SOIL CARBON SEQUESTRATION IN CONSERVATION AGRICULTURE

A Framework for Valuing Soil Carbon as a Critical Ecosystem Service

Conservation agricultural systems sequester carbon from the atmosphere into long-lived soil organic matter pools – while promoting a healthy environment and enhancing economically sustainable production conditions for farmers throughout the world. Soil organic carbon is fundamental to the development of soil quality and sustainable food production systems. Soil, soil organic carbon, and soil quality are the foundations of human inhabitation of our Earth. We must enhance the ability of soil to sustain our lives by improving soil organic carbon.

Conservation agricultural systems have been successfully developed for many different regions of the world. These systems, however, have not been widely adopted by farmers for political, social and cultural reasons.

Through greater adoption of conservation agricultural systems, there is enormous potential to sequester soil organic carbon, which would:

(1) help mitigate greenhouse gas emissions contributing to global warming and

(2) increase soil productivity and avoid further environmental damage from the unsustainable use of inversion tillage systems, which threaten water quality, reduce soil biodiversity, and erode soil around the world.

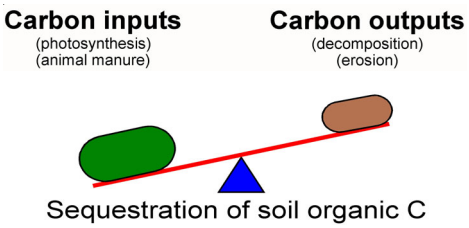
Rising atmospheric concentrations of carbon dioxide (CO_2), nitrous oxide (N_2O), and methane (CH_4) are global threats to the future of human civilization. Agricultural activities around the world contribute about 15% to the annual emissions of these greenhouse gases.

Research during the past few decades has demonstrated the significant contribution that conservation agricultural systems can have on reducing emission of greenhouse gases, as well as sequestering carbon in soil as organic matter. Due to environmental constraints of climate, landscapes and plants, the rate of soil carbon sequestration is different in different parts of the world. In general, soil carbon sequestration during the first decade of adoption of best conservation agricultural practices is 1.8 tons CO_2 per hectare per year. On 5 billion hectares of agricultural land, this could represent one-third of the current annual global emission of CO_2 from the burning of fossil fuels (i.e., 27 Pg CO_2 per year).

Conservation agriculture systems have three guiding principles that can be globally applied:

- Minimizing soil disturbance, consistent with sustainable production
- Maximizing soil surface cover by managing crops, pastures and crop residues
- Stimulating biological activity through crop rotations, cover crops and integrated nutrient and pest management

These three principles help to assure the positive balance between carbon inputs and carbon outputs.



Sequestration of soil organic carbon by farmers can provide an environmental commodity that benefits all of society through the mitigation of greenhouse gases. Early markets have shown that carbon offsets from conservation agriculture can be quantified, verified and traded. Carbon credit trading will provide an economic opportunity for farmers to adopt these ecologically based approaches to farming.

Changing agricultural practices can be risky to farmers, and therefore, creation of incentives, policies and legislation is justified. Although soil carbon sequestration may be the driver for incentive payments, there are other key environmental and economic services that can be derived from conservation agricultural systems.

FINANCIAL BENEFITS FOR FARMERS

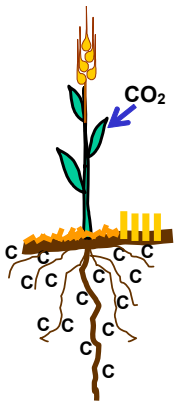
- Greater yields and improved yield stability in variable weather
- Reduced fuel and labor requirements
- Greater resilience to drought through better water infiltration and retention
- Alleviation of labor demand at key times in the year, permitting diversification into new on-farm and off-farm enterprises
- Better cycling of nutrients and avoiding nutrient losses
- Higher profit margin with greater input-use efficiency
- Increasing land value due to progressive improvements in environmental quality

BENEFITS TO COMMUNITIES & SOCIETY

- More reliable and cleaner water supplies resulting in lower treatment costs
- Less flooding due to better water retention and slower runoff, resulting in less damage to roads, canals, ports and bridges
- Improved air quality with less wind erosion
- More secure food and water sources
- Economic and industrial development opportunities
- Improved quality of life

ENVIRONMENTAL BENEFITS

- Favorable hydrologic balance and flows in rivers to withstand extreme weather events
- Reduced incidence and intensity of desertification
- Increased soil biodiversity
- Less soil erosion resulting in less sediment in rivers and dams
- Potential for reduced emissions of other greenhouse gases, including methane and nitrous oxide, if compaction is avoided
- Reduced deforestation due to land intensification and more reliable and higher crop yield
- Less water pollution from pesticides and applied fertilizer nutrients
- Less hypoxia of coastal ecosystems



PRIORITY ACTIONS

1. Enable conservation agriculture to be recognized within any renegotiated clean development mechanism formed by the United Nations Framework for Climate Change Convention after the current expiration in 2012.
2. Promote closer interaction between government agencies, farmers, private sector, technology generators and disseminators, and non-government organizations in policy reform, as well as for the design and application of stewardship incentives for broad acceptance of conservation agriculture.
3. Mobilize the commercial sector to recognize the importance of ecosystem services provided by conservation agriculture, particularly its role in soil carbon sequestration.
4. Develop a science-based synthesis on how carbon might provide ecosystem services from conservation agriculture. This should include optimized measurement methodologies and determining the potential of soil carbon sequestration for defined crop management systems and ecoregions of the world.
5. Develop standardized protocols for applying science-based information to conservation agriculture projects that provide ecological goods and services using internationally accepted guidance, such as ISO 14064 for greenhouse gas emission reductions.
6. Seek government endorsement of conservation agriculture for development of national and international policies to value ecosystem services.
7. Support adoption of conservation agricultural technologies through payment for ecosystem services (e.g., soil carbon sequestration and water quality benefits).

This summary document was derived from the Conservation Agriculture Carbon Offset Consultation, attended by approximately 80 individuals, on 28-30 October 2008, at the Beck Agricultural Center in West Lafayette, Indiana, USA. The Consultation was sponsored by the United Nations Food and Agriculture Organization (FAO) and the Conservation Technology Information Center (CTIC), with technical support from United Nations Framework Convention on Climate Change (UNFCCC) staff. [The views expressed are those of the participants and not endorsed by the UNFCCC.]