Agriculture and Climate Change: An Agenda for Negotiation in Copenhagen

Direct and Indirect Mitigation Through Tree and Soil Management

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Many opportunities exist for mitigating greenhouse gas (GHG) emissions through better management of trees and soils. There is potential for both direct mitigation through better management of carbon in agricultural landscapes and indirect mitigation through reduced pressure on carbon stored in forests, peatlands, and wetlands. Effectively harnessing these opportunities will take bold action in climate change negotiations.

Mitigating GHGs through better farm management of soil and trees

The fourth assessment of the Intergovernmental Panel on Climate Change (IPCC) focuses on direct mitigation in agriculture, concluding that 90 percent of the technical potential for direct mitigation is through sequestration of soil carbon in developing regions, particularly in Southeast Asia, South America, East Asia, and Eastern Africa. The greatest opportunities for cost-effective mitigation are through changes in cropland and grazing land management, restoration of organic carbon to cultivated soils, restoration of degraded lands, and agroforestry.

In harnessing the potential for soil carbon sequestration, a major challenge has been the cost of measuring and monitoring soil carbon, with measurement costs possibly exceeding the market value of soil carbon enhancement. Fortunately, some promising solutions to this problem have been found. For example, researchers at the World Agroforestry Centre have developed techniques for estimating soil characteristics from the reflectance properties of soil samples. Combined with satellite imagery, these techniques can be used to generate soil carbon maps for large landscapes.

The IPCC report draws the somewhat surprising conclusion that agroforestry—the deliberate management of trees in agricultural landscapes—has less potential for cost-effective carbon storage on agricultural land than many other land-use practices. Other studies have reached different conclusions. An earlier IPCC report found large potential for carbon sequestration through improved management of existing agroforestry systems and through conversion of degraded lands into agroforestry. A 2005 review of the evidence from Africa found that improved fallow systems using agroforestry can sequester between 0.1 and 5.3 metric tons (mt) of carbon per hectare per year, while conservation farming systems without trees can only sequester 0 to 0.36 mt per hectare per year. One reason for this wide range of estimates is the large variety of farming systems that can be described as agroforestry.

An advantage of tree-based systems is that current technologies make it easier to estimate above-ground biomass than soil carbon. A study conducted on various land uses in the semiarid Sahel found a strong positive correlation between total biomass and soil carbon, with carbon in the soils 5 to 20 times higher than carbon in the trees. Correlations are similarly high in more humid areas, where a higher proportion of carbon is stored above ground. Thus the potential is high for estimating total soil and above-ground carbon from data on above-ground carbon, rainfall, and soil type. A further advantage of agroforestry systems is that they can generate substantial benefits through increased income and products (such as livestock feed, fuelwood, fruit, and medicines). Higher levels of soil carbon increase soil fertility and thus enhance agricultural production.

Suggested negotiating outcome: Provide financial and institutional support for a mix of early action, coordinated research, capacity building, and information sharing to enhance carbon storage in agricultural landscapes.

Given the wide range of systems that can be classified as agroforestry or conservation agriculture, more coordinated empirical studies are needed on biomass, soil organic carbon, and soil fertility implications of those systems in a range of circumstances. There is also a need to refine and expand the use of techniques for large-scale measurement of soil and biomass carbon.

Reducing pressure on forest resources

One of the greatest opportunities for agriculture to mitigate climate change is indirect—through reduced pressure on forest resources. The decision on Reduced Emissions from Deforestation in Developing Countries (REDD), adopted by the 13th Conference of Parties to the Framework Convention on Climate Change (FCCC), "... encourages Parties...to address the drivers of deforestation relevant to their national circumstances, with a view to reducing emissions from deforestation and forest degradation." In 2009, negotiations in the FCCC have focused on REDD-plus, which considers reduced emissions from deforestation and degradation, and enhancement of carbon stocks through sustainable forest management and afforestation.

Of the many drivers of deforestation, expansion of agriculture is most important. The Food and Agriculture Organization of the United Nations (FAO) estimates that in 2005, agricultural lands occupied almost 50 million square kilometers of the earth's surface, having increased by about 10 percent since the 1960s. Expansion of smallholder agriculture is a particularly important driver of deforestation in Sub-Saharan Africa, where food production per capita has stagnated despite agricultural area expanding by about 2 percent per year. The 2008 World Development Report showed that growth in agricultural production has relied primarily on expansion of farming area in Africa and on more intensive use of purchased inputs in Asia. Despite being heavily dependent on agriculture, most African countries invest low proportions of their national budgets on agricultural research and development.

