MAPS

Mitigation Action Plans & Scenarios

AGRICULTURAL EMISSIONS MITIGATION:

understanding modelling and policy implications

POLICY BRIEF // Agriculture

March 2013

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Key Message

- Agriculture is both a major contributor to greenhouse gas emissions and a potential sink for drawing carbon out of the atmosphere.
- It is important to determine which drivers of key emission sources need to be addressed. These drivers can be identified by assessing the influence of new technologies, population growth and economic growth on emissions.
- Many models exist that measure GHG emissions in the agriculture sector, but few have been specifically designed to assess mitigation actions within the sector.
- No single model can fully address the potential mitigation actions in the agriculture sector, but a combination of different models can be used to give more accurate guidance.
- Policy makers have a key role to play in helping to overcome barriers to implementation of the mitigation options generated by models. It is unlikely that implementation barriers will be overcome without significant policy incentives for mitigation in this sector.

Objective

This policy brief aims to communicate the methods used by researchers to model possible outcomes of different actions to curb GHG emissions associated with agriculture.

Introduction

Climate change has clear and obvious impacts on agricultural production. In turn, the agricultural sector also contributes to emissions. Agriculture contributes 50% of global methane (CH_4) emissions, 60% of global nitrous oxide (N_2O) emissions and is a net contributor of 10-12% of total anthropogenic greenhouse gas emissions (Smith et al., 2007). Indirect emissions in agriculture include the use of fossil fuels in farm operations, the production of agrochemicals and the conversion of land to agriculture (Bellarby et al, 2008).

Agricultural lands cover a significant area of the Earth's land surface. Land under agricultural production includes cropland, managed grasslands and permanent crops.

Agriculture under the UNFCCC

Despite the agriculture sector's importance in the generation of emissions, the sector has not received much attention in climate change negotiations in the past. It as however gained momentum since the United Nations Framework Convention on Climate Change's (UNFCCC) seventeenth Conference of the Parties (COP17) in Durban. This is probably due to more recognition of the sector's key role in reducing emissions. Agriculture is important for economies of many low- and middle-income countries and emissions in this sector are expected to rise in future as population, income levels, agricultural intensification and dietary preferences for meat and dairy increase in these countries (Wollenberg et al, 2012).

Mitigation in agriculture

A variety of potential emissions reduction options exist in agriculture (Smith et al., 2007). Although there is no universally applicable list of mitigation actions, countries could consider options for their agricultural sectors which:

- reduce emissions from methane and nitrous oxide,
- remove greenhouse gases from the atmosphere through carbon sequestration,
- avoid or displace emissions, e.g. by maintaining existing biomass or soil carbon, or increasing energy efficiency (Smith et al, 2007).

Proposed practices have to be evaluated against local agricultural systems taking regional properties, social settings, historical land use and management factors into account.

Globally, the agricultural sector has the potential to mitigate about 5,500 to 6,000 million tons (Mt) of carbon dioxide (CO_2). The United Nations Intergovernmental Panel on Climate Change's (IPCC) Fourth Assessment Report (IPCC, 2007) found that 89% of agriculture's mitigation potential lies in enhancing soil carbon sinks through cropland management, grazing land management, restoration of organic soils and degraded lands, bioenergy and water management.

Win-win solutions

Efforts to reduce agriculture's GHG emissions can contribute to economic development and environmental sustainability. They can complement socio-economic development policies and other dimensions of environmental quality improvement, particularly in the context of developing countries. Agricultural emissions reduction efforts such as reduced tillage, improved soil management, livestock management, and many others can:

- Improve agricultural productivity and assist with food security
- Improve water quality and conservation, soil quality, and air quality
- Conserve biodiversity, wildlife habitats and conservation of biomes
- Potentially reduce poverty (Wlokas et al 2012).

There are many different modelling approaches to evaluate the impacts of mitigation actions within the agricultural sector, as well as the socio-economic and environmental consequences of these actions. The outcomes of these modelling processes are needed to give relevant, evidence-based information to policy makers.

When policies integrate socio-economic, agricultural, and environmental implications they have a greater impact on reducing agriculture-linked emissions than when climate policies alone are used, since these focus only on emission reduction. Policy makers have an important role to play in creating policy incentives that will allow the barriers to implementation to be overcome.

Evaluating models

A number of modelling tools are available to researchers within the agricultural sector to evaluate emissions and mitigation action within the sector. These tools can:

- measure and quantify emissions generated by the sector,
- ascertain how effective certain emissions reduction efforts might be, and
- identify the possible economic implications of these emission reductions.

