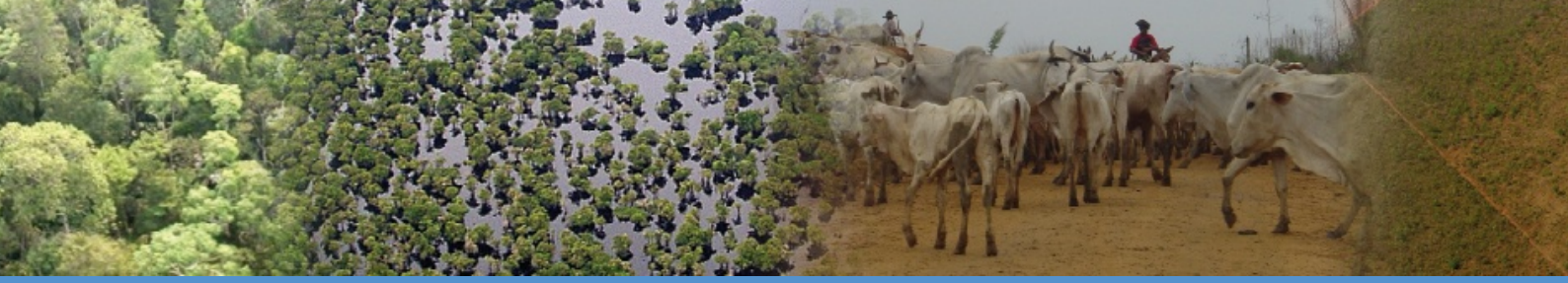

Emerging activities to combat climate change – use of FAO data and IPCC GHG Inventory Guidelines for Agriculture and Land Use

Report of Joint FAO-IPCC-IFAD Expert Meeting

13-14 November 2014, Rome, ITALY

Task Force on National Greenhouse Gas Inventories

Food and Agriculture Organization of the United Nations

IFAD
Investing in rural people

ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

Emerging activities to combat climate change – use of FAO data and IPCC GHG Inventory Guidelines for Agriculture and Land Use

Report of Joint FAO-IPCC-IFAD Expert Meeting on Emerging activities to combat climate change – use of FAO data and IPCC GHG Inventory Guidelines for Agriculture and Land Use

Rome, Italy

13 – 14 November 2014

Supporting material prepared for consideration by the Intergovernmental Panel on Climate Change (IPCC). This supporting material has not been subject to formal IPCC review processes.

This Expert Meeting on Emerging activities to combat climate change – use of FAO data and IPCC GHG Inventory Guidelines for Agriculture and Land Use was jointly organized by the Food and Agriculture Organization of the United Nations (FAO), the IPCC and International Fund for Agriculture Development (IFAD).

IPCC co-sponsorship does not imply IPCC endorsement or approval of these proceedings or any recommendations or conclusions contained herein. Neither the papers presented at the Expert Meeting nor the report of its proceedings have been subjected to formal IPCC review.

FAO and IFAD co-sponsorship does not imply FAO and IFAD endorsement or approval of these proceedings or any recommendations or conclusions contained herein.

This meeting report was prepared jointly by the organizers from FAO (Dr. Francesco N.Tubiello and Dr. Till Neeff) and the Technical Support Unit for the IPCC Task Force on National Greenhouse Gas Inventories (Mr. Kiyoto Tanabe, Dr. Baasansuren Jamsranjav and Ms. Maya Fukuda), and subjected to review by the meeting participants.

Published by IGES, Hayama, Japan on behalf of the IPCC

Please cite as:
IPCC, FAO, IFAD (2015). *Emerging activities to combat climate change – use of FAO data and IPCC GHG Inventory Guidelines for Agriculture and Land Use*. Eds: Tubiello, F.N., Neeff, T., Tanabe, K., Baasansuren, J. and Fukuda, M. Report of the joint FAO-IPCC-IFAD Expert Meeting, Pub. IGES, Japan.

IPCC Task Force on National Greenhouse Gas Inventories (TFI)
Technical Support Unit
% Institute for Global Environmental Strategies
2108 -11, Kamiyamaguchi
Hayama, Kanagawa
JAPAN, 240-0115
E-mail: nggip-tsu@iges.or.jp
Fax: +81-46-855-3808
http://www.ipcc-nggip.iges.or.jp
Printed in Japan

ISBN 978-4-88788-188-4

Foreword

The Task Force on National Greenhouse Gas Inventories (TFI) of Intergovernmental Panel on Climate Change (IPCC) has, as part of its mandate, the objective of encouraging users to adopt the IPCC methodological guidelines for estimating national inventories of greenhouse gases. This report is one of a series, developed though expert meetings, which aims to assist users of the guidelines by addressing specific problem areas.

The Expert Meeting on Emerging Activities to Combat Climate Change – Use of FAO Data and IPCC GHG Inventory Guidelines for Agriculture and Land Use was held at the Headquarters of Food and Agriculture Organization of the United Nations (FAO) in Rome, Italy, on 13-14 November 2014. It was jointly organized by the IPCC, FAO and the International Fund for Agricultural Development (IFAD).

This meeting aimed to consider how the information on access and use of the FAO datasets in Agriculture, Forestry, and other Land Use (AFOLU) GHG inventories could be continuously updated and made available to inventory compilers in an efficient and user-friendly way. The outcome of this meeting is expected to help inventory compilers collect data for use in their national GHG inventories. In this context, this meeting was considered as 10th Expert Meeting on Data for the IPCC Emission Factor Database (EFDB) under the IPCC TFI.

The meeting also aimed to identify needs for data and guidance in support of monitoring, reporting and verification of emerging activities in the agriculture and land use sectors, aimed at combating climate change in coming decades.

The Co-chairs of the Task Force Bureau would like to thank all those involved in this meeting, in particular FAO, and IFAD for enabling the expert meeting to take place and all the expert participants of the meeting without whom this report would not be possible.

Thelma Krug

Co-Chair Task Force Bureau

Taka Hiraishi

Co-Chair Task Force Bureau

Acknowledgements

The Expert Meeting on Emerging Activities to Combat Climate Change – Use of FAO Data and IPCC GHG Inventory Guidelines for Agriculture and Land Use was a joint effort of Task Force on National Greenhouse Gas Inventories (TFI) of Inter-governmental Panel on Climate Change (IPCC), Food and Agriculture Organization of the United Nations (FAO) and International Fund for Agriculture Development (IFAD). The organisers would like to thank all these bodies for their support and co-operation. Thanks are also due to the experts from many countries, FAO and IFAD who took part in the meeting deliberations and helped in the preparation of the meeting report. The organizers acknowledge support by the Governments of Norway and Germany to the workshop through the Monitoring and Assessment of GHG Emissions in Agriculture Project (MAGHG) and its Team: Francesco N. Tubiello, Till Neeff, Sandro Federici, Mirella Salvatore, Rocio Condor-Golec, Esther Mertens, Paolo Prosperi, Alessandro Ferrara, Alessandro Flammini, Paulina Prasula, Heather Jacobs, Riccardo Biancalani, and Paola Cardenas.

Executive summary

Background on expert exchanges about the use of FAO data for national GHG inventories since 2009

In 2009, a joint *IPCC-FAO-IFAD Expert Meeting on Activity Data for LULUCF/AFOLU* identified data gaps and possible solutions aimed at improving the use of FAO datasets for AFOLU national greenhouse gas (GHG) inventories. A meeting report was produced that summarises *Datasets for use in the IPCC Guidelines* available at FAO.

FAO data has been significantly enhanced since the 2009 Expert Meeting. In response to its recommendations, the Governments of Germany and Norway funded FAO via the *Monitoring and Assessment of GHG Emissions and Mitigation Potential Project (MAGHG)* that developed the FAOSTAT Emissions Database, launched in 2012. It contains a global set of tier 1 emission estimates for the agriculture and land use domains, with coverage from 1961-2012 (agriculture) and 1990-2012 (land use) and projections to 2030 and 2050.

In 2014 IPCC, FAO and IFAD jointly organized a follow-up event, the *Expert Meeting on Emerging Activities to Combat Climate Change – Use of FAO Data and IPCC GHG Inventory Guidelines for Agriculture and Land Use*. It served both as a reflection of progress made since 2009 and as an opportunity to build on lessons learned and address emerging needs for improved statistics for national GHG inventories, mitigation, and adaptation and food security. It was attended by 93 participants from 26 countries, including several authors of IPCC GHG Inventory Guidelines, the Co-chairs and the Technical Support Unit of the IPCC Task Force on National Greenhouse Gas Inventories (TFI), experts from FAO, IFAD and UNFCCC, and other AFOLU experts.

The 2014 Expert Meeting had the *objective to discuss the use of FAO data and IPCC GHG Inventory Guidelines for AFOLU with a view on emerging activities to combat climate change*. Specifically, this involved discussing:

- How FAO datasets can help in inventory compilation using the IPCC GHG Inventory Guidelines by providing activity data, emission factors and other parameters and facilitating quality assurance, quality control and verification;
- How the information on international, predominately FAO, datasets could be continuously updated and made available to relevant user-groups for estimating emissions and removals of GHG from the AFOLU sector;
- How the FAO datasets and IPCC GHG Inventory Guidelines could potentially be used for other purposes such as mitigation analysis for agriculture and land use at national and project scale;
- How to effectively develop required capacities to use FAO datasets and IPCC GHG Inventory Guidelines.

This report summarises the discussions and results of the 2014 Expert Meeting. This includes an update to the 2009 publication about datasets for use in the IPCC Guidelines.

The FAO datasets and tools and how they can be used with IPCC GHG Inventory Guidelines

Data collection, storage and analysis is a key function of FAO. FAOSTAT is FAO's corporate data repository. It contains data reported by annual surveys next to dedicated data collection initiatives on areas of particular interest. With its member countries FAO has a range of such data collection initiatives of relevance for GHG inventory compilers. These include the Global Forest Resource Assessment, the GlobAllmeTree and the World Census of Agriculture 2020. There are also various initiatives ongoing at FAO to provide countries with tools that are useful to GHG inventory compilers. Such tools included the OpenForis, the Global Livestock Environmental Accounting Model and the Land Cover Classification System.

