Science Societies

Components of soil carbon accounting

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It is critical for farmers, scientists, and CCAs to work together to achieve soil health and build soil C.

There is an incredible amount of interest in soil carbon (C) markets, but are there ways for CCAs to engage in them? How can we make sense of the bewildering number of opportunities? The goal of this article is to clarify components of soil C markets and soil C accounting and to outline practical avenues that CCAs interested in getting involved may consider. The Assessing Soil Health Series is part of a larger Soil Science Society of America webinar series produced in partnership with The Soil Health Institute and sponsored by The Walton Family Foundation.

There is an incredible amount of interest in soil carbon (C) markets, but are there ways for CCAs to engage in them? There are more than 100 voluntary C markets with over 60 different pricing solutions (Ashtekar, **2021**). Additionally, there are more than 50 major corporations that have announced their intent to be C neutral by 2040, and more than 900 U.S. companies have gone public with a climate-smart or C project commitment. How can we make sense of this bewildering number of opportunities? The goal of this article is to clarify components of soil C markets and soil C accounting and to outline practical avenues that CCAs interested in getting involved may consider.

In our **last article**, we defined the FAO calculation of soil C stock, reviewed the physical sampling technique for soil C, and discussed the effect of spatial variability on the outcome of a C stock estimate. So, if you have questions about soil C sampling, we

refer you back to that article (**https://doi.org/10.1002/crso.20156**). Here we assume that some management practice has been applied that, over time, resulted in a measurable increase in soil C in units of megagrams of carbon dioxide equivalent (Mg CO_2E, note that 1 Mg is equal to 1 metric ton).

Carbon Markets Basics

A C credit is generated when a project either reduces greenhouse gas (GHG) emissions or removes C from the atmosphere. This article focuses on credits gained from removing C from the atmosphere by storing it in soil, rather than reducing emissions. There are two primary types of credits, offsets and insets. An inset credit occurs within a single entity. That entity removes C from the atmosphere at some stage in its value chain and counts that removal in its C emissions budget. Offsets involve two independent entities; hence, offsets are generated by one independent entity purchasing C removal from another. Carbon offsets are usually developed for a C market whereas C insets are created within a business supply chain (Cooper, 2018). There is more variety in what can count as an inset, but because they are transacted in a market, C offsets have more rigorous criteria that must be applied. Because there is more uniformity for offsets, we describe the process for generating a C offset below, but many of the same considerations and steps could be applied to developing insets too.

Carbon offset markets may be regulated markets, such as in the California and Quebec cap-and-trade programs, or voluntary such as much of the C markets developing in the U.S. In a regulated market, emitters must stay under an emissions cap, pay to emit more, or purchase an offset for their emissions. In a voluntary market, emitters are not regulated but rather choose to purchase an offset for some or all of their emissions. Because any regulated market will be accompanied by its own guidance, the focus of

this article is on voluntary markets. In a voluntary market, nobody is legally required to meet any standard, as long as the buyer and seller agree that a project will meet their needs. Voluntary buyers vary in their tolerance in confidence for the credits they purchase, meaning some buyers require more certainty in a C credit than others. Buyers get this confidence by purchasing offsets certified by a third party. Examples of certifying institutions that work in voluntary markets are Verra, Climate Action Reserve (CAR), American Carbon Registry (ACR).

Creating a Carbon Offset

The first step in the development of a C offset is the methodology document. Within those following Verra, CAR, and ACR, there are more than 100 different methodologies, including multiple methodologies for agriculture, renewable energy, and industrial projects. The methodology document defines what counts as an offset and how it can be generated (Priddy, **2021**). In the case of soil C, this includes the practices that can be used to increase soil C. For example, a particular methodology might include no-till but not include incorporating biochar on a field. An individual or group wanting to sell certified offsets would engage with a certifying body to select an existing methodology for its project or to create a new methodology. Important considerations for methodology development include additionality, permanence, leakage, discounting for uncertainty, and measurement, reporting, and verification protocol.

