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Social and Institutional Barriers to Climate Change Mitigation in Agriculture

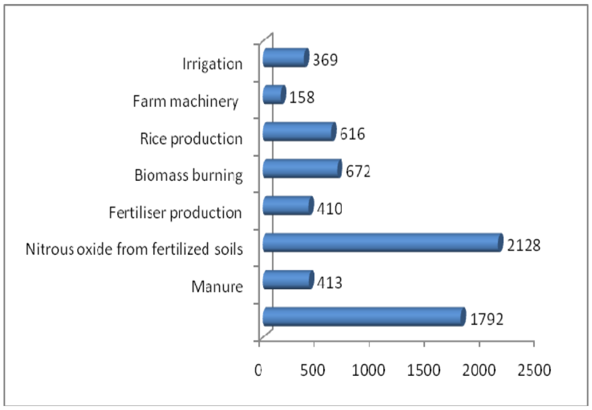
Agriculture is one of the major sources of greenhouse gas (GHG) emissions accounting for approximately 14 percent of total GHG emissions. However, unlike other sectors such as transport or energy, agriculture is potentially a significant carbon "sink". Moreover, because the majority of GHG emissions from agriculture originate in developing countries, early intervention could be highly cost-effective. This note examines the potential role of agriculture in climate change mitigation. It discusses: 1) the sector's current GHG emissions, 2) its potential to serve as a sink, 3) best management practices that can be adopted to mitigate climate change, and 4) social and institutional barriers to adopting agricultural mitigation measures, and ways to overcome them.

Introduction

Agricultural land currently covers 40-50 percent of the Earth's land surface and accounts for approximately 14 percent of global GHG emissions. Nitrous oxide and methane, which account for the vast majority of agricultural GHGs, come from various sources. Nitrous oxide (N_2O), the primary regulator of stratospheric ozone, originates from nitrogen-based fertilizers, while methane gas is commonly emitted by both livestock- particularly ruminants such as cattle, goat, and sheep, which produce it as a by-product of digestion (enteric fermentation)- and wetland rice fields- which release methane in the course of anaerobic decomposition. Agricultural emissions also come from various other sources such as degradation of land, use of fossil fuel, and burning of agricultural residues (see figure 1).

With the continuing population expansion, the demand for cereal and animal based foods is expected to rise in coming decades. Increased demand for food and livestock also means a likely increase in emissions from the agriculture sector unless there is technological advancement in farming and livestock rearing. Nitrous oxide emissions are expected to increase up to 35-60% and methane emissions could jump by as much as 60% by 2030 (FAO, 2002). With a combined 95% increase in the period 1990 to 2020, the Middle East and North Africa region and Sub-Saharan Africa are expected to experience the highest growth in emissions.

Figure 1. Sources of agricultural greenhouse gases, excluding land use change (Mt CO_2-eq)



Data Source: Bellarby et al. (2008)

Agricultural emissions are also expected to increase in other regions. In East Asia, increased rearing of livestock is expected to push emissions higher as the region's burgeoning urban population drives up demand for livestock and dairy products. In South Asia, increase in use of nitrogen-based fertilizers and manure to meet the growing demand for food is expected to continue driving up emissions.

Nonetheless, the technical mitigation potential, although important may go unrealized in the absence of robust economic and regulatory structures that place a premium on the price of carbon. The global economic potential for GHG agricultural mitigation depends upon the carbon price (see figure 2), and is estimated to be lower than the technical potential, which is estimated to be ~5500-6,000 MtCO2-eq/yr.

Mitigation Potential of Agriculture

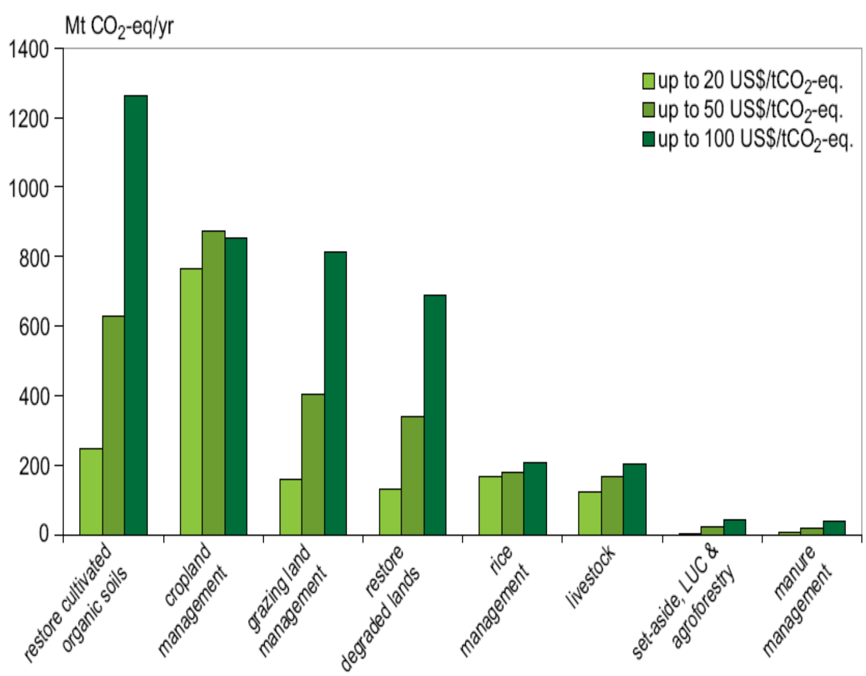
In 2007, the Intergovernmental Panel on Climate Change estimated that the current agricultural technical mitigation potential is expected to be around 5-6 gigatons CO2e (excluding land use change). About 80 percent of agriculture emissions come from developing countries and approximately 70 percent of agricultural mitigation potential could be realized in developing countries (IFAD, 2008).