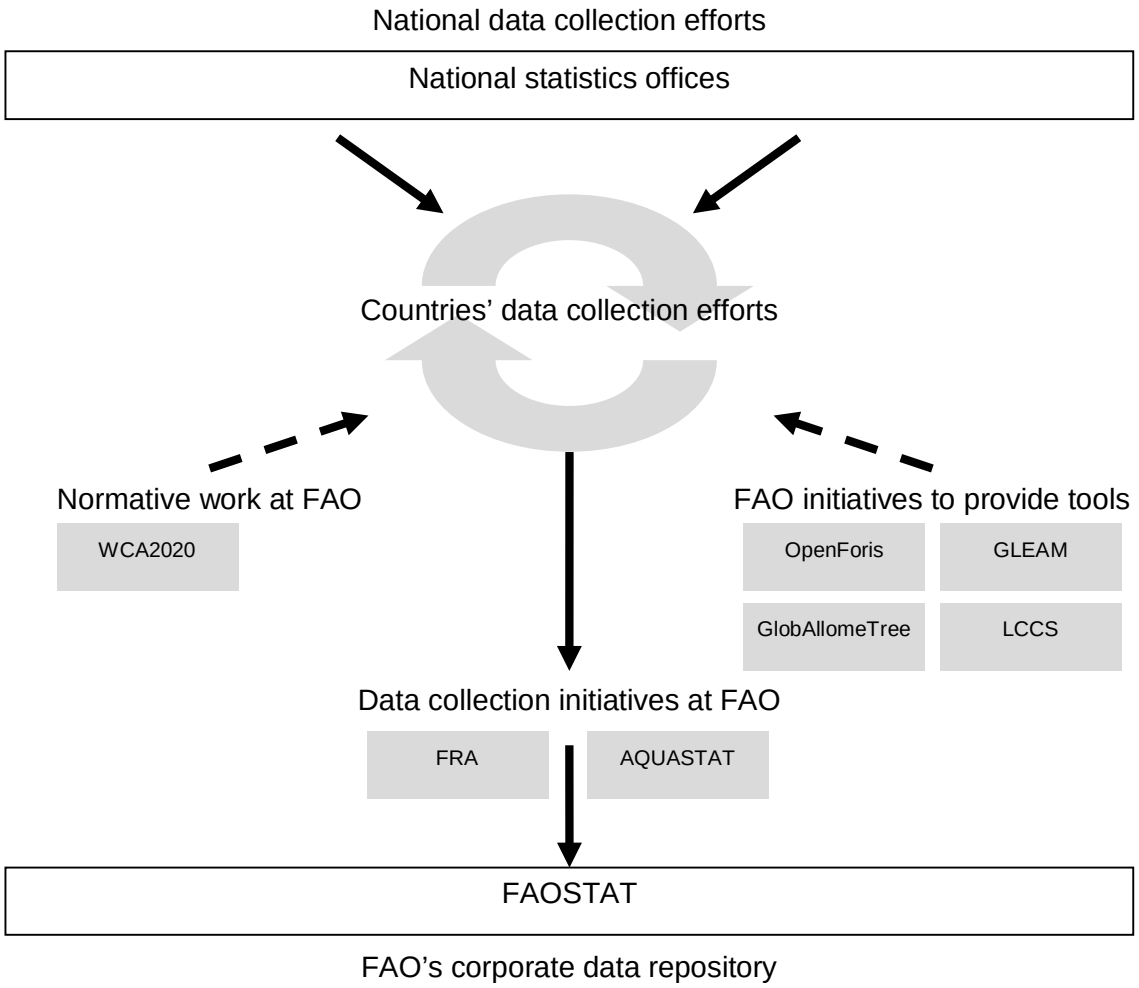

Figure 1: Data collection and tools between FAO and its member countries

An overview of activity data and emission estimates available at FAO are contained in overview tables within this report. Six tables collect information on agriculture: enteric fermentation, manure management, rice, agricultural soils, savannah burning and other data. Another six tables contain information on land use: forest land, grassland, cropland, wetland, other land and settlements. A last table summarises databases with emission and stock factors, where all factors are for estimation of emissions from forest land and grassland.

Conclusions from expert exchange and recommendations for further work at IPCC and FAO

The Expert Meeting collected a set of conclusions and recommendations. Notably, there were discussion sessions on emerging data and methodological development needs that delivered important conclusions and basis for developing recommendations in the plenary.

The *discussion session on emerging data needs* focused on the following topics:

- Data gaps with a view on activity data chiefly regarding past and potential future land-use change, including the access to remote sensing data and regional data, and
- Institutional coordination between data producers and GHG expert communities and other users.

The *discussion session on methodological development needs* focused on the following topics:

- The need to develop methodological principles for national GHG inventories, i.e. within the boundaries of guidelines for reporting on national GHG inventories, and
- The application of the IPCC GHG Inventory Guidelines for assessing results of mitigation actions, including REDD+ activities and including through life-cycle assessments of specific products.

The meeting delivered a *set of recommendations on further work*, as follows:

1. FAO should build further on the utility of FAOSTAT as a data portal both for activity data and for emission estimates.
2. FAO should explore the feasibility of providing information on the direction of land-use changes.
3. Approaches for basing reference emission scenarios on food supply and demand projections should be explored.
4. A dialogue between relevant technical agencies and statistics offices, at both the national and international levels should be promoted, to address current needs for national and sub-national GHG information, for use in national analysis, including inventories.
5. Capacity development on national GHG reporting processes linking to food security considerations continues being relevant, in particular with a view on the use of existing datasets and methodological guidance.
6. FAO should explore how data in the corporate repositories provide useful input for mitigation analysis.
7. Further consideration of the linkages among GHG emissions and food security and adaptation would be useful.
8. Exchange of data and information should be enhanced between IPCC and other agencies providing data, methodologies and capacity development.
9. IPCC should facilitate access to newly available data sources for activity data and emission factors, as well as complementary tools and methodological guidance.
10. It would be useful for the IPCC to further consider the utility and possibility of additional guidance on issues relevant for mitigation actions.

Table of contents

Background on expert exchanges about the use of FAO data for national GHG inventories since 2009

An Expert Meeting in 2009 on use of FAO data for national GHG inventories

In 2009, a joint *IPCC-FAO-IFAD Expert Meeting on Activity Data for LULUCF/AFOLU* identified data gaps and possible solutions aimed at improving the use of FAO datasets for AFOLU national greenhouse gas (GHG) inventories. The intent of this meeting was to address the need for guidance on AFOLU GHG emissions estimates identified at the expert meeting on IPCC guidance on estimating emissions and removals from land use such as agriculture and forestry held in 2008 by the IPCC Task Force on National Greenhouse Gas Inventories (TFI).

The 2009 Expert Meeting culminated with a set of recommendations, including proposed refinements to data collection efforts by FAO. These outcomes were summarized in the report on *Datasets for use in the IPCC Guidelines - FAO data and how it can be used in the IPCC Agriculture and Land Use Guidelines*. This report indicated that although FAO has compiled some of the most useful international datasets for AFOLU national GHG inventories, data gaps and harmonization issues needed to be addressed in order to make these datasets more compatible with national GHG inventory requirements.

The AFOLU sector presents a substantial challenge for inventory compilation in developing countries due to a dearth of reliable national data. The ease of access and use of FAO data for AFOLU inventories were issues that had already been examined at the 2008 meeting of the IPCC TFI. In 2009, experts noted the difficulties inventory compilers faced in accessing FAO datasets and translating the available FAO data to what was required according to the IPCC GHG Inventory Guidelines. Experts acknowledged the number and variety of useful datasets; however, they also highlighted the challenge of data integration into national GHG inventories.

The obstacles identified in 2009 included the accessibility of international datasets and their relevance to IPCC GHG Inventory Guidelines. First, the reporting categories and definitions used in FAO datasets did not match those in the guidelines. In cases where FAO datasets cannot contain common definitions or reporting categories, experts suggested that they provide additional information for easier interpretation.

Second, FAOSTAT and the Global Forest Resources Assessment (FRA) datasets did not separately contain information on managed land, did not contain disaggregated information for several parameters (i.e. wood removal by land category), and did not have sufficient information on land use conversion to derive a land use conversion matrix. Thus, it was suggested that FAO start to include additional land-use data and that certain aggregate source categories (i.e. livestock and emissions from soils) fill in gaps to sufficiently disaggregate information on several key parameters.

Lastly, experts suggested that improvements be made to the presentation of and access to this data. The meeting report cited the multiplicity of datasets on the same topic, as well as a large amount of data in unpublished or offline formats, and suggested the preparation of a website listing all data available for inventory preparation.

Improvements to FAO datasets since 2009

FAO data has been significantly enhanced since the 2009 Expert Meeting. In response to its recommendations, the Governments of Germany and Norway funded FAO via the *Monitoring and Assessment of GHG Emissions and Mitigation Potential Project (MAGHG)* to begin addressing the gaps identified by building new datasets and developing guidance and training in support of IPCC and UNFCCC processes for the AFOLU sector.

As a result of these activities, and in a broad international collaboration, FAO launched the FAOSTAT Emissions Database in 2012. It contains a global set of tier 1 emission estimates for the agriculture and land use domains, with national and regional coverage from 1961-2012 (agriculture) and 1990-2012 (land Use) and projections to 2030 and 2050, based on existing and newly developed activity data for the AFOLU sector.

The FAOSTAT Emissions Database contributed to the recent fifth IPCC Assessment Report with global and regional analysis of AFOLU emissions and mitigation potentials. The database is increasingly being used by experts in member countries as a tool to support the national GHG inventory processes and mitigation analysis. FAOSTAT was recently enhanced with a new suite of analysis tools for quality assurance and verification, and comparisons with UNFCCC data, as well as tools that enable access to geo-referenced data and enable the development of indicators. Additionally, FAOSTAT is working toward increased transparency on institutions that report country

activity data via annual FAO surveys. This increases the transparency of GHG emissions estimation, and informs GHG compilers who may need to discuss activity data with those involved in the country reporting process.

The context of developing countries' national GHG inventories under the UNFCCC

The GHG reporting modalities under the United Nations Framework Convention on Climate Change (UNFCCC) are developing. Most of non-Annex 1 Parties have reported their national GHG inventories as part of National Communications (NCs) at several-year intervals.

These Parties are now required to also submit Biennial Update Reports (BURs) under the UNFCCC. BURs should include updates of national GHG inventories, information on mitigation actions and their effects, constraints and gaps, and related financial, technical and capacity needs, etc. First BURs were due by December 2014 (consistent with the Party's capabilities or level of support provided), and every two years thereafter. Several countries have identified the need for capacity development to bridge technical gaps in the reporting of GHG emissions in the AFOLU sector.

Biennial Update Reports also undergo a process of International Consultation and Analysis (ICA). Teams of technical experts conduct a technical analysis, followed by a facilitative sharing of views among countries. The ICA aims to enhance the transparency and accountability of information reported in BURs.

In addition, mitigation in developing countries has gained much momentum under the UNFCCC since 2009. Nationally Appropriate Mitigation Actions (NAMAs) are being developed in several countries and in many countries there are capacity-development programmes underway relating to an emerging scheme for reducing emissions from deforestation and forest degradation (REDD+). Furthermore, countries have engaged in a process of submitting Intended Nationally-Determined Contributions (INDCs) to the global effort against climate change.

The 2014 Expert Meeting on emerging activities to combat climate change – use of FAO data and IPCC GHG Inventory Guidelines for Agriculture and Land Use

The 2014 Expert Meeting considered how FAO datasets can support the process of national GHG inventory compilation using IPCC GHG Inventory Guidelines by providing activity data, emissions factors, and facilitating quality assurance, quality control and verification for the AFOLU sector. It also assessed ways in which datasets first compiled at the 2009 meeting can be continuously updated and made available to relevant user groups. Lastly, the meeting explored ways that FAO datasets and IPCC GHG Inventory Guidelines could potentially be used to conduct mitigation analysis for AFOLU activities at national and project scale.