Additionality

If offsetting emissions are to be effective for climate change prevention, CO_2 levels in the atmosphere must be reduced. This means new C needs to come out of the atmosphere and be stored elsewhere. Carbon offsets are considered additional if they are removed from the atmosphere as a result of a practice change, *a purposeful action to remove C from the atmosphere*. For this reason, soil health management practices

previously enacted for other purposes likely won't qualify for additionality and will not be buyable C offsets for GHG that the buyer emits currently. The fact that past practices don't count as offsets can create tension because early adopters may not be rewarded through C markets, but it is important to remember that soil health management practices can be profitable even without soil C payments (**https://soilhealthinstitute.org/economics/**). Some buyers in voluntary markets agree to purchase "vintage" soil C from past practices that occurred within a certain time frame to support early adopters.

Permanence



Example of a practice that builds soil C—soybeans growing through a rye cover crop.

Taking C out of the atmosphere as an offset and then releasing it again isn't useful to fight climate change. Permanence, or keeping credited carbon out of the atmosphere permanently, is critical to C offset methodology. A certified offset method will include the length of time the C is to be sequestered. In some methodologies, such as for forestry, this may be 100 years. In the case of soil C, this would mean that a farmer that adopted no-till to sequester C is expected to keep that C in the soil for the defined time period that the C was intended to be permanent. Because farmers may not be able to guarantee a practice use far into the future, soil C markets often have shorter permanence periods than other C markets (e.g., ≥10 years).

Leakage

Leakage occurs when an action that sequesters C in one location increases emissions elsewhere. This undermines the purpose of storing soil C, which is to keep GHG out of the atmosphere. Leakage is a key reason that certifying bodies may be selective about additional practices to be adopted. Certifying bodies must avoid practices that appear to store soil C but actually "leak" GHG elsewhere.

Discounting for Uncertainty

One of the most challenging aspects of C markets is that no physical goods or services are conveyed from the seller to the buyer. Instead, we only know how much C has been sold, and that quantity of C is based on a modeled or measured estimate. Hence, the uncertainty associated with estimated C is included in the sale as a discount on the sale price. Uncertainty has a role in selecting the estimate type such as modeling, type of measurement, or a combination of modeling and measurement. Models are less costly than measurements but have greater uncertainly; hence, some of the amount saved by using models may be lost to a discount if the uncertainty is too high.

Measurement, Reporting, and Verification Protocol

The measurement, reporting, and verification (MRV) protocol included in the methodology document states how C will be monitored to verify that the C stored is really there. This will include whether measurements, models, or a combination of the two will be used for MRV.

With so much detail needed to develop a methodology document for a certified offset, and because technical and legal review is needed, creating a new methodology can take a year or more and be quite costly (Priddy, **2021**). Once methodology is established, projects that use that methodology can be developed. Figure **1** depicts how C offsets are generated and used (retired).