Mitigation Measures

Agricultural mitigation measures seek to either increase the capacity of land to absorb carbon emissions ("sink") or limit emissions produced in agricultural processes ("souce"). There are four broad categories of measures:

1) Cropland and pasture management
2) Restoration of degraded land
3) Livestock and manure management
4) Bioenergy use

Figure 2. Economic potential for GHG agricultural mitigation by 2030



Source: Smith et al. (2007)

Cropland and Pasture Management

Cropland and pasture management is considered to be one of the most promising agricultural mitigation measures. As croplands in many parts of the world are intensely harvested, they offer many opportunities to impose practices that reduce net GHG emissions. The technical potential of soil organic carbon sequestration through adoption of recommended management practices for world cropland soil alone is expected to be in between 0.4 billion to 1.2 billion metric tons of carbon per year. Some of the crop and pasture management technologies that increase soil carbon sequestration include: (a) no-till farming with residue mulch and cover cropping, (b) crop rotations, (c) use of soil amendments (such as compost, zeolites, and biochar), (d) controlled fire as a rejuvenation method, and (e) reduction of soil disturbance.

Restoration of Degraded Lands

Land degradation is a global problem causing GHG emissions. Emissions from degraded lands can often be addressed in a cost-effective manner by restoring the land. It is estimated that approximately 600 million to 1 billion metric tons of carbon can be sequestered through restoration of degraded soils every year. Measures that help restore degraded lands and reduce emissions include: reforestation, re-vegetation (e.g. planting grasses), improving fertility through nutrient amendments, application of organic substrates like manures, biosolids and composts, and retaining crop residues.

Degraded land can be restored through carbon sequestration quite inexpensively. With the cost of carbon sequestration as low as USD 1.77 per tCO_2e, agroforestry offers a significant and cost-effective means of reclaiming land productivity and reducing atmospheric concentrations of GHGs. For instance, in Colombia the Caribbean Savannah Carbon Sink Project stopped land degradation on the coastal plains by using silvopastoral and reforestation systems. As a result of these measures, the ecosystem is expected to sequester approximately 0.25 metric ton CO_2e by 2017.

Livestock and Manure Management

Farmed livestock is the second largest source of anthropogenic methane- a gas with a global warming potential 20 times that of CO_2. Enteric fermentation in cattle accounts for approximately 80 million metric tons of the total annual methane emissions, which is more than methane emission arising from landfills and biomass burning. Moreover, methane emissions from farmed livestock are expected to grow very rapidly. By 2030, methane and nitrous oxide emissions from agriculture are projected to increase by 35-60 percent. There are several ways to reduce emissions from livestock. They include: (a) helping farmers in developing countries obtain and maintain higher-yielding breeds, (b) imposing regulatory frameworks for managing manure in all countries, (c) improving the diets of ruminants, (d) manipulation of the intestinal bacteria of rumens.

Likewise, methane from manure can be reduced by cooling, use of solid covers, mechanical separation of solids from slurry, composting of manure, or through methane capture. For instance, the Thailand Advance Energy Plus Company (AEP) Livestock Waste Management Project aims to reduce 59,781 tCO_2e of greenhouse gas emissions from swine manure annually through biogas capture.

