Reducing the costs of GHG estimates in agriculture to inform low emissions development

Report from an International Workshop

Held at the Food and Agriculture Organization of the United Nations, Rome, Italy
10-12 November 2014

Purpose:

To develop rigorous low cost data and methods that will effectively enable planning, monitoring and evaluating climate change mitigation in agriculture at the national and sub-national levels

Objectives:

- Review available methods and data and set an agenda for developing rigorous and low cost estimates of GHG emissions to effectively design interventions and monitor and evaluate climate change mitigation in agriculture.
- Support use of lower cost methods by linking national needs to recent innovations among practitioners and scientists.

Summary

Sixty practitioners, policy makers and scientists reviewed and shared knowledge on the available robust and low-cost methods and data for GHG emission estimation in agriculture in a CCAFS/FAO workshop in Rome, October 2014. The participants emphasized that iterative interaction between data collection, data quality assurance and modelling is needed as well as protocol development for GHG estimation in agriculture. Emission factor development is also key, including in regional, national and sub-national levels. Easily accessible platforms where to store data and models would enhance sharing and better coordination. The country level coordination is also important in order to harmonize data collection practices, tools and methods. As countries are at different level in terms of GHG inventories and access to data, capacity need assessment will help providing right type, targeted support for capacity development. It is also important to ensure the policy level awareness raising, engagement and commitment. Linking adaptation and mitigation will reduce data needs and provide incentives for action. New tools for estimation are being developed, including remote sensing and crowd-sourcing, modeling and utilizing the national surveys and agriculture censuses that can help reduce data costs.

Background

The agricultural sector is facing the challenge of achieving food security goals and adapting to climate change while also reducing global greenhouse gas emissions. Addressing mitigation in the agriculture sector will become increasingly important due to the scale of global emissions from agriculture and increases in population growth, consumption of meat and dairy products, and use of nitrogen fertilizers.

Demand for improved emissions data is growing across the globe with the new UNFCCC requirement for Biennial Update Reports (BURs) and the need to verify emission reductions associated with Nationally Appropriate Mitigation Actions (NAMAs). Also the private sector is interested in emissions, not least for branding and labeling the products. Yet planning, monitoring or evaluating agricultural mitigation has been limited by many factors, among which by the need for methods for GHG estimations in agriculture that are both precise, meaning scientifically adequate and comparable, location and practice specific for a given purpose, and low cost, allowing for their application at large scales, by non-scientists and adapted to the context of developing countries. Agriculture planners have also lacked the information about the methods that are available. This workshop sought to address these limitations by bringing practitioners, policy makers and scientists together, with a focus on how to meet the needs of developing counties.

This workshop built on a series of previous workshops organized by CCAFS and FAO/MICCA. See: http://ccafs.cgiar.org/quantification-data-unveils-opportunities-low-emissions-agricultural-development and http://www.fao.org/climatechange/micca/87844/en/

Key messages from the workshop

Challenges to estimating and monitoring emissions

Collecting data on farm activities, making measurements to establish emission factors, and establishing national systems for compiling and analyzing data are expensive, and uncertainties in current data remain high. In response, country representatives identified several key challenges to agricultural greenhouse gas accounting in developing countries.

Poor or insufficient data on agricultural activities: Countries need multiple kinds of data in order to estimate emissions, but these are often not available. For example, agricultural ministries may have national statistics on fertilizer imports and exports, but little data on crop-specific fertilizer use and area under each crop—necessary pieces of information for estimating emissions from fertilizer use.

Lack of emission factors: Emission factors are values that are used to relate a greenhouse gas-generating activity (such as cattle production) with the quantity of a greenhouse gas released into the atmosphere. Such values are specific to particular environments and management systems, and they are often unavailable for developing country conditions. As the emission factors in the IPCC database are mostly based on commercial systems in developed countries, up-dates and totally new emission factors are needed. The relationship between activities and emissions can also be quantified using complex models, but both approaches require numerous field measurements to calculate emission factors or calibrate and validate models. There is particular scarcity of data on livestock systems.

Access to data and coordination: Generally, multiple institutions within a country collect information on agricultural activities, each for their own use. Often, data are not shared between different government units. When they are, data may be in forms that are not compatible, or different ministries may collect the same information but come up with conflicting statistics.

