Carbon Management & Sequestration Center
C-MASC

School of Natural Resources
2021 Coffey Road
422B Kottman Hall
Columbus, Ohio 43210

Phone: 614-292-9069

Soil Carbon Credits

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Information note: soil carbon offsets and the second commitment period

The IPCC (2007) has recognized that carbon (C) sequestration in the world's agricultural soils is an important option of mitigation and adaptation to climate change. Yet soil C has been excluded from the Kyoto Protocol mechanisms due to perceived methodological barriers. The science and practice of land use and C management has progressed considerably since 2000, so these potential barriers can now be met, resulting in high quality emissions reductions from sustainable land management (SLM). Significant co-benefits associated with soil organic carbon (SOC) storage make SLM an integrated solution to the inter-related issues of poverty, resilience and sustainable development.

Mitigation potential

Agricultural lands and rangelands cover 6 billion ha, around 40 percent of the earth's land surface area. Of this, 70 percent is used for pasture, 27 percent for arable land and 3 percent for perennial crops. Soils hold 2500 Gt C, twice as much as the biotic pool and the atmosphere combined. Most agricultural soils have lost 30 to 40 t C ha^{-1} (30-75 percent) of their historic soil organic carbon (UNFCCC 2008), and have significant additional C storage capacity (Lal et al. 2007). Agriculture has a technical mitigation potential[1] of 1.5-1.64 Gt C (5.5–6 Gt CO2e) per year by 2030 (IPCC 2007), of which 89 percent is represented by soil organic carbon sequestration (Smith et al. 2007). This can be achieved through adoption of conservation agriculture along with mulch farming and integrated nutrient management on cropland soils, sustainable stocking rates on grazing lands, introduction of grasses and legumes on grazing lands, improved nutrient management and irrigation of grazing and crop lands, restoration of overgrazed land, conversion of abandoned and degraded cropland to grassland and forest land, the restoration of eroded and degraded soils, and avoided land conversion through intensification of agriculture.[2] Existing technologies are ready to be implemented immediately (UNFCCC 2008).

[1] Excluding fossil fuel offsets from biomass.
[2] There are also significant GHG mitigation opportunities associated with methods including the storage of soil inorganic carbon as char, with similar agricultural benefits (Lehmann 2007, 2008), and composting.

Key challenges

The following examples illustrate that perceived barriers to verifiable carbon sequestration in agricultural soils can be surmounted.

Risk of carbon loss due to changes in management

Permanence can be addressed through legally-binding contractual agreements with landowners (e.g., easements), followed by regular monitoring. Other elements of the solution include aggregation and systemic transitions to SLM. Where the project developer is a reliable public agency, the risk of reversal is lower. Where the project developer is a for-profit entity, it may be held legally accountable for the credits generated. Both legal accountability and financial incentives may be harnessed to help secure soil C gains. Aggregation or bundling of project lands through a respected local organization would allow smallholders to participate in C markets (FAO 2008) and can be used to monitor compliance at the local level.

Integrated project design is necessary to ensure that gains in soil carbon are not offset by increases in emissions of N_2O and CH_4. Mitigation opportunities also exist to reduce emissions of these gases from agricultural production systems. These factors have implications for permanence: If properly incentivized, GHG emissions reduction components may be synthesized to create farm-wide sustainable management plans, in which carbon sequestration is embedded with other reductions measures. This would reduce the risk of loss of newly stored C due to changes in management.

Establishing baseline and verification of additionality

Commonly envisaged barriers to C sequestration include difficulties in establishing baseline, and a lack of information in certain countries and regions (IPCC 2007). Where this is a problem it can be overcome with the increasing sophistication and availability of satellite data—and of satellite-data-driven and ecosystem models—and the use of growing databases that chart the effects of different management practices on soil carbon stocks.