The 2014 *Expert meeting on emerging activities to combat climate change – use of FAO data and IPCC GHG Inventory Guidelines for Agriculture and Land Use* served both as a reflection of progress made since 2009 and as an opportunity to build on lessons learned and address emerging needs in the area of improved statistics for use in national GHG inventories, mitigation, and rural development. It was attended by 93 participants (61 men and 32 women) from 26 countries, including authors of IPCC GHG Inventory Guidelines, other AFOLU experts, experts from FAO, IFAD, UNFCCC, and the IPCC TFI (Co-chairs and its Technical Support Unit).

Participants made recommendations on available global datasets for the implementation of guidelines, good practices for the verification of country-level estimates using global datasets, and good practices for the eventual use of IPCC GHG Inventory Guidelines to assess activities beyond national GHG inventories, such as linkages to adaptation planning and applications within permanent reporting systems and processes.

Experts discussed the development of methodological principles for national GHG inventories within the boundaries of guidelines, and highlighted the necessity for the application of IPCC GHG Inventory Guidelines in GHG reporting and estimation of mitigation achieved by NAMAs, REDD+ activities, and the life cycle assessment (LCA) of specific products. Finally, experts considered whether the accurate assessment of mitigation in the AFOLU sector requires new methodological work including that by the IPCC TFI.

Such new methodological work would be in the context of an emerging focus on mitigation. First, there are challenges surrounding the quantification of GHG emissions reductions for NAMAs. The UNFCCC has not given specific guidance on the impact measurement of specific mitigation actions, or whether an emissions factors dataset tailored to specific mitigations actions is needed. Methodologies are also uncertain on reference level construction that will properly quantify deviation from BAU levels and emissions trends. Lastly, methodologies are necessary for

the stratification of national GHG inventories in order to identify subsets for category boundaries, spatial boundaries, and time boundaries.

The 2014 Expert Meeting had the objective to discuss the use of FAO data and IPCC GHG Inventory Guidelines for AFOLU with a view on emerging activities to combat climate change.

Specifically, this involved discussing:

- How FAO datasets can help in inventory compilation using the IPCC GHG Inventory Guidelines by providing activity data, emission factors and other parameters and facilitating quality assurance, quality control and verification;
- How the information on international, predominately FAO, datasets (that were first compiled at a joint FAO-IPCC-IFAD meeting in 2009) could be continuously updated and made available to relevant user-groups for estimating emissions and removals of GHG from the AFOLU sector;
- How the FAO datasets and IPCC GHG Inventory Guidelines could potentially be used for other purposes such as mitigation analysis for agriculture and land use at national and project scale;
- How to effectively develop required capacities to use FAO datasets and IPCC GHG Inventory Guidelines.

This report

This report summarises the discussions and results of the 2014 Expert Meeting. This includes an update to the publication about Datasets for use in the IPCC Guidelines. It contains sections that

- Explain the *Background on expert exchanges about the use of FAO data for national GHG inventories since 2008* and lay out objective, audience and structure of this report (this section);
- Provide *Technical background* on the IPCC GHG Inventory Guidelines and their use in the AFOLU sector, on statistical processes and on mitigation and life-cycle analysis;
- Contain a detailed and updated *Overview of the FAO datasets and tools and how they can be used with IPCC GHG Inventory Guidelines* in a tabular format;
- Identify *Conclusions from expert exchange and recommendations for further work at IPCC and FAO* to address national GHG inventory compilers' emerging data and methodological development needs;
- Contain the agenda and the list of participants in the *Annex*.

Technical background

IPCC GHG Inventory Guidelines and their use in the AFOLU sector

IPCC GHG Inventory Guidelines provide methodologies for the estimation of anthropogenic emissions by sources and removals by sinks of GHGs for the purpose of completing a national GHG inventory. Thus far, the guidelines developed are as follows:

- Revised 1996 Guidelines for National Greenhouse Gas Inventories (*Revised 1996 IPCC Guidelines*), IPCC (1997)
- Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (*GPG 2000*), IPCC (2000)
- Good Practice Guidance for Land-Use, Land-Use Change and Forestry (*GPG-LULUCF*), IPCC (2003)
- 2006 IPCC Guidelines for National Greenhouse Gas Inventories (*2006 IPCC Guidelines*), IPCC (2006)
- 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands (*Wetlands Supplement*), IPCC (2014)
- 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol (*KP Supplement*), IPCC (2014)

GPG2000 and GPG-LULUCF provide elaboration of guidance in the Revised 1996 IPCC Guidelines. These two GPG reports are meant to be used in conjunction with the Revised 1996 IPCC Guidelines. Wetlands Supplement and KP Supplement provide methodological guidance which is supplementary to the 2006 IPCC Guidelines. These two supplements should be used in conjunction with the 2006 IPCC Guidelines.

Under the UNFCCC, Annex 1 Parties must use the 2006 IPCC Guidelines to prepare and report their national GHG inventories for submission in 2015 and onwards, while they were required to use the Revised 1996 IPCC Guidelines together with GPG2000 and GPG-LULUCF for inventory submission until 2014. Non-Annex 1 Parties should use the Revised 1996 IPCC Guidelines and are encouraged to use the GPG2000 and the GPG-LULUCF according to the decision taken at the 8th Conference of the Parties (COP8) in 2002, but some of them have started using the 2006 IPCC Guidelines.

The most common methodological approach followed in the guidelines is to multiply the information on the extent of human activity within a given period (activity data) with the emissions/removals per unit activity (emission factor).

*Emissions or removals = activity data * emission factor.*

This basic equation can be modified to include other estimation parameters than emission factors such as changes in carbon stocks in pools in AFOLU. The methods provided in the guidelines vary in their degree of complexity from the simplest ones (tier 1) to more complex methods (tier 3) as explained in Box 1 below.

Thus, along with complexity these methods vary greatly in their data needs. The IPCC GHG Inventory Guidelines also give guidance on the selection of tier, with higher tiers suggested for major sources and sinks. FAOSTAT and other international datasets are relevant for the tier 1 method.

Box 1: Framework of tier structure for AFOLU data. (Source: 2006 IPCC Guidelines, Vol.4, Ch.1 for AFOLU, 2006 IPCC.)

Tier 1 methods are designed to be the simplest to use, for which equations and default parameter values (e.g., emission and stock change factors) are provided in this volume. Country-specific activity data are needed, but for tier 1 there are often globally available sources of activity data estimates (e.g., deforestation rates, agricultural production statistics, global land cover maps, fertilizer use, livestock population data, etc.), although these data are usually spatially coarse.

Tier 2 can use the same methodological approach as tier 1 but applies emission and stock change factors that are based on country- or region-specific data, for the most important land-use or livestock categories. Country-defined emission factors are more appropriate for the climatic regions, land-use systems and livestock categories in that country. Higher temporal and spatial resolution and more disaggregated activity data are typically used in tier 2 to correspond with country-defined coefficients for specific regions and specialized land-use or livestock categories.

At tier 3, higher order methods are used, including models and inventory measurement systems tailored to address national circumstances, repeated over time, and driven by high-resolution activity data and

disaggregated at sub-national level. These higher order methods provide estimates of greater certainty than lower tiers. Such systems may include comprehensive field sampling repeated at regular time intervals and/or GIS-based systems of age, class/production data, soils data, and land-use and management activity data, integrating several types of monitoring. Pieces of land where a land-use change occurs can usually be tracked over time, at least statistically. In most cases these systems have a climate dependency, and thus provide source estimates with inter-annual variability. Detailed disaggregation of livestock population according to animal type, age, body weight etc., can be used. Models should undergo quality checks, audits, and validations and be thoroughly documented.

The GHG emissions and removals from the terrestrial ecosystem arise from carbon stock changes in the carbon pools and from non-CO2 emissions from a variety of sources including biomass burning, soils, livestock enteric fermentation and manure management.

IPCC uses six land-use categories to report emissions and removals from land use and land-use conversions:

- Forest Land
- Cropland
- Grassland
- Wetlands
- Settlements
- Other Land

The guidelines provide broad definitions for these categories. This allows countries to use national definitions depending on national circumstances. IPCC also uses managed land as a proxy for the identification of anthropogenic emissions and removals. Thus, it is important to note that national definitions may be different from internationally accepted definitions used by agencies such as FAO.

GHG emissions and removals from each land use include CO2 from biomass, dead organic matter and soils, and non-CO2 emissions from biomass burning and certain land use specific emissions. CH4 and N2O from livestock management are estimated by livestock types. While carbon stock changes are estimated by the area or area change multiplied by the carbon stock changes per unit area, the non-CO2 emissions are generally estimated from the emissions factor for a specific gas and source category multiplied by activity data.

Thus, the IPCC methods require information on activity data such as areas/area changes of different land use categories, population, biomass, and emissions factors, or the data and parameters used to estimate them, such as biomass stocks per unit area, growth rates, biomass losses per unit area, biomass expansion factors, and livestock parameters.

According to the 2006 IPCC Guidelines, countries may choose one of three approaches for land representation to obtain and represent information on area/area changes for national GHG inventories. The three approaches are explained in Box 2 below.

The 2006 IPCC Guidelines use a system of stratification based on climate, ecosystem, soil type, and management practices to apply emission and stock change factors for estimating biomass, dead organic matter and soil-carbon stock changes. However, inventory compilers can employ a country-specific classification as well as country-specific emission and stock change factors for using tier 2 and 3 methods.

Box 2: Approaches to land representation for AFOLU data. (Source: 2006 IPCC Guidelines, Vol.4, Ch.3 for AFOLU, 2006 IPCC.)

Approach 1 represents land-use area totals within a defined spatial unit, which is often defined by political boundaries, such as a country, province or municipality. Another characteristic of Approach 1 data is that only the net changes in land-use area can be tracked through time. Consequently, the exact location or pattern of the land uses is not known within the spatial unit, and moreover the exact changes in land-use categories cannot be ascertained. Datasets are likely to have been prepared for other purposes, such as forestry or agricultural statistics. Frequently, several datasets will be combined to cover all national land classifications and regions of a country. In this case the absence of a unified data system can potentially lead to double

counting or omission, since the agencies involved may use different definitions of specific land use for assembling their databases.

The essential feature of Approach 2 is that it provides an assessment of both the net losses or gains in the area of specific land-use categories and what these conversions represent (i.e., changes both from and to a category). Thus, Approach 2 differs from Approach 1 in that it includes information on conversions between categories, but is still only tracking those changes without spatially-explicit location data, often based on political boundaries (i.e., locations of specific land use and land-use conversions are not known). Tracking land-use conversions in this manner will normally require estimation of initial and final land-use categories for all conversion types, as well as of total area of unchanged land by category. The final result of this Approach can be presented as a non-spatially-explicit land-use conversion matrix. The matrix form is a compact format for representing the areas that have come under different conversions between all possible land-use categories. Existing land-use databases may have sufficient detail for this Approach, or it may be necessary to obtain data through sampling or other methods. The input data may or may not have originally been spatially-explicit (i.e., mapped or otherwise geographically referenced).

Approach 3 is characterized by spatially-explicit observations of land-use categories and land-use conversions, often tracking patterns at specific point locations and/or using gridded map products, such as derived from remote sensing imagery. The data may be obtained by various sampling, wall-to-wall mapping techniques, or combination of the two methods.