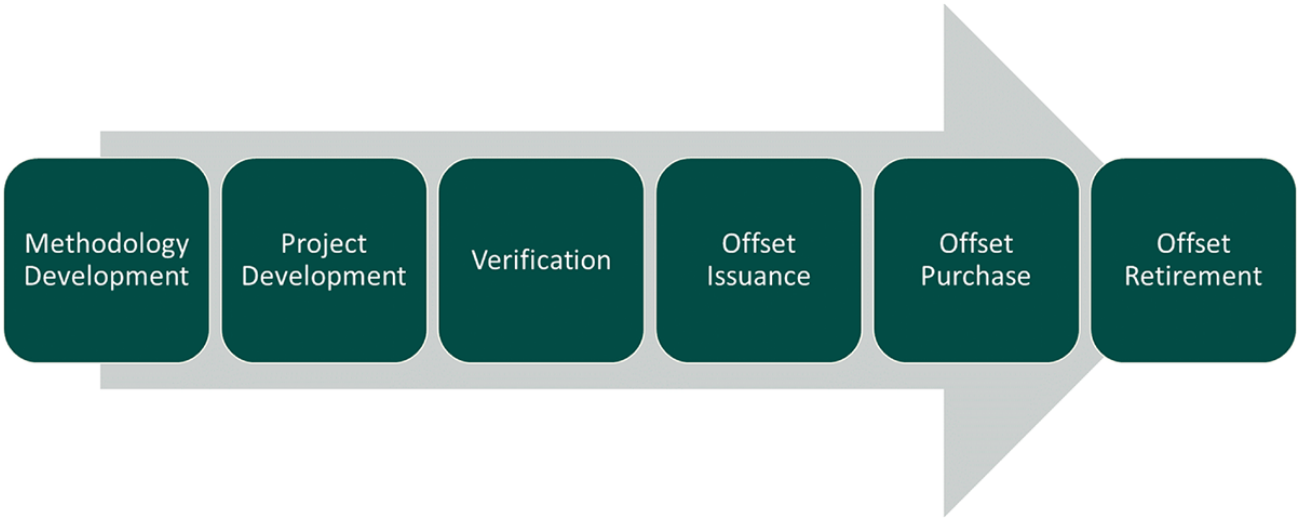


Figure 1, *Life cycle of a C offset, adapted with permission from ClimeCo.*

In the context of soil C, a project might include baseline soil sampling, adoption of soil-health-promoting practices, and measurement of the amount of soil C gained. For a certified offset, the data demonstrating the change in soil C would need to be verified by a third party (usually not the same as the certifying body). The certifying body then examines the reported and verified C change and issues an offset to the entity that generated the offset. This offset can now be sold. For the offset buyer to count the offset against their C emissions, the offset must be recorded as retired, meaning that it cannot be traded again, which would be considered "double counting."

How Can CCAs Engage in Carbon Markets?

There are many players in C markets, including owners, developers, validators, brokers, and traders (Broekhoff et al., **2019**). In a soil C market, the landowner, farmer, or rancher could be considered the owner of the project. A CCA may serve as a project developer to facilitate the process of offset creation. The work of a developer might include recommending a methodology from a certifying body, planning and implementing soil C monitoring, preparing reports for verification of offsets, and interacting with brokers of exchanges. While other entities may have more knowledge about the structure of C markets than a CCA, the CCA has the advantage of indispensable local agronomic

knowledge, and perhaps the most valuable item, the trust of the project owner. If C markets are to be successful, a great deal of quality agronomic knowledge will be needed to implement and record agronomic practices that build soil C. As C markets mature, engaging in the marketplace can complement existing services and consolation that CCAs offer. As well, developing C insets will require many of the same elements as developing C offsets for a market, and CCAs can engage in those opportunities by providing agronomic knowledge, project implementation, and reporting for groups who want to create insets in their value chains.

Don’t Lose a Soil Health Focus

While much interest and energy are focused on soil C markets, it is important that soil managers and agricultural advisers not lose focus on soil health. While many methodologies exist to create C offsets (beyond soil C capture), the methods that create soil C capture in agriculture have well-established benefits to agriculture and society. Farmers and ranchers don’t need to choose between managing for soil C and managing for soil health because the principles and practices needed to achieve them are the same. Increased soil health increases farm profitability, improves resilience to extreme weather, increases drought resilience, reduces soil loss, reduces runoff, and protects environmental quality of neighboring lands and environments. Healthy soil provides many ecosystem services to society, among them storage of atmospheric C. While markets for other ecosystem services like water quality, water quantity, and biodiversity lag behind C markets, CCAs who engage in soil C markets can play a key role as champions of all the many services that healthy soil provides.

Summary

There is much interest in soil C markets as a way for businesses to meet voluntary climate change commitments. For these markets to function, projects must be undertaken that remove C from the atmosphere and store it in soil. There is a distinction between soil C offsets, which are sold in markets, and soil C insets, which are accounted for within the value chain of a single entity. In voluntary markers, C offsets that are certified by a third party have higher certainty associated with them than uncertified credits.



Certified Crop Advisers can provide local agronomic expertise, such as how to build soil C through reduced tillage.

Creation of a methodology document is the first step in generating a soil C offset. The methodology document includes the practices that can be used to store C; the process for measurement, reporting, and verification that must be followed; and other considerations such as additionality, permanence, leakage, and discounting for uncertainty. Project developers and owners work together using the methodology document to develop and report on the offset project so that a third party can verify and issue the offset. Certified offsets can be sold to buyers who retire them to claim them against their emissions.

There are opportunities for CCAs to engage in soil C markets and C insetting related to project development because CCAs have local agronomic knowledge and can provide planning, implementation, and reporting for agronomic practices. Many of these same functions may be performed by CCAs to help create soil C insets though insets are not sold in a market. It is important that CCAs keep a soil health focus so that their clients

can benefit from the profitability brought by increased soil health and so that healthy soils can provide a diversity of ecosystem services to society.

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