Suggested actions for reducing costs of GHG estimates

Workshop participants developed action points for reducing the cost of greenhouse gas emission estimates in different agriculture sectors.

Incorporate climate-relevant data into agricultural censuses and surveys: Integrating GHG-relevant information into agricultural censuses is an efficient way to collect such data. This may become standard in 2020 census rounds, as FAO has just developed a new module for GHG-relevant data within the World Census of Agriculture. Such data can also be included in other national surveys; e.g. Malawi's National Statistics Office has incorporated questions on land management into its Integrated Household Survey.

Outsource data collection to the crowd: New applications such as Geo-Wiki ask people to interpret visual images in order to improve land cover data. With the spread of texting and smartphone technology in developing countries, such "citizen science" approaches have big potential. Other applications such as Collect Earth developed by FAO combine freely available visual data from NASA and USGS with cloud-based processing services like Google Earth Engine to allow desk-based data collection by in-country experts.

Integrate measurements and modeling: Models are key to estimating emissions without the need for direct measurement, but models need to be validated and calibrated to local conditions. Researchers undertaking measurements could collect auxiliary data such as rainfall, temperature, and crop performance to support models. When these data are known, it is possible to use models to extrapolate measurement data to other sites with similar climatic and management characteristics, thus reducing measurement needs. Models can be used to identify areas of greatest uncertainty in order to prioritize measurements. Continuous interaction between modelers and scientists doing measurements is key.

Target measurements to maximize usefulness: In addition to prioritizing based on areas of greatest uncertainty, targeting key farming systems and practices and using statistical sampling to efficiently capture information can reduce data needs. For example, researchers in Costa Rica developed 17 clusters of livestock systems according to agro-ecological zones and animal management. These clusters explained most of the variability in emissions, so they were able to develop emission factors for these clusters, and not spend money on unnecessary measurements. This approach also reduced the uncertainty of estimates, because for each cluster they could describe in better detail the feeding and management of the animals.

Improve use of global databases for emissions: It was suggested that an expert group could support data synthesis and modeling from existing literature. This would generate much-needed additional emissions factors for more locations and management practices. Further, people conducting measurements and calibrating models should make concerted efforts to share their information in platforms such as the Emissions Factor Data Base

([EFDB](#)) and Global Research Alliance Modeling Platform ([GRAMP](#)) so it can be used at national, sub-national and international levels.

Build the right capacities: "We always just say 'we need more capacity'! But we need the right capacity," several workshop participants emphasized. Developing countries need not only training, but also long-term mentoring and follow-up. Capacity and strengthening of institutions are needed e.g. locally for field data collection, and nationally for identifying and using relevant tools, analyzing and interpreting data, and modeling.

Link adaptation and mitigation to motivate action: Participants repeatedly emphasized that there are complementarities between adaptation- and mitigation-related information. Emphasizing adaptation benefits of mitigation options increases buy in. Explicitly linking the two can both reduce data needs and provide incentives for action.

Do not let lack of data get in the way of action: Even though there is limited data, perfect data must not get in the way of good data and there is the need to move forward, with targeted increments of improvement, such as synthesis of data and improving certainty windows around emissions of key agriculture practices.

Better coordination between decision makers, farmers, supporting organizations and all other stakeholders in order to improve communication of science findings. An inventory of success stories of emission estimations would enhance up-scaling. Nevertheless, sharing failures and null results is important too!