Statistical processes

Governmental data collection is governed by their statistical systems. These aim to produce a comprehensive set of integrated statistics that are immensely more powerful for users than statistics collected without harmonisation. For data collection, governments usually rely on national statistics offices (NSO) and a network of statistics bureaus within other agencies. These are busy with the planning, collecting, analyzing and disseminating of statistical information. Statistical data collection is always meant to be of policy relevance and to guide the governmental decision-making.

In this context, national GHG inventories are just one set of data that governments collect and their integration should be straightforward. Integration could concern, for example, the use of ongoing data collection efforts by national statistics offices for the purposes of national GHG inventories. Nonetheless, in many countries national GHG inventory compilers do not usually closely collaborate with the national statistics offices. There is therefore much room for further learning and institutional development.

Mitigation and life-cycle analysis

Mitigation actions and policies for mitigation relating to AFOLU sector are typically concerned with the products from agriculture and land use. The definitions and categories in the IPCC GHG Inventory Guidelines are, however, not structured along the lines of products, but along datasets. This is why the national GHG inventory is not typically an optimal starting point for discussions about mitigation.

For example, policy-makers interested in mitigation, may be keen to discuss GHG implications of meat production. The national GHG inventory contains many relevant estimates scattered across the inventory (to name but a few: enteric fermentation and manure management of animals, grassland in so far as animals are held on pastures, cropland in so far as fodder is grown as crop, energy in so far as animals are in heated stables or is processed, transport in so far as meat is transported to consumers). All these pieces of information are immensely useful, relevant to meat production and are contained in the national GHG inventory. But information needs to be extracted and packaged differently to be useful input for defining mitigation approaches.

Life cycle assessment (LCA) is a powerful tool that may be used to quantify the environmental impacts of products and services. Typically, it includes all processes, from cradle-to-grave, along the supply chain of the product. GHG emissions could be assessed for agriculture and land-use products in an LCA approach too. An LCA could rely on GHG estimates from a national GHG inventory and repackage such information according to products and services of policy relevance.

The FAO datasets and tools and how they can be used with IPCC GHG Inventory Guidelines

This report lists and describes a set of key initiatives at FAO for collecting data and development of tools for use by GHG inventory compilers. It also includes an updated set of tables with data, sources, and remaining gaps. Compared to similar tables included in the 2009 report on *Datasets for use in the IPCC Guidelines*, it shows significant improvements in the availability of data.

Countries' data collection efforts serve a range of national purposes. Policy relevance is guiding principle for design of national statistics. All parts of the national administrations are potential users of such statistics and often they collect data. National statistics offices coordinate *national data collection efforts*.

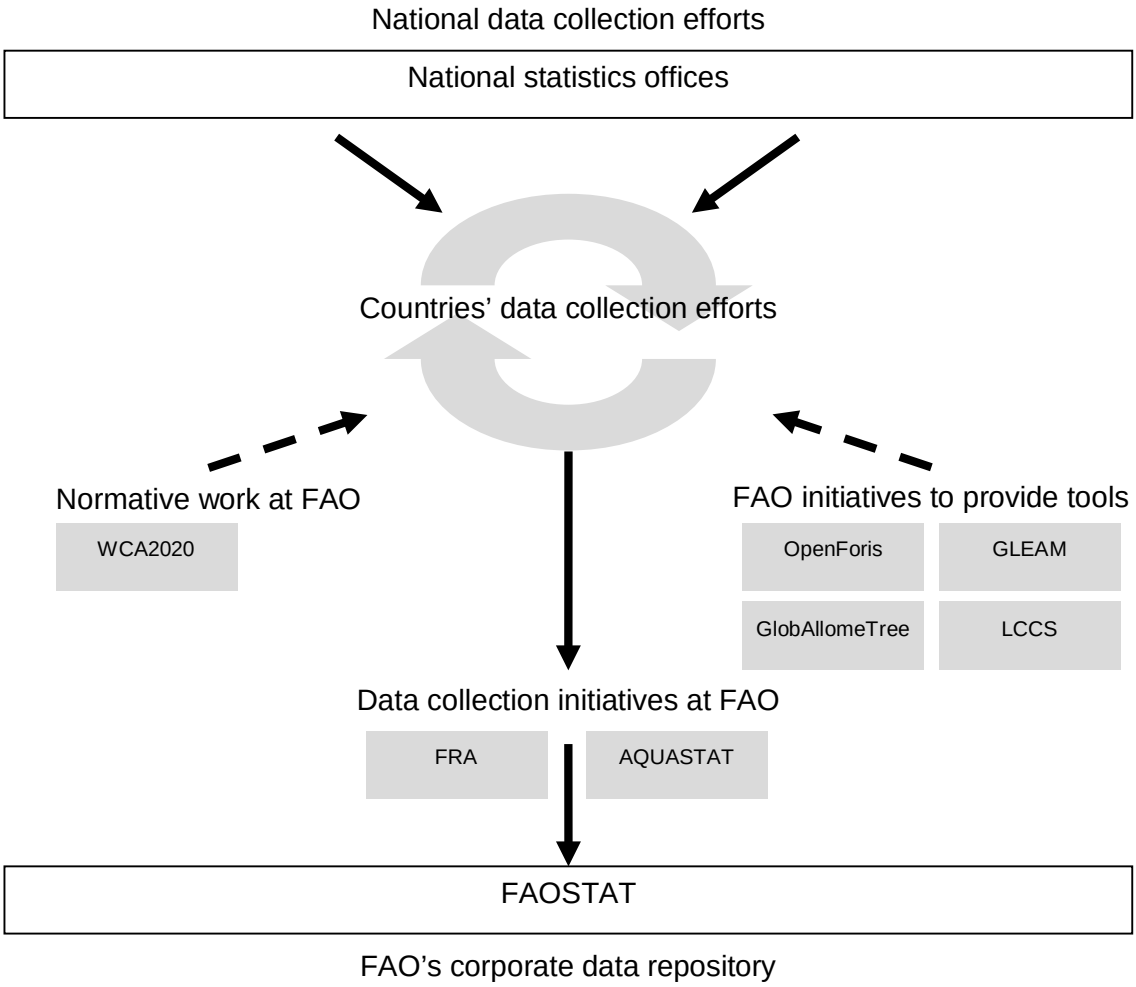

Figure 2: Data collection and tools between FAO and its member countries.

Data collection, storage and analysis is a key function of FAO. FAOSTAT is *FAO's corporate data repository*. FAOSTAT contains data reported by annual surveys next to dedicated data collection initiatives on areas of particular interest.

FAO carries out important *normative work* with countries. This includes the World Census of Agriculture 2020.

FAO has a range of *data collection initiatives* with countries of relevance for GHG inventory compilers. These include the Global Forest Resource Assessment, and AQUATSTAT. While there is some degree of independence of these initiatives they are all guided by FAO's corporate approach to data collection as per FAOSTAT. FAOSTAT stores and disseminates much of the data collected.

There are also various *initiatives ongoing at FAO to provide countries with tools* that are useful to GHG inventory compilers. Such tools included the OpenForis, GlobAllomeTree, the Global Livestock Environmental Accounting Model and the Land Cover Classification System.

Key initiatives at FAO for data collection for normative work

The *FAOSTAT database* is the main FAO corporate repository for statistical data and is accessible online (http://faostat3.fao.org). Generally the data sets are annual data, and are updated on a yearly basis via country questionnaires. Each data domain in FAOSTAT has its own data collection process and schedule. Generally, data is collected from FAO member countries (Ministries of Agriculture or national statistics offices). Additional data is obtained from other international organizations that have collected from countries, or from other official sources. The database is updated annually and contains a chronological time series since 1961.

Regarding land use, this dataset is a product of several independent reporting processes which use partially overlapping land use categories, and therefore the dataset is not totally consistent. The land use dataset contains a large number of classes and subclasses of agriculture land, for which data are annually collected through a questionnaire sent to countries. It also contains data on forest area collected through the Global Forest Resources Assessment reporting process (see below for more detail). Data on forest area are available since 1990. Annual figures were obtained by linear interpolation between reporting years. Other land is calculated as the total land area minus agriculture area minus forest area.

The *FAOSTAT Emissions Database* is an integral part of FAOSTAT. It draws together country-level tier 1 estimates for the major emission categories in agriculture and land use since 1961. The estimates are based on IPCC 2006 default emission factors and on activity data mostly contained within FAOSTAT and the Global Forest Resources Assessment. Other international geospatial datasets were used as appropriate, and these are also made available for download alongside the FAOSTAT Emissions estimates. Metadata explain the approaches for calculations and their data sources in detail, accessible either from the browse pages of individual subcategories, or from a dedicated metadata landing page at http://faostat3.fao.org/download/G1/*/E.

Under the *Global Forest Resources Assessment (FRA)* FAO has collected forest area/forest resources data at 5 to 10 year intervals since 1946. The FRA is based on data that countries provide to FAO in surveys and covers 234 countries and territories. FAO compiles and analyses the information and presents the current status of the world's forest resources and their changes over time. The most recent update of FRA data was published in 2010, and the next update will be in 2015. Forest land use and other forest resource data are provided through the FRA website, some of which is also incorporated into the FAOSTAT database. In 2015 FAO will release a new data portal to allow easy access and analysis of FRA data together with other FAO databases.

The variables collected in FRA relevant to greenhouse gas inventories are:

- Forest area
- Planted forest area
- Primary forest area
- Other wooded land area
- Wood removals and woodfuel removals
- Afforestation
- Reforestation
- Forest area designated for production and multiple use
- Annual increment
- Growing stock (split on broadleaves and conifers)
- Biomass (above ground, below ground and dead wood)
- Carbon stocks (all five pools)
- Disturbance
- Land area and forest area burned

Beginning with 1950, the *FAO World Census of Agriculture (WCA)* collects a global census on agricultural statistics at least once every decade using standard international concepts, definitions and methodology. The FAO world programme for the census assists countries by providing guidelines to generate internationally comparable figures on variable defining structure of agriculture, such as number and area of farms by size, number of livestock by type and age/sex classification, land tenure and land use, crops grown and agricultural inputs. FAO encourages countries to develop their programmes of censuses and surveys, keeping in view their priorities, practices and resource availability within the framework of a modular approach advocated in WCA 2010. The census is organized

at least one time every decade and a census report is released. The data is not incorporated in the FAOSTAT directory. Data is accessible directly from the website (http://www.fao.org/economic/ess/ess-wca).

Initiatives at FAO to provide tools useful for GHG inventory compilers

The FAOSTAT Emissions Analysis Tools support countries' GHG inventory compilation. Among other things, the online tools draw on a comparison between national GHG inventory data provided to the UNFCCC via National Communications with tier 1 estimates of the FAOSTAT Emissions Database. For countries at the beginning of their inventory process, the emissions analysis tools can be used to identify data gaps and thus help plan actions necessary to improve their inventories. For countries that already have a robust GHG inventory process in place, the tools can be used to perform QA/QC operations. The tools allows the user to verify it's emissions with the FAOSTAT Emissions Database.