However, no single method can fully capture the complexity of emissions reduction actions that could be used across the board in the agriculture sector.

Decisions on which model to use depends on the model's simplicity, how accessible the input requirements are, the flexibility of the model to the national context and local data, how user-friendly it is, and its affordability.

In 2012 the MAPS Programme held an agriculture workshop - AgriLab in Bogota, Colombia. It looked at the different models available to researchers in Latin American countries that assess the impacts of mitigation actions in the agriculture sector. It was found that different models may be applicable for different national circumstances.

For more information, see the **MAPS AgriLab report**.

Modelling methodology

There are different steps in a mitigation analysis of agricultural emissions.

Step one: look at biophysical potentials, sometimes referred to as technical potentials. That is, given the current rate of emissions, how much emission reduction is possible with a change in practice without consideration of economic or social consequences.

Step two: consider the costs of emission reduction actions. There are costs associated with adopting new practices, and these costs can be represented in an economic model to predict returns from adopting the new action. This type of analysis will allow modellers to predict the anticipated adoption rates at different carbon prices.

Step three: build social aspects into the analysis process. Here one would represent the social preferences for set emission reduction practices and the likelihood of shifting to another practice given financial or policy incentives.

Important considerations

There are several important considerations to take into account when considering mitigation actions and the choice of models in the agricultural sector:

1. Mitigation actions may affect more than one greenhouse gas (GHG): The net benefit of mitigation opportunities depends on the overall effect on all major GHGs (including CH_4 and N_2O), therefore it is important to consider the impact of a mitigation option on all GHGs and not just CO_2.

2. Livestock and crop farming require different modelling and mitigation approaches: Mitigation actions for livestock emissions are different from those of crops. As a result, no single modelling framework for the sector can address mitigation actions in this sector. A combination of models might be used to gain a holistic picture.

3. Effectiveness of mitigation actions may change over time: The associated emission reduction may be achieved temporarily or indefinitely. This depends on the complex interaction of many variables.

4. There is interaction between mitigation and adaptation: Some of the mitigation actions have synergies with adaptation scenarios and the combined benefits from these linkages could be more than the sum of mitigation and adaptation benefits. Combined efforts and funding in this sector could prove to yield more benefits to address both mechanisms.

5. There is a lack of accurate data and country specific tools for reliable modelling: The data required for compiling GHG inventories is not the same as that required for cost-benefit analysis of mitigation options (AgriLab 2012). Countries must be aware that their locally collected data on climate, agriculture, natural resources and markets are required to develop meaningful and reliable models.

Conclusion

Most models that measure agriculture emissions and assess mitigation actions are from countries where agriculture is an important contributor to GHG emissions and to the country's socio-economic strength. These models are critical tools for developing GHG inventories and assessing options for reductions.

Accurate data is required for meaningful and reliable modelling. In turn, such models will provide more consistent data to estimate future local conditions with an increasing degree of accuracy.

About MAPS

Brazil, Colombia and Peru, together with Chile and South Africa, are part of the Mitigation Action Plans and Scenarios (MAPS) Programme; a collaboration amongst developing countries to establish the evidence base for the long term transition to robust, carbon efficient economies. Through its collaboration MAPS offers an opportunity to establish synergies and share lessons with participating developing countries as well as the wider climate-change and development community, using the in-country processes as 'living laboratories'. Central to MAPS is the facilitated interaction between key stakeholders and in-country research teams. The rigour of information generated by research and the involvement of stakeholders produces results that are credible, legitimate and relevant. These results provide a sound basis with which to answer key policy questions.

Policy recommendations:

- It is essential to consider a variety of models to understand the likely economic implications of different mitigation actions in the agriculture sector.
- The choice of model(s) should be based on its suitability to national circumstances.
- Mitigation actions will depend on the sources of emissions and the potential of those sources to undertake mitigation actions.
- Modelling methodologies depend on the impact that the mitigation action will have on socio-economic aspects of the agricultural sector and the country.
- Agriculture mitigation is gaining momentum in international negotiations and MAPS countries will also need to engage in increasing actions to mitigate GHG emissions in this sector.

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Further reading

- CGIAR – Climate change mitigation in agriculture – Pro-poor climate change mitigation - http://ccafs.cgiar.org/events/tag/theme-3-pro-poor-climate-change-mitigation
- FAO – Mitigation of Climate Change in Agriculture (MICCA) Programme http://www.fao.org/climatechange/micca/en/
- MAPS – Agriculture Lab – http://www.mapsprogramme.org/

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