Challenges and solutions for data on agricultural greenhouse gas emissions

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ABSTRACT

IPCC Guidelines provide the methodological guidance to countries for reporting their annual inventories of greenhouse gas emissions (GHG) and removals to the United Nations Framework Convention on Climate Change (UNFCCC). The methods contained in the IPCC Guidelines differ in their complexity ranging from the simplest Tier 1 method, based on globally or regionally applicable default parameters, through Tier 2 methods based on country specific data, to Tier 3 methods involving more detailed modelling and/or inventory based approaches. The IPCC category Agriculture, Forestry and Other Land Use (AFOLU) presents a unique challenge to the inventory-compilers, especially from developing countries, due to the lack of national data.

The Food and Agriculture Organization of the United Nations (FAO) has long maintained global datasets on agriculture and forestry that constitute an extremely valuable resource for compilation of inventories of greenhouse gas (GHG) for the AFOLU sector as noted in the IPCC Guidelines. However, these datasets cater to a wide range of information needs and may differ from the data required for GHG compilation in certain key respects. In addition, GHG-related data are needed by an ever-increasing stakeholder community for a number of purposes. Assessing the environmental impact of agricultural products through life-cycle assessments (LCA), for example, is becoming a key requirement in both the public and private sectors. To meet the new needs of stakeholders requires a broader set of data at a finer resolution.

This paper highlights these major challenges and provides some suggested solutions for filling the data gaps in the agricultural sector, as well as support for national inventory compilers and other stakeholders. It also outlines the additional benefits of improved estimates in GHG assessments for the agricultural sector.

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1. Background

IPCC Guidelines provide the methodological guidance to countries for reporting their annual inventories of greenhouse gas emissions and removals to the United Nations Framework Convention on Climate Change (UNFCCC). The methods contained in the IPCC Guidelines differ in their complexity ranging from the simplest Tier 1 method, based on globally or regionally applicable default parameters, through Tier 2 methods based on country specific data, to Tier 3 methods involving more detailed modelling and/or inventory based approaches. The IPCC category Agriculture, Forestry and Other Land Use (AFOLU) presents a unique challenge to the inventory-compilers, especially from developing countries, due to the lack of national data.

The Food and Agriculture Organization of the United Nations (FAO) has long maintained global datasets on agriculture and forestry that constitute an extremely valuable resource for compilation of inventories of greenhouse gas (GHG) for the AFOLU sector as noted in the IPCC Guidelines. However, these datasets cater to a wide range of information needs and may differ from the data required for GHG compilation in certain key respects. In addition, GHG-related data are needed by an ever-increasing stakeholder community for a number of purposes. Assessing the environmental impact of agricultural products through life-cycle assessments, for example, is becoming a key requirement in both the public and private sectors. To meet the new needs of stakeholders requires a broader set of data at a finer resolution.

This paper is based on the outcomes of two meetings: IPCC – FAO – IFAD Expert Meeting held in Rome, Italy, 20-22 October, 2009 (link 1) and FAO Expert Consultation on GHG emissions and mitigation potentials in the agriculture, forestry and fisheries sectors, Rome, 2-4 December, 2009 (link 2).

The first meeting identified data that is already available for data compilers to use in the preparation of national inventories and links to access the data with relevant metadata is provided in the report. The expert consultation focused on identifying major data gaps in estimating GHG emissions and calculating the mitigation potential of the agriculture, forestry and other land-use (AFOLU) sectors. Discussions focused primarily on: major data gaps, data collection and harmonization of processes, and the need for an international framework for terrestrial assessment and its development to meet the requirements of stakeholders

Link 1: http://foris.fao.org/static/data/nrc/IPCC-FAO_IFAD_Meetingreport20100423FINAL.pdf
Link 2: www.fao.org/climatechange/59239/en/

2. Data that is available

During the consultations a number of key international data sources for GHG were identified. Detailed references are provided in Annex 1. These key data sources include:

- Eurostat - Land Use/Cover Area frame statistical Survey - LUCAS Database;
- FAO – FAOSTAT – Agricultural Production, Land-use, Fertilizer consumption;
- FAO – Forest Resource Assessment and National Forest and Monitoring Assessment;
- FAO - World Reference Base for Soil Resources (WRB): Map of world soil resources and Harmonized World Soil Database;
- FAO - Global Climate Maps;

- FAO - Global Planted Forests Thematic Study;
- FAO/IIASA – Agro-ecological Soil Database;
- IPCC - Emission Factor Database;
- IPCC - 2006 IPCC Guidelines AFOLU and 2003 GPG LULUCF.