The *Global Livestock Environmental Accounting Model (GLEAM)* is a GIS-based model for livestock production activities and related resource flows in all countries. The necessary inputs of the model are land-based feed resources that are available and the livestock numbers and population with live weights. The GLEAM model gives as an output the feed basket and animal nutrient requirements (gross energy intake) which will determine the feed intake of an animal and therefore it's subsequent emission. It covers the main eleven global livestock commodities and predominant production systems from cradle to retail point, and includes the main GHG emissions categories.

Data categories (emissions estimates) populated using FAOSTAT (mainly tier 1) GLEAM (higher tier levels) may include:

- Annual Livestock Population
- Manure Excreted (N content)
- Climate region or temperature
- Manure management systems
- Livestock Population
- Livestock distribution
- Livestock population by age/gender
- Live-weights by livestock sub-categories
- Mature Weight
- Average weight gain per day
- Average Daily milk production
- Fat content
- % of female pregnant
- Wool production
- Offspring

The *Global Land Cover Network (GLCN)* initiative is the result of a common effort of partners and sponsors to respond to the international community's need for a standardized global land cover database. Its objectives include the harmonization of land cover definition, classification systems, mapping and monitoring specifications, and the ongoing construction of a global database, among others. The GLCN developed an internationally agreed standardized classification system for land cover, the *Land Cover Classification System (LCCS)*. This system is also recommended as a tool that serves to countries to classify their national forest cover according to an international standardized classification. The GLCN covers global products, meanly land cover maps and their underlying met-data. All project outcomes are digital and readily to upload in a geographic information system software (http://www.fao.org/geonetwork/srv/en/main.home).

GlobAllomeTree is the first international web platform for tree allometric equations. Created in 2013, the platform responds to increasing requests for forest-resource assessments. GlobAllomeTree provides allometric equations for (currently 57) countries worldwide, from boreal forests to tropical rainforests. As an auxiliary tool, it may be used in emissions estimates of Carbon stock density—living biomass under the IPCC Forest Land category. Through the website all datasets can be accessed (http://www.globallometree.org/). GlobAllomeTree has been developed by FAO. However, it has not been incorporated into the FAOSTAT.

FAO operates a *programme of support to National Forest Monitoring and Assessment (NFMA)* since the year 2000. The programme responds to country requests for enhanced forest data acquisition and assisting them in setting up and organising multipurpose national forest monitoring and assessment systems.

The adopted methodology covers variables both biophysical and socio-economic attributes of forest and data is collected on socio-economic themes on non-forest land also. The data collected and variable definitions are harmonized with international standards, in particular with FAO's Global Forest Resource Assessment (FRA), the Land Cover Classification System (LCCS) and the IPCC GHG Inventory Guidelines.

Several countries have completed a national forest inventory with FAO support: Cameroon, Comoros, Costa Rica, Ecuador, Gambia, Guatemala, Honduras, Kyrgyzstan, Lebanon, Nicaragua, Philippines, Tanzania, and Zambia. In addition, country projects are currently on-going in: Argentina, Bangladesh, Brazil, Cambodia, Colombia, Congo, DRC, Ethiopia, Panama, Peru, Paraguay, PNG, Viet Nam, and Zambia (phase II).

Under the umbrella of this programme, FAO developed software tools to enable easy forest management. Open Foris is a set of free and open-source software tools that facilitates flexible and efficient data collection, analysis and reporting. It includes Collect, Collect Mobile, Calc, Collect Earth and a Geospatial Toolkit. All software tools and the corresponding tutorials are downloadable from the website (http://www.openforis.org/home.html).

- *Open Foris Collect Earth* is a tool that uses Google Earth, Bing Maps and Google Earth Engine to enable data collection and analysis of high resolution satellite imagery for a number of purposes, including multi-phase National Forest Inventories, land-use assessments, agricultural and urban area monitoring, and the quantification of deforestation, reforestation, and desertification.
- *Open Foris Calc* is a robust tool for data analysis and results calculation. The input data and metadata come from Open Foris Collect and Calc provides a flexible way to produce aggregated results which can be analyzed and visualized through the open source software Saiku. Calc allows expert users to write custom R modules to perform calculations working with a variety of sampling designs.
- *Open Foris Geospatial Toolkit* is a collection of command-line utilities for processing of geographical data. It aims to simplify the complex process of transforming raw satellite imagery for automatic image processing to produce valuable information. It is particularly useful for processing big amounts of raster data, and provides a wide range of functionalities including image manipulation, statistics, segmentation and classification.

Structure of data tables with activity data and emission estimates

Activity data and emission estimates available at FAO have been collected into overview tables for the purpose of this report. A distinction was made for data from agriculture and from land use. Six tables collect information on agriculture, respectively enteric fermentation, manure management, rice, agricultural soils, savannah burning and other data. Another six tables collect information on land use, respectively forest land, grassland, cropland, wetland, other land and settlements. A last table is a collection of emission and stock factor databases, where all factors are for estimation of emissions from forest land and grassland. The tier 2 approach uses a variety of factors (feed intake, digestibility of animals, etc.), no particular effort has been made by FAO to collect this data on a global level.

All tables have a consistent structure. Some categories are further subdivided, for example that is the case for agricultural soils. The table includes factors for emissions from synthetic fertilizers, manure, etc. Often a table is not further subdivided in IPCC categories. For each category a description is given for the required information needed to be able to calculate the emission for the specific IPCC category. The datasets that FAO provides are then further distinguished between activity data and emission estimate. For each activity data and emission estimate it is indicated if the dataset is useful for a methodology of tier1 and approach1 or for higher tiers and approaches. For each IPCC category references, auxiliary tools and ancillary data are provided if available.

The tables are online available with clickable links to the respective datasets.

Tables with data for use by national GHG inventory compilers in the agriculture sector

In the agriculture sector, emission sources and data requirements are broken down as follows:

- Enteric fermentation
- Manure management
- Rice

- Agricultural soils
- Savannah burning
- Other agriculture

The guidelines provide methods for estimation of emissions of methane from *enteric fermentation* and methane and nitrous oxide from *manure management*. The estimation methods require the basic definition of livestock subcategories for tier 1 methods and subcategories based on enhanced characterization for the higher tier methods. Accordingly the tier 1 methods require only the annual average population of the basic subcategories along with the IPCC default emission factors while higher tier methods require the annual average population of the subcategories from the enhanced characterization and other data such as feed intake data for enteric fermentation and manure management system usage data for manure management.

For the estimation of emissions from *rice* cultivation, there are detailed data required on the management practices. Next to areas, these include the water regime and, importantly, the amount of organic amendments and other fertilisers to farming systems.

The guidelines provide methods for the estimation of direct and indirect N2O from *agricultural soils*; indirect N2O emissions take place due to volatilization/re-deposition, leaching and runoff. There are also methods for *other agriculture* CO2 emissions from application of lime and urea to the soils. The activity data required for N2O emission estimation is the amount of N input to the soil from synthetic N fertilizers, organic N (e.g. animal manure, compost, sewage etc.), crop residue and N mineralization. The N input is obtained from annual synthetic (mineral) fertilizer application data, the annual harvested dry matter yield, area harvested for various crops, area of crops burnt and some other parameters. The emissions from urea application require the data on annual application of urea and lime.

To estimate emissions from *savannah burning* a range of data are required. Among the data, the area burned by land cover type or ecosystem is a prerequisite. Preferably this information is available on a spatial basis. The emission factor is the combustion factor for each stratum. This combustion factor is related to the above ground biomass stock of the stratum.

Enteric fermentation

Table 1: Overview of databases available at FAO containing activity data to estimate GHG emissions from enteric fermentation. Gray shaded cells indicate that data items are not needed for respective level. Those data items with a (*) are not available online and the specified FAO division should be contacted. Those data items with a (**) are geospatial activity data.

Required information	Activity data		Emission estimates		References	Auxiliary tools	Ancillary data
	Tier 1	Higher tiers	Tier 1	Higher tiers			
Livestock population	FAOSTAT	Not available	FAOSTAT	GLEAM Model GHG Estimates (AGAL*)	FAO GHG Report	FAOSTAT Emissions Analysis Tools	
Livestock distribution		FAOSTAT			FAOSTAT GHG Manual		
Livestock population by age/gender		By Country, Year 2005 (AGAL*)			Geonetwork: The Gridded Livestock of the World		
Live-weights by livestock sub-categories		By Country, Year 2005 (AGAL*)			AGAL, Life cycle assessment report ruminants 2005		
Mature weight		By Country, Year 2005 (AGAL*)			AGAL, Life cycle assessment report chickens and pigs 2005		
Average weight gain per day		By Country, Year 2005 (AGAL*)			Tackling Climate Change through Livestock		
Average daily milk production		FAOSTAT					
Fat content		By Country, Year 2005 (AGAL*)					

% of female pregnant		By Country, Year 2005 (AGAL*)					
Wool production		FAOSTAT					
Offspring		By Country, Year 2005 (AGAL*)					

Manure management

Table 2: Overview of databases available at FAO containing activity data to estimate GHG emissions from manure management. Gray shaded cells indicate that data items are not needed for respective level. Those data items with a (*) are not available online and the specified FAO division should be contacted. Those data items with a (**) are geospatial activity data.

Required information	Activity data		Emission estimates		References	Auxiliary tools	Ancillary data
	Tier 1	Higher tiers	Tier 1	Higher tiers			
Annual livestock population	FAOSTAT	Not available	FAOSTAT	GLEAM Model GHG Estimates (AGAL*)	FAO GHG Report	FAOSTAT Emissions Analysis Tools	
Manure excreted (N content)	FAOSTAT				FAOSTAT GHG Manual		
Climate region or temperature	FAOSTAT Georeferenced Data**				FAO - GAEZ		
Manure management systems		By sub-categories and Country, Year 2005 (AGAL*)					

Rice cultivation

Table 3: Overview of databases available at FAO containing activity data to estimate GHG emissions from rice cultivation. Gray shaded cells indicate that data items are not needed for respective level. Those data items with a (*) are not available online and the specified FAO division should be contacted. Those data items with a (**) are geospatial activity data.

Required information	Activity data		Emission estimates		References	Auxiliary tools	Ancillary data
	Tier 1	Higher tiers	Tier 1	Higher tiers			
Harvested area	FAOSTAT	Not available	FAOSTAT	Not available		FAOSTAT Emissions Analysis Tools	AQUASTAT Crop Calendar
Harvested area by each rice management system	Not available		Not available				
Type of irrigation system / rainfed	Not available		Not available				
Amount of organic amendments	Not available		Not available				
Duration of cultivation	Not available		Not available				
Soil type	Not available		Not available				
Rice cultivar	Not available		Not available				

Agricultural soils

Table 4: Overview of databases available at FAO containing activity data to estimate GHG emissions from agricultural soils. Gray shaded cells indicate that data items are not needed for respective level. Those data items with a (*) are not available online and the specified FAO division should be contacted. Those data items with a (**) are geospatial activity data.