There are a number of methods used to quantify soil C pool in terrestrial ecosystems. These include *direct measurement*, such as dry combustion of augered core soil samples and in-field spectroscopy technologies (stationary and mobile, some involving minimal disturbance); *indirect measurement*, such as use of remotely sensed data and key indicators gathered from light aircraft or satellite, and eddy covariance measurements; use of process-based *ecosystem models*, based on robustly observed patterns and providing extrapolative predictability; and other *data treatment* methodologies, such as site stratification and geostatistical analysis, which improve the effectiveness of data gathered and greatly reduce the cost of quantification.

Two or more of these methods can be employed in a combination methodology to quantify and verify emissions reductions through soil C sequestration in comparison to a 'business as usual' baseline. Improvements and innovations continue to occur in the development, synthesis, use, and cost-effectiveness of such methodologies in private, public and public-private spheres. The diversity of available methods and methodological options enables the selection of optimal combinations of scientific defensibility, cost-effectiveness and applicability.

In time it is likely that a number of different methodologies will develop for application in different scenarios worldwide, according to criteria such as land use, project action and price opportunity. Where scientific data is incomplete, UNFCCC AR-AMS0004 methodology provides a framework for incentivizing small holders to adopt improved land management practices while producing verifiable changes in soil stocks over time.

Leakage

Leakage can be addressed using methods in existing approved project methodologies (e.g., addressing leakage in project design, monitoring of key indicators and discounting), or by establishment of national sectoral baselines.

Access to markets

Barriers to smallholder participation can and should be removed through bundling or aggregation, and project development and implementation that are appropriate for local socio-economic and cultural conditions. This approach could be critical in opening up mitigation markets to smallholders, as urged by delegates to last year's *High-Level Conference on World Food Security*.

Co-benefits and Resilience

The SOC is a by-product of the reduction of oxidized C that occurs during photosynthesis, and constitutes 58 percent of SOM, which is the basis of all agricultural production. This transformation thus provides win-win opportunities in terms of emissions mitigation, increased resilience of production systems and increased agricultural productivity. SOC plays a unique role in soil functioning, providing food for microorganisms, denaturing pollutants, increasing plant-available water and yield, decreasing the risk of flooding and reducing the need for synthetic fertilizer. Increasing SOC pool improves soil's water holding capacity and soil structure thus reducing risks of drought and erosion. Increasing SOC pool by I t/ha/yr on croplands can increase food production by 24 –40 million t, filling the food deficit in food-insecure regions. Increasing stocks of SOC in agricultural lands also has potential to strengthen agroecosystem and smallholders' resilience to the effects of climate change and extreme climatic events. Because of these critical and substantial co-benefits, soil C sequestration also provides opportunities for bundling emissions reductions with other payments for ecosystem services

These benefits do not detract from the quality of soil C credits. Instead they should provide urgent humanitarian and environmental impetus to overcome the key challenges around the inclusion of soil C offsets in the second commitment period, and could be recognized in the form of premium credits (FAO 2008). Crucial to feeding a predicted population of 9.4 billion people in 2050 and meeting other increased demands on soils such as biofuel production, soil ecosystems must be stabilized and resilience increased through adoption of SLM technologies on existing agricultural lands[3,4].

Conclusions

Agriculture has a technical mitigation potential[5] of 1.5-1.64 Gt C (5.5–6 Gt CO2e) year by 2030 (IPCC 2007b), of which 89 percent is represented by SOC sequestration (Smith et al. 2007). Management practices to achieve this are already available. Methods to measure, monitor and verify changes in C stocks are well developed. Perceived methodological barriers can be overcome. The world's poorest people depend directly on soil quality for survival. Because of direct links with atmospheric CO_2 and other ecosystem services, this is also true for the rest of humanity.

Climate change provides an opportunity of unprecedented magnitude to improve the viability and sustainability of our agroecosystems, and the lives dependent upon them. A critical window of opportunity now exists. We urge the Parties to the Kyoto Protocol to take the necessary actions to include soil C sequestration from SLM as an eligible activity in LULUCF measures in the second commitment period.

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[3] *A priori* UN Millenium Development Goals of halving poverty and hunger.
[4] 70% of mitigation potential is in developing countries (World Bank 2008).

[5] Excluding fossil fuel offsets from biomass