Workshop Agenda and presentations

DAY 1: Monday, 10 November 2014

Time	Subject	Presenters
08:30-09:00	**Arrival and Registration**	
09:00-09:30	**Welcome and Objectives**	Kaisa Karttunen, FAO Constance Neely, FAO Lini Wollenberg, CCAFS
09:30-10:30	**Opening Panel: Challenges for agricultural GHG quantification** *Experts from national ministries described the purpose, needs and challenges related to estimating GHG emissions from agriculture in their countries.*	
	Challenges for agricultural greenhouse gas quantification *http://www.slideshare.net/cgiarclimate/agus-challenges-for-agric-ghg-quant-nov-10-2014*	Fahmuddin Agus, Indonesian Soil Research Institute
	GHG emission in agriculture in Vietnam *http://www.slideshare.net/cgiarclimate/van-trinh-ghg-emission-in-agric-vietnam-nov-10-2014*	Mai van Trinh, Institute for Agricultural Environment, Vietnam
	GHG estimations for agriculture in Kenya *http://www.slideshare.net/cgiarclimate/okumu-ghg-estimation-for-agric-kenya-nov-10-2014*	Michael Okumu, Ministry of Agriculture, Livestock and Fisheries, Kenya
	GHG inventory in Zambia *http://www.slideshare.net/cgiarclimate/phiri-ghg-inventory-in-zambia-nov-10-2014*	Michael Phiri, Zambia Environmental Management Agency
11:00-11:45	**Plenary session: Emissions data guidelines of UNFCCC and climate finance mechanisms** *Presenters reviewed the types and precision of data required for MRV of climate investment projects and for national reporting to UNFCCC.*	
	UNFCCC inventory reporting needs, collecting data and using this information to inform nationally appropriate mitigation actions (NAMAs) and low-emissions development strategies (LEDS) *http://www.slideshare.net/cgiarclimate/ogle-unfcc-inventory-reporting-needs-nov-10-2014*	Stephen Ogle, Colorado State University
	GHG accounting methods and requirements for Global Environment Facility projects *http://www.slideshare.net/cgiarclimate/apel-gef-ghg-accounting-methods-requirements-nov-10-2014*	Ulrich Apel, Global Environment Facility
	Clean Development Mechanism methodologies for the agriculture sector http://www.slideshare.net/cgiarclimate/suzuki-cdm-methodologies-for-agriculture-nov-10-2014	Kenjiro Suzuki, UN Climate Change Secretariat
11:45-15:30	**Working group session A: Innovations that decrease the costs of collecting biophysical and activity data**	
Session 1	**Refining estimates with national survey data. The example of the Malawi Integrated Household Survey** *http://www.slideshare.net/cgiarclimate/phiri-refining-ghg-estimates-using-national-household-survey-data-nov-10-2014*	George Phiri, FAO Malawi Office
Session 2	**Collect Earth: multi-purpose land monitoring** *http://www.slideshare.net/cgiarclimate/diaz-collect-earth-nov-10-2014*	Alfonso Sánchez-Paus Díaz, FAO
Session 3	**Using new soil data products for GHG estimation** *http://www.slideshare.net/cgiarclimate/nachtergaele-available-soil-databases-nov-10-2014*	Freddy Nachtergaele, FAO
Session 4	**Informed sampling for testing mitigation options to reduce costs** *http://www.slideshare.net/cgiarclimate/rufino-informed-sampling-for-targeting-mitigation-nov-10-2014*	Mariana Rufino, Center for International Forestry Research
Session 5	**Potential for crowdsourcing and using mobile phone technology: Geo-Wiki** *http://www.slideshare.net/cgiarclimate/see-potential-for-crowdsourcing-and-mobile-phones-nov-10-2014*	Linda See, International Institute for Applied Systems Analysis
Session 6	**Approaches to activity data collection in livestock systems** *http://www.slideshare.net/cgiarclimate/charmley-activity-data-collection-livestock-systems-nov-10-2014*	Ed Charmley, Commonwealth Scientific and Industrial Research Organisation
16:00-17:00	**Reporting back from working group A**	