IPCC category	Required information	Activity data		Emission estimates		References	Auxiliary tools	Ancillary data
		Tier 1	Higher tiers	Tier 1	Higher tiers			
Synthetic fertilizer	Fertilizer use (consumption in nutrients)	FAOSTAT	Not available	FAOSTAT	Not available	FAO GHG Report	FAOSTAT Emissions Analysis Tools	
Manure left on pasture	Amount of total N in manure	FAOSTAT	Not available	FAOSTAT	Not available	FAOSTAT GHG Manual		
Manure applied to soils	Amount of total N in manure	FAOSTAT	Not available	FAOSTAT	Not available			
Cultivated histosols	Area of cultivated organic soils	FAOSTAT	FAOSTAT Georeferenced Data**	FAOSTAT	Not available	Harmonized World Soil Database		
Crop residues	N content in crop Residue	FAOSTAT	Not available	FAOSTAT	Not available			
Field burning of agricultural residues	Biomass burned (combustion factor)	FAOSTAT	Not available		Not available			
	Area and yield by crop	FAOSTAT	Not available		Not available			

Above information by each crop management system	Not available / country specific	Not available / country specific	Not available / country specific	Not available / country specific			

Savannah burning

Table 5: Overview of databases available at FAO containing activity data to estimate GHG emissions from savannah burning. Gray shaded cells indicate that data items are not needed for respective level. Those data items with a (*) are not available online and the specified FAO division should be contacted. Those data items with a (**) are geospatial activity data.

Required information	Activity data		Emission estimates		References	Auxiliary tools	Ancillary data
	Tier 1	Higher tiers	Tier 1	Higher tiers			
Area burned by land cover	FAOSTAT	FAOSTAT Georeferenced Data**	FAOSTAT	Not available	GFED	FAOSTAT Emissions Analysis Tools	
Biomass burned by land cover / ecosystem type	FAOSTAT	FAOSTAT Georeferenced Data**		Not available			
Combustion factor by land cover / ecosystem type	Not available	Not available	Not available	Not available			

Other agriculture

Table 6: Overview of databases available at FAO containing activity data to estimate GHG emissions from other agricultural activities. Gray shaded cells indicate that data items are not needed for respective level. Those data items with a (*) are not available online and the specified FAO division should be contacted. Those data items with a (**) are geospatial activity data.

IPCC category	Required information	Activity data		Emission estimates		References	Auxiliary tools	Ancillary data
		Tier 1	Higher tiers	Tier 1	Higher tiers			
Liming	Amount of liming (for total land)	Not available	Not available	Not available	Not available			
	Liming by crop management system	Not available	Not available	Not available	Not available			
Urea	Amount of urea application	FAOSTAT	Not available		Not available			
	Urea by crop management system	Not available	Not available	Not available	Not available			

Tables with data for use by national GHG inventory compilers in the land-use sector

For land use, emission sources and data requirements are broken down by the six land-use categories. Within the land-use categories, sub-categories can be defined. The six main categories are the following:

- Forest land
- Grassland
- Cropland
- Wetlands
- Settlements
- Other land

For the assessment of land use, the most important data items include:

- Land representation, that is a set of definitions for management systems within land-use categories and sub-categories, following a stratification by climate and soil types, next to a land-use conversion matrix representing areas and area changes
- Emission factor data for land use, chiefly carbon density estimates for all land-use categories and sub-categories and across several carbon pools

The data for *land representation* include the land use definitions and a corresponding land-use conversion matrix. *Land-use definitions* are required for land-use categories and sub-categories next to management system. The FAO datasets relate to a breakdown of land-use categories at a global level and employ globally-valid definitions based on the Land Cover Classification System. They reflect the IPCC's six main land-use categories and its default stratification by climate and soil types. Definitions are, however, highly dependent on the context of individual countries and will usually follow the structure of nationally-available datasets. FAO land area definitions are often reflecting the land cover rather than the land-use. FAO needs to improve to assist countries to harmonize national land cover maps and turn them into land use maps that are suitable for IPCC reporting. The same is true for management systems that reflect to the specifics of how crops are grown and grasslands are managed. There is not yet information available at the FAO on typical management systems within countries.

Currently available data at FAO mainly relate to areas of land-use categories at certain time points. This allows for applying approach 1 to land representation. For applying IPCC's approach 2 to land representation a *land-use conversion matrix* is required that lists areas that remain and areas that change between inventory time-points. There are not yet regionally differentiated land-use conversion matrices available at FAO.

Emission factor data for land use include, most importantly, carbon density estimates for the land-use categories and sub-categories are the most important emission factors for the national GHG inventory of land use and land-use change. Such carbon density estimates are required for the carbon pools of vegetation. Definitions are highly dependent on the national context, and so are the carbon densities of individual land-use categories, sub-categories and management systems. Nonetheless, there are some emission factor data available at FAO.

Land representation

Table 7: Overview of databases available at FAO containing activity data and methods for land representation. Gray shaded cells indicate that data items are not needed for respective level. Those data items with a (*) are not available online and the specified FAO division should be contacted. Those data items with a (**) are geospatial activity data.

Required information	Activity data		Definitions and data sources	Auxiliary tools	Ancillary data
	Tier 1 / approach 1	Higher tiers and approaches			
Land categories (forest land)	FAOSTAT	Not available	FRA	Collect Earth (Open Foris)	
Land categories (all categories)			FAOSTAT GHG Manual	Land Cover Classification System	Global land cover network
Soil classification	Harmonized World Soil Database**				
Vegetation types	FAO - GAEZ				
Managed vs. unmanaged lands	Not available	Not available	Not available		
Reforestation	FRA	Not available	FRA	Collect Earth (Open Foris)	
Annual / perennial crops	FAOSTAT	Not available	FAOSTAT	Land Cover Classification System	Global Land Cover-SHARE (GLC-Share)
Grassland area woody / herbaceous	FRA (other wooded land)	Not available	Not available		
Primary / secondary / planted forest class	FRA	Not available	FRA	Collect Earth (Open Foris)	

Gross deforestation (anthropogenic vs. not anthropogenic	Not available	FRA	FRA	Collect Earth (Open Foris)	
Afforestation (anthropogenic vs. not anthropogenic)	Not available	FRA	FRA	Collect Earth (Open Foris)	
Productive vs. non-productive forest class	FRA	Not available	FRA		
Forest Disturbance Class	FRA	Not available	FRA		
Rainfed / irrigated croplands	FAOSTAT	Not available	FAOSTAT		
Cropland area by management practices (e.g. degree of tillage, organic matter inputs, etc)	Not available	Not available	Not available		
Grassland area unimproved / improved	Not available	Not available	Not available		
Cultivated organic soils	FAOSTAT Georeferenced Data**	Not available	FAOSTAT GHG Manual		
Peatland burning (area affected)	Not available	FAOSTAT	GFED	GFED	FAOSTAT Emissions Analysis Tools

Peatland burning (biomass burned)	Not available	FAOSTAT	GFED	GFED	FAOSTAT Emissions Analysis Tools
Harvested wood products	FAOSTAT	Not available	FAO yearbook of forest products		

Emission factor data for land use

Table 8: Overview of databases available at FAO containing emission factor data to estimate GHG emissions from land use. Gray shaded cells indicate that data items are not needed for respective level. Those data items with a (*) are not available online and the specified FAO division should be contacted. Those data items with a (**) are geospatial activity data.

IPCC category	Required information	Carbon stock data		Definitions and data sources	Auxiliary tools	Ancillary data
		Tier 1 / approach 1	Higher tiers and approaches			
Forest land	Living biomass C stocks		FRA	FRA	GlobAllomeTree	
	Annual increment		FRA	FRA		
	Growing stock (broadleaves vs. conifers)		FRA	FRA	Calc (Open Foris)	
	DOM C stock		FRA	FRA	Calc (Open Foris)	
	SOM C stocks		FRA	FRA	FAO soil portal	

	Wood removals		FRA	FRA		
	Fuelwood		FRA	FRA		
Grassland (other wooded land)	Living biomass C stocks		FRA	FRA	GlobAllomeTree	
	Growing stock (broadleaves vs. conifers)		FRA	FRA	Calc (Open Foris)	
	DOM C stock		FRA	FRA	Calc (Open Foris)	
	SOM C stocks		FRA	FRA	FAO soil portal	
Cropland	SOM C stocks		Not available		FAO soil portal	

Conclusions from expert exchange and recommendations for further work

The Expert Meeting collected a set of conclusions and recommendations. As per the topic of the event, these focus on the use of FAO data and IPCC GHG Inventory Guidelines for agriculture and land use, given rapidly emerging activities to combat climate change.

Discussions on emerging data and methodological development needs

Conclusions and recommendations were gathered through two days of technical sessions, discussions in breakout groups and a concluding plenary. Notably, there were discussion sessions on emerging data and methodological development needs that delivered important conclusions and basis for developing recommendations in the plenary.

The *discussion session on emerging data needs* focused on the following topics:

- Data gaps with a view on activity data chiefly regarding past and potential future land-use change, including the access to remote sensing data and regional data, and
- Institutional coordination between data producers and GHG expert communities and other users.

Generally, it emerged from the discussion that FAO has effectively followed up on an Expert Meeting in 2009 that recommended to make available activity data for AFOLU national GHG inventories in a structured manner. Directions for further possible work at FAO around quantifying mitigation also emerged from discussion that are contained in the below conclusions and recommendations. These should be considered in the context of implementing ongoing work at FAO on GHG-relevant statistical data and analysis tools in coordination between relevant divisions, including statistics, natural resources, forestry and agriculture.

The *discussion session on methodological development needs* focused on the following topics:

- The application of the IPCC GHG Inventory Guidelines for planning, and assessing results of, mitigation actions including REDD+ activities and NAMAs, and also for life-cycle assessments of specific products.

and

- The need and possibility of development of additional methodological guidance for NAMA quantification/AFOLU mitigation, taking into account the current boundary of the IPCC GHG Inventory Guidelines.

Generally, it emerged from the discussion that the methodological guidance in the current IPCC GHG Inventory Guidelines is relevant and can be a basis for quantifying mitigation. Some more guidance or advice to address issues associated with mitigation quantification and LCA would be useful and possible. How to develop and deliver such guidance or advice needs further consideration, taking into account the IPCC TFI's on-going work as well as relevant work undertaken by other organizations or programmes.

Conclusions

The meeting delivered the following conclusions:

1. *FAOSTAT* contains a set of activity data allowing for compiling a complete national GHG inventory for AFOLU using default emission factors. The tables contained in this report lay out in detail how FAOSTAT can be used by national GHG inventory compilers. The FAOSTAT Emissions Database contains the corresponding set of country-by-country emission estimates.
2. There are not currently available adequate international *data sources on mitigation actions*; there are gaps both with regards to emission factors and activity data, chiefly information about land-use change. Although data within FRA allows the application of approach 1 to land representation, this is of only limited utility for assessing results of mitigation actions. In addition, the IPCC Emission Factor Database (EFDB) does not currently include information related to mitigation actions specifically.
3. Countries do not always employ consistent *definition frameworks for land use and land cover*. Some countries lack agreed definition frameworks leading to inconsistent data on land use and land cover. Internationally available frameworks include FAO's Land-Cover Classification System. Continued capacity development on employing methodological guidance may be necessary and useful.