3. Data and Knowledge Gaps

Whilst major key data sources have been identified, there are still major data gaps and inconsistencies regarding requirements for countries for reporting their annual inventories of greenhouse gas emissions (GHG) and removals to the United Nations Framework Convention on Climate Change (UNFCCC). International agricultural statistics have traditionally focused on issues relating to agricultural production, agricultural trade and food security. FAO has statistical datasets from the 1960s which focus on agricultural production and trade (crops, livestock) in quantity and monetary terms. The statistical domains which are used to generate the key agricultural and food security indicators (such as production yields or the number of undernourished in a country) are well-established and have long time series of data for most countries. The FAO FAOSTAT database (http://faostat.fao.org/) was developed with this focus on agricultural production and food security and subsequently is structured to primarily suit these needs. Where there are key data gaps for producing indicators such as production yields or number of undernourished, considerable efforts are made to estimate data to ensure these key indicators can be calculated.

With the new and developing needs for broader agricultural-related data, especially related to the environment, a major review of content and structure of databases such FAOSTAT is required. For example the FAOSTAT database has the following main domains: Production, Trade, Food Supply, Supply Utilization Accounts and Food Balances, Food Security, Prices, Resources, Forestry, and Fisheries. Only within the Resources domain are there agri-environmental-related datasets (Land-use, Fertilizers, Pesticides and Water). There is not only a need to re-structure the domains and datasets in FAOSTAT so the data series can interact better, but also to re-focus them with a view to meeting current and future user needs. The Agricultural Production domain in FAOSTAT should not just focus on production and productivity-related dimensions and indicators such as yield or production indices, it should also be related to the agricultural inputs required for the production such as land, water, fertilizers, pesticides`, etc. FAOSTAT could be re-structured to provide more agri-environmental-related datasets and indicators, among other data currently unavailable in its present form.

During the IPCC – FAO – IFAD Expert meeting, the need to re-focus FAOSTAT was raised and subsequently illustrated in the following example (among others). The IPCC Agriculture, Forestry and Other Land Use (AFOLU) guidelines for data compilers has the item: "4.6.2 Harvested annual dry matter yield for different crops." Currently, most items in the FAOSTAT Production domain are reported in "fresh weight," i.e. direct from harvesting with no processing. In order to use the FAOSTAT data (which dates back to 1961), inventory compilers would first need to convert the FAOSTAT "fresh weight," data into the dry matter yield equivalent for the different crops. Updating FAOSTAT to actually provide the dry matter yield equivalent for the different crops would be a rather easy operation once the appropriate conversion factors are identified.

The current data collections in FAOSTAT are insufficient in meeting the needs of data compilers/reporters under the IPPC - AFOLU Guidelines. Efforts need to be made to collect more agri-environmental-focused data at national levels and consolidate the national statistical data in

internationally available statistical data collections such as FAOSTAT. Examples of specific data gaps are provided in section 5.

At the national level, many country statistics are not yet designed for collecting data on parameters relevant for GHGs (which should be undertaken in a continuous and systematic way). Assessments such as life-cycle analysis, which requires information at each stage and for each input of production systems, is even more difficult to gather. Many countries need additional capacity and guidance on gathering this type of data, and incentives to release it. Emission factors and carbon stock factors are often available but need further development and validation.

4. General Data Gaps

A number of general issues on the subject of data gaps were identified in the sessions and include:

- Data gaps are particularly large in developing countries. Around 110 countries regularly report agricultural production-data to FAO. The non-reporting countries are unlikely to be in a position to start reporting in the short-term. Considerable investment in staff and resources is needed to improve this situation;
- Data quality generally has not been systematically assessed. It is therefore difficult to evaluate the quality of data within some national datasets;
- A lot of the data required is in private hands (particularly for the processing phase). The issue of confidential (commercial) data is one which is becoming more pressing for FAO, particularly in regard to production of various agri-environmental inputs such as fertilizers and pesticides;
- Some data is too aggregated, some too site-specific (particular for the processing phase, where figures might be plant-specific) – the right balance between practicality and accuracy is required in order to identify good and bad practices and reward improvements;
- Guidance is needed to deal with data gaps (estimation procedures etc.). Clear and consistent data imputation procedures need to be established and implemented in the various agri-environmental data domains;
- Baseline emissions factors from different farming systems need to be established and better descriptions of agricultural land management practices and their emission impacts are needed.

