees may include registration, insurance, and/or transaction fees, depending on the agreement (Sellers et al. 2021). This can affect how much the farmer is paid. For example, if the company keeps 15% of the credits earned to cover fees and withholds 25% of the credits to protect the future loss of sequestered carbon, then the farmer keeps 60%. If the carbon price is $20 per metric ton of CO_2e, then the farmer gets $12 per metric ton of CO_2e (Sellers et al. 2021). Net profitability of sequestered carbon is a function of the price of carbon, the cost of implementing eligible practices, any loss of agricultural productivity, costs associated with measuring carbon improvements, and fees charged by project partners, brokers, and sales platforms (Myers 2021).

Ideally, the practices eligible for carbon markets are equivalent to conservation or best management practices (BMPs) and will have positive economic and environmental outcomes. Like BMPs, growers should consider several tradeoffs before adopting practices and signing up for programs. Chosen practices should make sense for the enterprise. They should both solve an environmental problem (in this case, climate change) and maintain profits. Other considerations are synergies with other farm management practices, learning curves, available expertise, cost of new equipment, and economies of scale, among others. Outside of the cost associated with learning and implementing a new practice, growers should consider tradeoffs related to the carbon programs themselves, duration of the contract, rights they forfeit while enrolled, and administrative costs and penalties. Like BMP adoption, there is no one-size-fits-all.

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Carbon Credit Verification Companies

SustainCERT: https://www.sustain-cert.com/

Gold Standard: https://www.goldstandard.org/

Verra: https://verra.org/