4. There is not currently available comprehensive methodological guidance on *estimating impacts of mitigation policies*. Existing guidance in the IPCC GHG Inventory Guidelines concentrates on the national GHG inventory. Although the IPCC GHG Inventory Guidelines is relevant and can be a basis for quantifying mitigation, some more guidance or advice is necessary in order to address issues associated with mitigation quantification.
5. There is not currently available comprehensive and universally-accepted methodological guidance on *building reference emission levels*. Countries need to engage in building reference emission levels for land use in the context of REDD+ where such guidance could be used.
6. There is not currently available comprehensive methodological guidance on *stratifying national GHG inventory estimates according to the boundaries of mitigation actions*. This is a barrier for using national GHG inventories for tracking results of mitigation actions.
7. *Life-cycle assessments* for agricultural and forest products is useful to guide national mitigation approaches. However, currently national GHG inventory information cannot be directly or easily used as there is no guidance available on how national GHG inventory information relates to *life-cycle assessments*.
8. Several agencies have made available a range of *new tools and methodological guidance* in support of national GHG inventory planning, preparation and evaluation and which are complementary to the IPCC GHG Inventory Guidelines. The GFOI has made available a Method and Guidance Document laying out how to use the guidelines for the MRV of REDD+, including information on the use of remotely-sensed information. FAO has made available a database on allometric equations, GlobAllomeTree. FAO has also made available within FAOSTAT a complete set of country-by-country inventory estimates that national GHG inventory compilers can use for quality assurance, quality control and verification.
9. *Institutional coordination on national GHG inventories* between the institutions leading their compilation and national statistics offices is at an early stage in many developing countries. There may be untapped synergies where national statistics offices could make available more and better data as input for national GHG inventories. National statistics offices may also support quality control and archiving national GHG inventory data.
10. Providing easy access to country-level *data on exposure* to dangerous climate change would be a useful input for adaptation planning. Notably, this includes socio-economic data such as data related to food security. FAO has relevant data available but their provision is not currently tailored to the requirements of adaptation planning.
11. FAO has much relevant data available for a global-level analysis of *linkages among GHG emissions and food security and adaptation*. Such a global-level analysis could provide important inputs to national development of climate-change related policies and measures, including mitigation actions. Data are not currently tailored for this specific need.

Recommendations on further work

Based on the above conclusions, the meeting delivered the following recommendations:

1. *FAO should build further on the utility of FAOSTAT as a data portal both for activity data and for emission estimates.* Further data becoming available for use in national GHG inventories should continue being included in the FAOSTAT database. Additional data collection efforts should be oriented towards the process of FAOSTAT as the corporate tool for providing access to information. This recommendation is based on conclusions about FAOSTAT and about institutional coordination on national GHG inventories.
2. *FAO should explore the feasibility of providing information on the direction of land-use changes.* This could be done through regional land-use conversion matrices and typologies of land-use changes. Such information would allow for assessing drivers of land-use change and provide important input for establishing reference levels. One context where this could be approached is the ongoing data-collection efforts under the FRA program. This recommendation is based on conclusions about FAOSTAT, about data sources on mitigation actions, and about new tools and methodological guidance.
3. *Approaches for basing reference emission scenarios on food supply and demand projections should be explored.* This could be done by using FAO's agricultural outlook studies as a starting point as these would provide the most important activity data underlying GHG calculations. This recommendation is based on conclusions about building reference emission levels.

4. *A dialogue between relevant technical agencies and statistics offices, at both the national and international levels should be promoted, to address current needs for national and sub-national GHG information, for use in national analysis, including inventories.* FAO is uniquely positioned to coordinate such a dialogue because it has a network of contacts with national statistics offices and also expertise on national GHG inventory data and methodologies. This recommendation is based on conclusions about institutional coordination on national GHG inventories.
5. *Capacity development on national GHG reporting processes linking to food security considerations continues being relevant, in particular with a view on the use of existing datasets and methodological guidance.* This is relevant regarding the definition frameworks for land use and land cover, which would target harmonizing different data sources and data at different scales. This is also relevant regarding newly available datasets, including those contained in FAOSTAT and its FAOSTAT Emissions Database. This is also relevant regarding tools and complementary methodological guidance to the IPCC GHG Inventory Guidelines. This recommendation is based on conclusions about definition frameworks for land use and land cover.
6. *FAO should explore how data in the corporate repositories provide useful input for mitigation analysis.* This could use methodologies commonly used in life-cycle analysis as a starting point to generate indicators on GHG implications of land use and its products. This would also draw on reference emissions scenarios. This recommendation is based on conclusions about life-cycle assessment and about estimating impacts of mitigation policies.
7. *Further consideration of the linkages among GHG emissions and food security and adaptation would be useful.* This report covers some relevant information. International analysis on the Food security - adaptation - GHG emissions nexus relevant to country circumstances would be possible and useful. Based on such analysis, non-prescriptive methodological advice may be given. This recommendation is based on conclusions about data on exposure and about linkages among GHG emissions and food security and adaptation.
8. *Exchange of data and information should be enhanced between IPCC and other agencies providing data, methodologies and capacity development.* Enhancing cooperation among IPCC and other agencies undertaking relevant activities such as the FAO and GFOI may facilitate tapping synergies on capacity-development efforts given differences in institutional approaches and mandates. This recommendation is based on conclusions about new tools and methodologies and about definition frameworks for land use and land cover.
9. *IPCC should facilitate access to newly available data sources for activity data and emission factors, as well as complementary tools and methodological guidance.* To help national GHG inventory compilers and to promote the use of IPCC GHG Inventory Guidelines by them, it is desirable that IPCC consider linking to external information resources such as FAO and GFOI. It is also worth considering the possible utility of integrating emission factors for mitigation actions into the IPCC Emission Factor Database (EFDB). This recommendation is based on conclusions about FAOSTAT, about international data sources on mitigation actions, and about new tools and methodological guidance, and about data on exposure.
10. *It would be useful for the IPCC to further consider the utility and possibility of additional guidance on issues relevant for mitigation actions.* There is not currently comprehensive guidance available on the principles to underlie building reference emission levels, on stratifying national GHG inventory estimates according to the boundaries of mitigation actions, on estimating impacts of mitigation policies, and on life-cycle assessment for agricultural and forest products. This recommendation is based on conclusions about stratifying inventory estimates according to the boundaries of mitigation actions, about building reference emission levels, about life-cycle assessment, and about estimating impacts of mitigation policies.

Annex 1: References

IPCC 1997, Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Volumes 1, 2 and 3. Houghton, J.T., Meira Filho, L.G., Lim, B., Tréanton, K., Mamaty, I., Bonduki, Y., Griggs, D.J. and Callander, B.A. (Eds). Intergovernmental Panel on Climate Change (IPCC), IPCC/OECD/IEA, Paris, France.

IPCC 2000, Good Practice Guidance and Uncertianty Management in National Greenhouse Gas Inventories. Penman, J., Kruger, D., Galbally, I., Hiraishi, T., Nyenzi, B., Enmanuel, S., Buendia, L., Hoppaus, R., Martinsen, T., Meijer, J., Miwa, K. and Tanabe, K. (Eds). Intergovernmental Panel on Climate Change (IPCC), IPCC/OECD/IEA/IGES, Hayama, Japan.

IPCC 2003, Good Practice Guidance for Land Use, land-Use Change and Forestry. Penman, J., Gytarsky, M., Hiraishi, T., Kruger, D., Pipatti, R., Buendia, L., Miwa, K., Ngara, T., Tanabe, K. and Wagner, F. (Eds). Intergovernmental Panel on Climate Change (IPCC), IPCC/IGES, Hayama, Japan.

IPCC 2010, Datasets for use in the IPCC Guidelines, eds: Eggleston H.S., Srivastava N., Tanabe K., Baasansuren J., Meeting Report of the IPCC – FAO – IFAD Expert Meeting on FAO Data for LULUCF/AFOLU Rome, Italy, 20-22 October, 2009, Pub. IGES, Hayama, Japan.

IPCC 2006, 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). Published: IGES, Japan.

IPCC 2014, 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands, Hiraishi, T., Krug, T., Tanabe, K., Srivastava, N., Baasansuren, J., Fukuda, M. and Troxler, T.G. (eds). Published: IPCC, Switzerland.

IPCC 2014, 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol, Hiraishi, T., Krug, T., Tanabe, K., Srivastava, N., Baasansuren, J., Fukuda, M. and Troxler, T.G. (eds). Published: IPCC, Switzerland.

Annex 2: List of participants

Ms/Mr	First Name	Last Name	Position	Organization
Mr	David Buluku	Adegu	Water & Natural Resources / Climate Change Secretariat	Ministry of Environment of Kenya
Mr	Andry	Andriantseheno	Statistician	United Nations Economic Commission for Africa
Mr	Illias	Animon	Forestry Officer	Food and Agriculture Organization of the United Nations (FAO)
Mr	Pedro	Arcuri	Liaison Officer for Europe	Embrapa
Mr	Francisco Luis	Aviña Cervantes	Head of Department of Studies on Socioeconomic Impacts of Climate Change	National Institute of Ecology and Climate Change (INECC), Mexico
Mr	Riccardo	Biancalani	Natural Resources Officer	Food and Agriculture Organization of the United Nations (FAO)
Mr	Viorel Nelu Bellmondo	Blujdea	Dr.	Forest Research and Management Institute
Mr	Luigi	Boschetti	Prof.	University of Idaho
Mr	Richard A.	Bourbonniere	Water Science & Technology Directorate, Research Scientist	Environment Canada
Mr	Johannes	Broetz	GHG inventory expert	Food and Agriculture Organization of the United Nations (FAO)
Mr	Tegshjargal	Bumtsend	Natural Resources Officer	Climate Change Coordination Office
Ms	Paola	Cardenas	Food Security Consultant	Food and Agriculture Organization of the United Nations (FAO)
Mr	Brian	Carisma	Statistician	Food and Agriculture Organization of the United Nations (FAO)
Ms	Silvia	Cerilli	Economist/statistician	Food and Agriculture Organization of the United Nations (FAO)
Mr	Yujuan	Chen	Junior Professional Officer	Food and Agriculture Organization of the United Nations (FAO)
Ms	Carolyn	Ching	AFOLU Manager	Verified Carbon Standard (VCS)