5. Specific Data Gaps

The expert consultation also identified specific data gaps that should be addressed, including:

- Emissions factors for nitrous oxide have large potential consequences but appropriate factors are currently scientifically uncertain. Data on the level of nitrous oxide from dispersed manure in rangeland systems is particularly lacking;
- Ruminant digestibility is a key area in need of more data for life-cycle assessments (LCA);
- A more systematic assessment of technologies and practices needs to be made;
- Improved estimation of carbon stocks and fluxes in the agricultural sector are required, especially regarding soil carbon (for example soil depth measurements);

- Improved data is required for certain agro-ecological zones, production and cropping systems and soil dynamics, e.g. data is poor or missing for many tropical cropping systems and most grasslands, and many soil management responses are often poorly understood;
- A tree biomass database containing original tree biomass measurements and models would be very valuable.
- Improved data on agricultural inputs (such as fertilizers), management practices and processing are required.

6. Methodological issues

Discussions also identified some key methodological issues that would have to be addressed in developing the GHG assessment. Issues included:

- It is important to use existing IPCC methodology were possible, which would then be supplemented with additional methodologies and protocols;
- Agreement would be needed on the required special resolution (scale depends very much on the end uses) and frequency of the measurements required (which is very dependent on spatial variability, pilot sampling or the use of remote sensing and stratification);
- Geo-referenced data on cropping systems will be required. The usage of remote sensing for the detection and classification of land-use needs to be assessed;
- An agreed upon, improved system for accounting for the implicit land-use GHG costs of agricultural production with multiple uses (including food, fibre and energy);
- Determination of the choice of unit will be important. For example, emissions per unit of a single commodity will be different from emissions per unit of nutritive value (e.g. protein or calories) which might also be context-specific;
- For emissions from land-use change, an agreement will be needed upon how to handle emissions timing. Timing must be considered in two ways:
    - First, how to account for different times of actual physical emissions, for example, how to count relatively immediate land-use change emissions over time. To date, this aspect of timing is handled in one of three ways: counting all emissions instantaneously, using an amortization period, and using some form of discount rate;
    - Second, how to account for different residence times and radiative forcing of different GHGs, i.e. whether in LCA of a time-bound activity or policy measure, the atmospheric lifetimes of the different greenhouse gases are appropriately considered using the standard global warming potentials, which are calculated by amortizing the heating effects of the gases over 20, 100 (IPCC preference) or 500 years;[3]
- Guidance on the scale of application, which would vary with the type of emissions and activities or products considered;
- Guidance on the accounting of co-products from agricultural production;
- Guidance on the level of uncertainty acceptable for different mitigation uses (e.g. offsets, Nationally Appropriate Mitigation Actions - NAMAs) and for assessing this uncertainty;

[3] Further issues relating to time in GHG LCA are addressed in the draft ANSI standard "Life Cycle Stressor-Effects Assessment Greenhouse Gas Accounting Framework: http://www.scscertified.com/cas/docs/Draft-American-(ANSI)-GHG-Accounting-Standard.pdf

- Analysis calculating mitigation benefits should take account of the robustness of the practice in achieving the projected reduction, i.e. how dependent the reductions are on the details of the implementation. More robust practices should receive higher awards/incentives;
- Guidance on emission segregation (from unregulated emissions) that is otherwise subject to limitations.

7. Conclusions

The expert consultation meeting allowed the initialization of the development of a terrestrial framework mechanism to assess GHG emissions and mitigation potential from the agricultural and forestry sectors. FAO now has the task of coordinating the process of developing the assessment framework in close collaboration with other partners such as IPCC, UNFCCC, CGIAR, and UNEP (and other institutions such as universities, government agencies and the private sector).