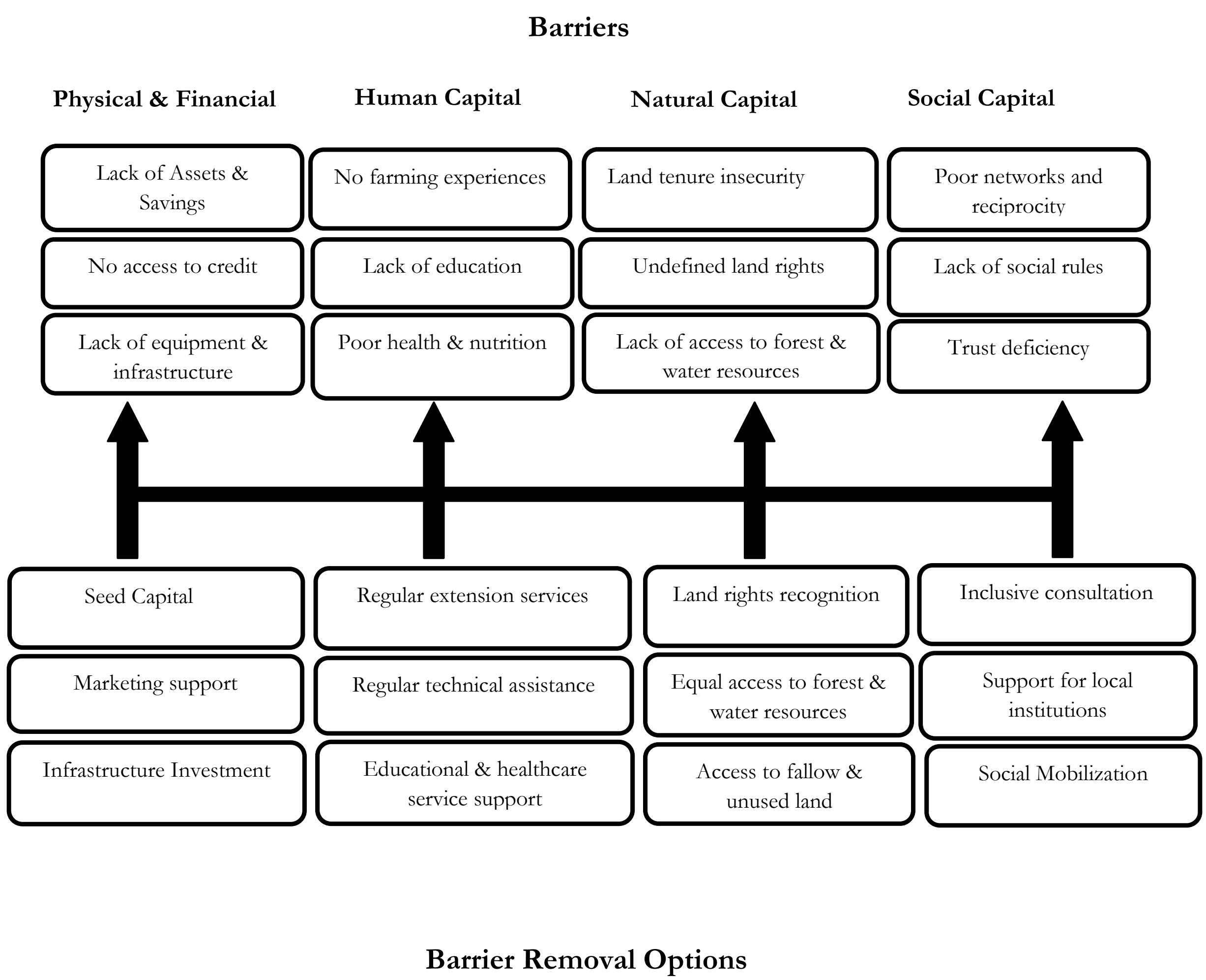
Bioenergy

Bioenergy, which includes bioethanol, biodiesel, and biomass, can affect net carbon emissions in two ways. First, it can displace fossil fuel energy consumption. For example, biofuel could displace a significant fraction of fossil fuel and reduce current GHG emissions by 9 to 24 percent in the United States. For instance, the impact of gasohol (a combination of gasoline and 10 percent ethanol) on air quality in São Paulo, Brazil has been an estimated 25 percent reduction in carbon monoxide. Second, the vegetation planted to produce fuel also acts as a carbon sink thereby offsetting global fossil fuel emissions through increased soil carbon sequestration.

Mitigation Barriers

Even though a significant mitigation potential exists in the agriculture sector, realizing this potential is not easy and may not be possible unless the existing social, economic, and institutional barriers are addressed. Figure 3 illustrates some of the important barriers and ways to overcome them. Household and community characteristics play a crucial role in influencing resource-poor smallholder farmers' decisions to participate in the proposed mitigation activities. Past payment for ecosystem services (PES) experiences clearly show that characteristics such as education, income, labor, skills and technical capacity, and access to credit to a large extent influence households' decisions to participate in such programs.

Figure 3. Factors affecting household and community participation in Agricultural Mitigation programs



Large scale participation of the poor will largely depend upon how well the programs are designed and to what extent they address household and community needs and capital asset differentials. This section identifies four of the most crucial barriers: (1) High start-up and transaction costs (2) Insufficient know-how (3) Land tenure insecurity (4) Lack of social cohesion & trust.