DAY 2: Tuesday, 11 November 2014

Time	Subject	Presenters
9:00 – 10:00	**Plenary session: FAOSTAT emissions database: available data and major gaps** *http://www.slideshare.net/cgiarclimate/tubiello-faostat-available-data-and-major-gaps-nov-11-2014*	Francesco Tubiello, FAO
10:00-11:00	**Presentations in plenary: Methods for low-cost field measurement**	
	Soil carbon stocks and changes: Land Degradation Surveillance Framework *http://www.slideshare.net/cgiarclimate/lang-soil-carbon-land-degradation-surveillance-framework*	Vince Lang, Szent Istvan University
	Quantifying greenhouse gas emissions from managed and natural soils *http://www.slideshare.net/cgiarclimate/butterbach-bahl-quantifiying-ghg-emissions-from-soils-chamber-method-nov-11-2014*	Klaus Butterbach-Bahl, International Livestock Research Institute
	Developing country-specific emission factors for livestock systems in Colombia *http://www.slideshare.net/cgiarclimate/cardenas-emissions-factors-livestock-systems-colombia-nov-11-2014*	Edgar Cardenas, Universidad Nacional de Colombia
11:30-12:30	**Working group session B: Filling the gaps in emission factors and carbon stock change estimates**	
Session 1	Enteric Fermentation	Carolyn Opio, FAO
Session 2	Soil and manure emissions	Klaus Butterbach-Bahl, International Livestock Research Institute
Session 3	Soil and aboveground carbon	Stephen Ogle, Colorado State University
13:30-14:00	**Reporting from working group session B**	
14:00-15:00	**Plenary discussion: Interaction of measurements and modeling** Models are critical for up-scaling emissions measurements. This session addressed how to harmonize the needs of modeling and field measurement in order to improve the predicting capabilities of models and reduce measurement needs.	William Salas, Applied Geosolutions Klaus Butterbach-Bahl, International Livestock Research Institute
15:30-17:00	**Working sessions: Developing country action plans for improving GHG estimation** Participants gathered in regional clusters to develop action plans for improving greenhouse gas estimation from agriculture	

DAY 3: Wednesday, 12 November 2014

Time	Subject	Presenters
9:00 – 10:30	**Tool bazaar** During this session, participants exchanged knowledge about tools and calculators for GHG estimation.	
Station 1	**Global Livestock Environmental Assessment Model – GLEAM** *http://www.slideshare.net/cgiarclimate/opio-global-livestock-enviro-assess-model-gleam-nov-12-2014*	Carolyn Opio, FAO
Station 2	**CCAFS-MOT: a decision support tool for geographic optimisation of agricultural mitigation options** *http://www.slideshare.net/cgiarclimate/feliciano-tool-for-geographic-optimization-mitigation-options-nov-12-2014*	Diana Feliciano, Jon Hillier, Sylvia Vetter, University of Aberdeen
Station 3	**Ex-Ante Carbon-balance tool introduction and training** http://www.slideshare.net/cgiarclimate/bockel-ex-act-intro-nov-12-2014 http://www.slideshare.net/cgiarclimate/bockel-ex-act-training-nov-12-2014-41713457	Louis Bockel, FAO
11:00-12:00	**Closing plenary: Action points needed for reducing the cost of GHG estimates in agriculture**	

Participants

Surname	First Name	Position	Institution
Agus	Fahmuddin	Soil Scientist	Indonesian Soil Research Institute
Ahuja	Richie	Regional Director, Asia	Environmental Defense Fund
Apel	Ulrich	Senior Environmental Specialist	Global Environment Facility (GEF)
Avagyan	Armine	FAO Consultant	FAO/MICCA
Bockel	Louis	Policy Officer	FAO/Agriculture Development Economics
Brotz	Johannes	FAO Consultant	FAO/UN-REDD
Butterbach-Bahl	Klaus	Greenhouse Gas Mitigation Scientist	International Livestock Research Institute (ILRI), Kenya
Cardenas	Edgar	Associate Professor, Project Leader	Universidad Nacional de Colombia
Chacon	Mauricio	National Manager, Livestock NAMA	Ministry of Agriculture and Livestock, Costa Rica
Charmley	Ed	Research Program Leader, Livestock	Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia
Ching	Carolyn	AFOLU Manager	Verified Carbon Standard
Chirinda	Ngoni	Scientist, Soils and Climate Change	International Center for Tropical Agriculture (CIAT), Colombia
Cortes	César	Liaison with the Ministry of Environment for LEDS in the agricultural sector	Ministry of Agriculture, Colombia
Crete	Philippe	Forestry Officer	FAO/UN-REDD
Cuong	Vu Chi	Deputy Director	National Institute of Animal Science, Hanoi, Vietnam
Federici	Sandro	FAO Consultant	FAO/MICCA
Feliciano	Diana	Research Fellow	University of Aberdeen, Scotland
Fox	Julian	Forestry Officer	FAO/UN-REDD
Franzluebbers	Alan	Plant Science, Research Ecologist	United States Department of Agriculture (USDA), US Representative to Global Research Alliance for Agricultural Greenhouse Gases (GRA)
Garcia	Claudia	FAO Consultant	FAO/MICCA
Gerber	Pierre	Livestock Policy Officer	FAO/Agriculture Department
Gordon	Alashya	Climate Change Officer	FAO/Climate, Energy and Tenure
Grewer	Uwe	FAO Consultant	FAO/Agriculture Development Economics
Hillier	Jon	Research Fellow	University of Aberdeen, Scotland
Karttunen	Kaisa	Senior Natural Resources Officer	FAO/MICCA
Kritee	Kritee	Senior Scientist, International Climate	Environmental Defense Fund
Lang	Vince	Research Scientist	Szent Istvan University, Hungary
Mondal	Raisul Alam	Director General	Department of Environment, Bangladesh
Mutuma	Evans	PhD Student	University of Hungary
Nachtergaele	Freddy	Project leader, FAO Soils unit	FAO/Land and water
Neef	Till	FAO Consultant	FAO/MICCA
Neely	Constance	Facilitator	FAO/MICCA
Nemitz	Dirk	Associate Programme Officer	United Nations Climate Change Secretariat
Nuutinen	Maria	Climate Change Officer	FAO/MICCA
Ogle	Stephen	Research Scientist, Associate Professor	Colorado State University, USA
Okumu	Michael	Climate Change Unit	Ministry of Agriculture, Livestock and Fisheries, Kenya
Opio	Carolyn	Natural Resources Officer	FAO/MICCA