A comprehensive appraisal is now being undertaken to assess the critical priority gaps that need to be filled, what inputs and costs are required and the country capacity building that needs to be undertaken at the national level. From this, a work programme will be developed which will focus on improvement of the data collection process, country capacity-building, development of country case study, the processing and analysis required in developing a global assessment. It is also being considered that part of the work should include development of a guidance document on how to apply LCA-type analyses for answering questions around GHG mitigation, adaptation and food security. The development of a database containing resources required for LCA type work (containing standardized data on production systems for raw materials, agro-ecological zones, land management practices, processing technologies, and other major elements of product lifecycles) is suggested. In addition, the assessment should support development of detailed technical guidance for potential appropriate national mitigation actions (NAMA). This was seen by some as an obvious priority for the FAO in establishing its support in developing countries to meet both food and climate objectives. The development of a data warehouse for FAOSTAT and other FAO databases is underway and will lead to easier integration and use of the agri-environmental data held in FAO.

8. Next steps

An international framework will be developed through the integration and expansion of existing assessments (such as the FAO Global Forest Resources Assessment) and will be based on IPCC principles and methods for AFOLU. The initiative will be developed in partnership with a number of key stakeholders including experts, universities, government institutions and the private sector. With these partners the following next steps will be taken:

- Define the scope of the assessment (objectives and results);
- Undertake an assessment of current sources of knowledge /data / practices to build an exact understanding of the current base from which the framework can be developed and identify the major uncertainties that are truly influential (i.e. propagate through estimation process) and which should be addressed;
- Detail a work programme on data collection process, country capacity building, development of country case studies and finally develop a global assessment;
- Survey a sample of countries for barriers and limitations to adopting or developing GHG emission databases and use this information to help devise a strategy to overcome the issues;
- Set up a mechanism for sharing information;

- Define immediate deliverables in short-term with long-term goals in perspective;
- Fast implementation of steps towards improving the data collection process;
- Capacity-building at country level;
- A country case study should be carried out and completed in 2010 as a first example. Eventually a global assessment using the IPCC Ter 1 method should be prepared allowing for extensive information to be available in 2012 (end of first Kyoto commitment period);
- FAO should focus on expansion of framework assessment to all countries and encourage capacity-building to allow independent access to reliable information and data;
- Review, restructure and re-focus FAOs FAOSTAT database to address the needs of agri-environmental data users.

Taking the above steps will lead to the building of capacity to meet national data needs as well as generating the data and information required to improve GHG emissions estimates for the agricultural sector.

Annex 1

Data sets for compilation of inventories of greenhouse gas for the AFOLU sector:

- Eurostat, *Land Use/Cover Area frame statistical Survey* (*LUCAS) Database* (http://www.lucas-europa.info)
- FAO, *Forest Resource Assessment* (FRA www.fao.org/forestry/fra)
- FAO, *National Forest and Monitoring Assessment* (NFMA www.fao.org/forestry/nfma/en/)
- FAO, *World Reference Base for Soil Resources: Map of world soil resources* (www.fao.org/AG/agL/agll/wrb/soilres.stm)
- FAO, *Harmonized World Soil Database* (www.iiasa.ac.at/Research/LUC/External-World-soil-database/HTML/index.html)
- FAO, *Global Climate Maps* (www.fao.org/nr/climpag/climate/index_en.asp).
- FAO, *Global Planted Forests Thematic Study* (http://www.fao.org/forestry/plantedforests/10368/en/)
- FAO, *FAOSTAT* (http://faostat.fao.org/default.aspx)
- FAO/IIASA, *Agro-ecological Soil database* (http://www.iiasa.ac.at/Research/LUC/External-World-soil-database/HTML/index.html)
- IPCC, *Emission Factor Data Base* (http://www.ipcc-nggip.iges.or.jp/EFDB/main.php)
- IPCC, *2006 IPCC Guidelines AFOLU and 2003 GPG LULUCF* (www.ipcc-nggip.iges.or.jp)

Annex 2

References:

FAO, *Datasets on agriculture, land use and forestry for use together with the IPCC Guidelines*, IPCC – FAO – IFAD Expert Meeting held in Rome, Italy, 20-22 October, 2009.

FAO, *FAOSTAT* (http://faostat.fao.org/default.aspx), FAO, Rome, 2010.

FAO, *GHG emissions and mitigation potentials in the agriculture, forestry and fisheries sectors*, FAO Expert Consultation on Rome, 2-4 December 2009.

Intergovernmental panel on Climate Change (IPCC), *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html)