High Start-up and Transaction Costs

The potential benefits from agricultural mitigation projects have to be weighed against the transaction costs. For resource-poor farmers facing capital constraints, high transaction cost could mean little gains. For example, a study conducted by The and Ngoc (2006) to assess constraints and opportunities for adopting PES schemes in the forestry sector in three selected upland communities in central Vietnam reveals that the transaction cost of USD 20 per hectare/per annum of forest enrolled in the PES scheme was about twice as high as the amount they received for a hectare of forest under the PES scheme. High start-up and transaction costs associated with small-scale agricultural projects could, thus, make these projects unattractive to the resource-poor smallholder farmers, because they may end up not benefiting from the project at all.

One way of lowering the transaction costs is by issuing contracts to groups rather than individuals. But even when the transaction costs are spread out, some forms of mitigation from smallholder agriculture may still not be cost effective because of low returns. In such cases, public finance may have an important role to play if the actual mitigation potential from smallholder agriculture is to be realized. Often, in addition to transaction cost support, investment and infrastructure support may also be necessary.

Insufficient know-how

Many smallholder farmers in poor developing countries lack the requisite knowledge to participate effectively in agricultural mitigation projects. For example, in the Old Peanut Basin of Senegal, the large majority of smallholder farmers reported not knowing the composition of certain types of fertilizer and the nitrogen fixing capacity of plants such as groundnut, and not having seen extension agents for over 30 years (Tschakert, 2007).

Poor farmers' ability to actually benefit from the proposed projects will greatly depend upon the skills required to participate in carbon offset schemes. Programs should, thus, ensure regular extension services and technical assistance.

Land tenure insecurity

In many developing countries, the prospects of implementing carbon sequestration projects may actually turn out to be a lot more difficult than anticipated because of the pervasiveness of land tenure insecurity. Participating in these projects require a significant upfront investment for land-use modifications or improvements. In the absence of secure tenure, resource-poor farmers do not have enough incentives to make long-term investments.

A review of agroforestry adoption in Africa clearly illustrates that land tenure security has a positive effect on the adoption of improved management practices (Pattanayak et al., 2003). A study conducted in Ethiopia, Kenya, Tanzania, and Uganda shows a correlation between security of tenure and conservation measures (Stahl, 1993).

In the absence of secure land tenure, it is difficult for poor farmers to make credible commitments to supply carbon offsets. One of the ways to getting started in areas with complex land tenure problems is by working on common lands and sharing project benefits with the entire community. In such cases, as land does not belong to any specific individual or household, the entire community gains from these group payments.

Lack of Social Cohesion & Trust

Social capital is an important factor in the acquisition and distribution of benefits from agricultural mitigation projects. The extent to which smallholder farmers will benefit from projects will depend upon their capacity to organize themselves and act as pressure groups for collective action and also on how well they can bargain with carbon traders and the state structures that mediate or regulate carbon trading programs. Equitable distribution of the benefits can only be ensured when individuals or groups participating in the projects are responsible for collectively selecting technologies, developing land management plans, mobilizing farmers' participation, establishing contracts and monitoring compliance.

Lack of social cohesion and trust is one of the major barriers towards successful implementation of agricultural mitigation programs, especially in countries or regions with low social capital due to ethnic conflict and conflict over the management of common pool resources. Mitigation programs will need to invest in supporting existing local institutions or the creation of new ones.

Conclusions

Agricultural mitigation projects can provide significant benefits to the poor through livelihood diversification; however, projects must be tailored to suit the local socio-economic and institutional context. Not all communities are alike in terms of resource endowments and entitlements. Even within the same community, households may differ in access to land, control over resources, capital assets, and the availability of both formal and informal institutions. If these differences are not taken into consideration, programs may end up widening the poverty gap rather than bridging it.

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About the Social Dimensions of Climate Change:

Climate change may be the defining social justice issue of our generation. It brings into sharp relief a vision of a world that is highly polarized - between heavy greenhouse gas-emitting countries and resource-poor countries that will suffer the worst consequences. The rich countries of the world are predominantly responsible for climate change, while poor people in poor countries bear the brunt of its impacts.

Already putting at risk the lives, livelihoods, health and well-being of hundreds of millions of people worldwide, climate change impacts the very existence of the poorest and most vulnerable who lack the financial, technical, human and institutional resources to adapt. Such threats include increased water stress, food insecurity resulting from droughts, desertification, new health risks, and increasing frequency and severity of extreme weather events.

The Social Development Department of the World Bank is taking the lead to build a greater understanding of how climate change affects people's lives and communities around the world, especially in developing countries, and of what can be done to reduce their vulnerability and build climate resilience.