Paredes	Sara	Leader, Greenhouse Gas Measurement	Ministry of Agriculture and Irrigation, Peru
Pathak	Himanshu	Professor, Principal Scientist, Center for Environment Science and Climate Resilience	Indian Agriculture Research Institute (IARI)
Phiri	Michael	M&E Specialist	Zambia Environmental Management Agency
Phiri	George	EPIC Project Coordinator	FAO Office, Malawi
Richards	Meryl	Science Officer, Low Emissions Agricultural Development	CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)
Rioux	Janie	Natural Resources Officer	FAO/MICCA
Rosenstock	Todd	Agricultural Economist	World Agroforestry Centre (ICRAF)
Rufino	Mariana	Senior Scientist, Forest and Environment	Center for International Forestry Research (CIFOR), Kenya
Ruizvillar	Maria	Programme Officer	FAO/Forest Department
Salas	William	President and Chief Scientist	Applied Geosolutions, USA
Sánchez-Paus Díaz	Alfonso	Forestry Officer	FAO/Forest Department
Sander	Ole	Climate Change Research Scientist	International Rice Research Institute (IRRI), Philippines
Sanz Sanchez	Maria	Programme Coordinator	FAO/UN-REDD
Sapkota	Tek	Mitigation Agronomist	International Maize and Wheat Improvement Center (CIMMYT), India
See	Linda	Research Scholar, Ecosystems Services and Management	International Institute for Applied Systems Analysis (IIASA), Austria
Stirling	Clare	Senior Scientist, Global Conservation Agriculture Program	International Maize and Wheat Improvement Center (CIMMYT)
Suzuki	Kenjiro	Programme Office, Sustainable Development Mechanism Programme	United Nations Climate Change Secretariat
Tubiello	Francesco	Natural Resources Officer	FAO/MICCA
van Trinh	Mai	Deputy Director General	Ministry of Agriculture and Rural Development, Vietnam
Vetter	Sylvie	Research Fellow	University of Aberdeen, Scotland
Wollenberg	Lini	Flagship Leader, Low Emissions Agricultual Development	CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)

Evaluation of workshop by participants

Participants responded positively to the end result of the workshop stating the workshop had met their expectations. The workshop overall was rated highly (mostly 4´s and 5´s).

The most important take away from the workshop has been the realization that knowledge on greenhouse gas assessments has advanced, however there is still room for scientists to better connect their research to the needs of the countries.. It was also highly recommended to link mitigation and adaptation, especially in developing countries.

Participants felt there was a great amount of knowledge present in the workshop and this gave them the opportunity to network and find opportunities for collaborations between researchers, governments and practitioners.

Overall, some participants mentioned the length of the workshop saying it was too short, as it seems there was very little time for modeling exercises and more tools to be discussed. Several participants felt also the missing element to the workshop was the lack of presence from experts working in adaptation.