If forests and woodlands are valued for the land they occupy, the timber that can be extracted, and the soil fertility they provide to extensive agriculture, then enhanced road access, more profitable land-use technologies, and stronger markets for food and fuel crops will increase pressure on forest resources. This appears to describe the major expansion of cattle ranching in the Amazon, cocoa production in the Guinea forests of West Africa, monoculture coffee growing in Vietnam, tobacco production in southern Africa, and oil palm production in Southeast Asia.

Different dynamics are possible, however. A review of evidence from around the developing world has concluded that technological

progress in intensive agriculture and labor-intensive technological progress can, under specific circumstances of labor absorption, reduce pressure on forests. Equally important for reduced deforestation, however, are the development and enforcement of secure property rights and control of migration into forest margin areas. However, the potential negative effects of intensification on nitrous oxide and methane emissions needs to be evaluated, since small emissions of these more dangerous GHGs may offset part of the reductions in carbon dioxide emissions occurring through reduced deforestation. A doubly effective solution can be achieved when intensive production systems also sequester substantial amounts of carbon and have a tight nitrogen cycle, as is the case for multistrata agroforestry systems.

Suggested negotiating outcome: Strengthen the contribution of soil and tree management in agriculture for a more effective REDD or REDD-plus mechanism.

The agreement on REDD reached in FCCC negotiations in 2007 recognized the need to address the drivers of deforestation. Negotiators should go further to recognize the implications of agriculture as a dominant driver. A mechanism that encourages reduced emissions from all land uses would be the most effective means to address these interactions.

Trade-offs and opportunities for synergies

There are both trade-offs and opportunities for synergies between carbon stocks and private economic returns to land users. During the past 15 years, the Alternatives to Slash and Burn Programme (ASB) has examined the trade-offs between carbon stocks and private economic returns to land users in landscapes across the tropical forest margins. The most recent ASB information on trade-offs examines the opportunity costs of avoided deforestation at sites in Cameroon, Indonesia, Peru, and the Philippines. The results show positive but relatively low opportunity costs in terms of forgone income per ton of extra carbon. In other words, reduced emissions from deforestation can be cost effective but certainly not free.

Suggested negotiating outcome: Provide land users with real incentives to maintain carbon stocks.

While land-use changes that both increase carbon stocks and farmers' income are possible, farmers generally will have to accept trade-offs. In-kind or monetary payments should be provided directly to farmers who bear the costs of forgone development opportunities.

Threatened carbon pools

Peatlands and wetlands are important carbon pools that are under particular threat from agriculture. A controversial 2006 report showed massive GHG emissions from conversion of peat forests and from poor management of peat soils converted earlier. Subsequent studies have made some adjustments to those results and emphasized the uncertainty surrounding these estimates. In a 2007 report, Swallow and others show that conversion of peat forests in the Jambi province of Indonesia has generated large amounts of emissions at very low returns to farmers, often followed by land abandonment. Peatlands are found in many developing countries, with many other developing countries containing large areas of high-carbon wetlands facing similar threats from agricultural expansion.

Suggested negotiating outcome: Address emissions from past conversion of peat forests and poor management of peatlands in all countries with substantial peatland areas.

A mechanism that encourages reduced emissions from all land uses could accommodate the pressing need to reduce emissions from peatlands and wetlands.

IPCC Guidelines Provide an Accounting Base

The IPCC's guidelines for reporting emissions from agriculture, forestry, and other land uses are already being used by developed countries in their reports to the FCCC. Rather than develop a patchwork of rules for different aspects of land use, a comprehensive accounting system such as the IPCC guidelines should be applied in all countries. Otherwise issues such as leakage and additionality may be addressed through complex rules, resulting in high transaction costs and low effectiveness. This problem undermined the potential for afforestation projects under the Clean Development Mechanism.

Suggested negotiating outcome: Base accountability for the net emissions from all land use on existing IPCC agriculture, forestry, and other land-use guidelines. ■

For Further Reading: Food and Agriculture Organization of the United Nations (FAO), *Global Forest Resources Assessment 2005*, Forestry Paper No 147 (Rome: FAO, 2006); A. Hooijer et al., *PEAT-CO2, Assessment of CO2 emissions from drained peatlands in SE Asia*, Delft Hydraulics report Q3943 (Netherlands: Delft Hydraulics, 2006); Swallow, B. et al., *Opportunities for Avoided Deforestation with Sustainable Benefits.* An Interim Report by the ASB Partnership for the Tropical Forest Margins (Nairobi, Kenya: ASB Partnership for the Tropical Forest Margins, 2007); T. G. Vagen, R. Lal, and B. R. Singh, "Soil Carbon Sequestration in Sub-Saharan Africa: A Review," *Land Degradation and Development* 16: 53–71 (2005).

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