Mr	Paulo	Cornejo	GHG Inventories and Mitigation Officer	Ministry of Environment of Chile
Mr	Philippe	Crete	Forestry Officer	Food and Agriculture Organization of the United Nations (FAO)
Mr	Nguyen Mong	Cuong	Research Centre for Climate Change and Sustainable Development, Director	The Consultative Institute for Socio-Economic Development of Rural and Mountainous Areas
Ms	Giorgia	DeSantis	Statistical Clerk	Food and Agriculture Organization of the United Nations (FAO)
Ms	Carola	Fabi	Statistician	Food and Agriculture Organization of the United Nations (FAO)
Mr	Sandro	Federici	International Climate Policy Consultant	Food and Agriculture Organization of the United Nations (FAO)
Mr	Alessandro	Ferrara	GHG Monitoring and Assessment Consultant	Food and Agriculture Organization of the United Nations (FAO)
Ms	Yelena	Finegold	Support spatial modelling of Reference Levels for REDD+	Food and Agriculture Organization of the United Nations (FAO)
Mr	Alessandro	Flammini	Specialist in GHG Emissions and Energy	Food and Agriculture Organization of the United Nations (FAO)
Ms	Maya	Fukuda	IPCC Taskforce on National Greenhouse Gas Inventories (TFI), Technical Support Unit (TSU), Programme Officer	Institute for Global Environmental Strategies (IGES)
Mr	Conrad	George	Senior Expert Global Climate Change Policy	Food and Agriculture Organization of the United Nations (FAO)
Mr	Adam	Gerrand	Natural Resources Officer	Food and Agriculture Organization of the United Nations (FAO)
Mr	Giacomo	Grassi		European Commission, Joint Research Centre (JRC)
Ms	Kakoli	Ghosh	Coordinator	Food and Agriculture Organization of the United Nations (FAO)
Mr	G.H. Sabin	Guendehou	Dr.	Benin Centre for Scientific and Technical Research

Mr	Matieu	Henry	Forestry Officer	Food and Agriculture Organization of the United Nations (FAO)
Mr	Taka	Hiraishi	IPCC Task Force on National Greenhouse Gas Inventories (TFI), Co-chair	Institute for Global Environmental Strategies (IGES)
Ms	Heather	Jacobs	Climate Change Consultant	Food and Agriculture Organization of the United Nations (FAO)
Ms	Baasansuren	Jamsranjav	IPCC Task Force on National Greenhouse Gas Inventories (TFI), Technical Support Unit (TSU), Programme Officer	Institute for Global Environmental Strategies (IGES)
Mr	Shijo	Joseph	Dr.	Center for International Forestry Research (CIFOR)
Mr	Eun	Kang	Support to various Treaty activities on Benefit-sharing Fund	Food and Agriculture Organization of the United Nations (FAO)
Ms	Åsa	Kasimir	Dr.	University of Gothenburg
Mr	Vladimir Nikolaevich	Korotkov	Head of Laboratory	Institute of Global Climate and Ecology
Ms	Thelma	Krug	IPCC Task Force on National Greenhouse Gas Inventories (TFI), Co-chair	Instituto Nacional de Pesquisas Espaciais (INPE)
Mr	Gernot	Laganda	Director (acting) Environment and Climate Division	International Fund for Agricultural Development (IFAD)
Mr	Keith	Lassey	Dr.	Lassey Research & Education
Mr	Kenneth	MacDicken	Senior Forestry Officer	Food and Agriculture Organization of the United Nations (FAO)
Mr	Mesheck	Malo	Technical Officer	Food and Agriculture Organization of the United Nations (FAO)
Mr	Giulio	Marchi	Geospatial Analyst and Trainer	Food and Agriculture Organization of the United Nations (FAO)
Mr	Toru	Matsumoto	IPCC Task Force on National Greenhouse Gas Inventories (TFI), Technical Support Unit (TSU), IT Officer	Institute for Global Environmental Strategies (IGES)

Mr	Robert	Mayo	Senior Economist/Statistician Consultancy	Food and Agriculture Organization of the United Nations (FAO)
Ms	Esther	Mertens	GHG Inventory Expert	Food and Agriculture Organization of the United Nations (FAO)
Mr	Carl P. (Mick)	Meyer	Dr.	Commonwealth Scientific and Industrial Research Organisation (CSIRO)
Ms	Koh	Mikuni	IPCC Task Force on National Greenhouse Gas Inventories (TFI), Technical Support Unit (TSU), Assistant	Institute for Global Environmental Strategies (IGES)
Mr	Danilo	Mollicone	Forestry Officer	Food and Agriculture Organization of the United Nations (FAO)
Ms	Simona	Mosco	Statistical Clerk	Food and Agriculture Organization of the United Nations (FAO)
Ms	Anne	Mottet	Livestock Policy Officer	Food and Agriculture Organization of the United Nations (FAO)
Ms	Eriko	Nakamura	IPCC Task Force on National Greenhouse Gas Inventories (TFI), Technical Support Unit (TSU), Assistant	Institute for Global Environmental Strategies (IGES)
Mr	Rasack	Nayamuth	Regional Project Coordinator	ESA
Mr	Till	Neeff	Climate Change Expert	Food and Agriculture Organization of the United Nations (FAO)
Ms	Constance	Neely		Food and Agriculture Organization of the United Nations (FAO)
Mr	Dirk	Nemitz	Associate Programme Officer	UNFCCC
Mr	Rafael	Novoa	Ph.D.	University of Chile
Ms	Katja	Oehmichen	Dr.	Thünen Institute of Forest Ecosystems
Mr	Stephen Michael	Ogle	Natural Resource Ecology Laboratory, Senior Scientist	Colorado State University
Ms	Bianca	Papi	Statistician	Food and Agriculture Organization of the United Nations (FAO)
Mr	Eric	Patrick	Adaptation Specialist	International Fund for Agricultural Development (IFAD)

Ms	Anu	Peltola	Statistician	UN Economic Commission for Europe
Mr	Jim	Penman	Honorary Professor	Environment Institute, University College London (UCL)
Ms	Angela	Piersante	Statistician	Food and Agriculture Organization of the United Nations (FAO)
Ms	Paulina	Prasuła	Climate Change Consultant	Food and Agriculture Organization of the United Nations (FAO)
Mr	Paolo	Prosperi	GHG Monitoring and Assessment Consultant	Food and Agriculture Organization of the United Nations (FAO)
Mr	Selvaraju	Ramasamy	Natural Resources Officer	Food and Agriculture Organization of the United Nations (FAO)
Mr	Nijavalli H.	Ravindranath	Prof.	Centre for Sustainable Technologies, Indian Institute of Science
Ms	Janie	Rioux	Natural Resources Officer	Food and Agriculture Organization of the United Nations (FAO)
Mr	Renato de Aragão Ribeiro	Rodrigues	Dr.	Brazilian Agriculture Research Corporation (EMBRAPA)
Mr	Simone	Rossi		Joint Research Centre (JRC)
Mr	Sebastian	Rüter		Thünen Institute of Wood Research
Ms	Mirella	Salvatore	Statistician	Food and Agriculture Organization of the United Nations (FAO)
Mr	Carlos Roberto	Sanquetta	Prof.	Federal University of Parana
Ms	María José	Sanz Sánchez	Programme Coordinator	Food and Agriculture Organization of the United Nations (FAO)
Mr	Alfonso	Sanchez-PausDiaz	Forest Inventory Database Developer and Trainer	Food and Agriculture Organization of the United Nations (FAO)
Ms	Marieke	Sandker	International expert to support modelling of Reference Levels	Food and Agriculture Organization of the United Nations (FAO)

Mr	Josef	Schmidhuber	Deputy Director	Food and Agriculture Organization of the United Nations (FAO)
Ms	Maria Helena	Semedo	Deputy Director - General	Food and Agriculture Organization of the United Nations (FAO)
Mr	Zoltán	Somogyi	Ph.D, Associate Professor	Hungarian Forest Research Institute
Ms	Doris	Soto	Senior Agriculture Officer	Food and Agriculture Organization of the United Nations (FAO)
Mr	Kiyoto	Tanabe	IPCC Task Force on National Greenhouse Gas Inventories (TFI), Technical Support Unit (TSU), Head	Institute for Global Environmental Strategies (IGES)
Mr	Edger	Teenstra	Knowledge Management Officer	Food and Agriculture Organization of the United Nations (FAO)
Mr	Francesco	Tubiello	Natural Resources Officer and Project Coordinator	Food and Agriculture Organization of the United Nations (FAO)
Mr	Aimable	Uwizeye	Nutrient use efficiency in livestock supply chains	Food and Agriculture Organization of the United Nations (FAO)
Ms	Marina	Vitullo		Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA)
Mr	Ren	Wang	Assistant Director General	Food and Agriculture Organization of the United Nations (FAO)
Mr	Tom	Wirth		US Environmental Protection Agency
Ms	Julia	Wolf	Natural Resources Officer	Food and Agriculture Organization of the United Nations (FAO)
Ms	Lini	Wollenberg	CCAFS Theme Leader	CCAFS
Mr	Chengyi	Zhang	Dr., Prof.	National Climate Centre, China Meteorological Administration

Annex 3: Meeting agenda

Day 1, 13 November 2014, Sheikh Zayed Centre (Atrium)

08:30-09.00 Registration

09:00-10:00 *Opening*

- Welcome to the event (Maria Helena M.Q. Semedo, FAO, and Taka Hiraishi and Thelma Krug, IPCC TFI, and Gernot Laganda, IFAD)
- Introduction to the event (Francesco N. Tubiello, FAO)
- Presentation: An overview of current climate-change agreements, ongoing discussions under the Ad Hoc Working Group on the Durban Platform for Enhanced Action, and associated implementation activities in land use (María José Sanz Sánchez, FAO)
- Presentation: New FAO updates on GHG emissions from AFOLU (Heather Jacobs, FAO)

10:00-10.30 Coffee break

10:30-12.30 *The need for up-to-date data and methodologies for AFOLU with evolving climate-change agreements* (chairs: Thelma Krug and Taka Hiraishi, IPCC TFI)

- Presentation: Need for up-to-date data to support inventory compilers in implementing IPCC methodologies to estimate emissions and removals for AFOLU Sector (Kiyoto Tanabe, IPCC TFI TSU)
- Presentation: New FAO data products and tools (Francesco N. Tubiello, FAO)
- Moderated discussion

12:30-13.30 Lunch break

13:30-15.00 *Data and methodologies for estimating GHG emissions and removals of land-based mitigation actions – issues around scale and boundaries* (chair: Giacomo Grassi, JRC)

- Presentation: Data for bringing together the national level and land-based mitigation actions in Costa Rica (Javier Fernandez, FONAFIFO)
- Presentation: Issues on temporal, spatial and activity boundaries for accounting for land-based mitigation actions, including for REDD+, NAMAs and projects (Sandro Federici, FAO, and Carolyn Ching, VCS)
- Moderated discussion

15:00-15.30 Coffee break

15:30-17.30 *Data and methodologies for estimating GHG emissions and removals of land-based mitigation actions – building reference scenarios* (chair: María José Sanz Sánchez, FAO)

- Presentation: Issues associated with reference levels (Jim Penman, UCL)
- Presentation: Data needs for building reference levels for REDD+ in Brazil (Thelma Krug, INPE)
- Presentation: FAO's long term outlook for global agriculture: basis for a GHG emissions baseline and food security assessments under climate change (Josef Schmidhuber, FAO)
- Moderated discussion

17.30 Closing

18.00-20.00 Reception at 'Apuleius'

Day 2, 14 November 2014, Mexico Room (D273bis)

09.00-10.30 *Data and methodologies for the joint analysis of mitigation-adaptation-food security benefits* (chair: Lini Wollenberg, CCAFS)

- Presentation: Data needs and gaps for identifying adaptation benefits (Selvaraju Ramasamy, FAO)
- Presentation: Metrics for multi benefit projects – a user perspective (Eric Patrick, IFAD)
- Moderated discussion

10.30-11.00 Coffee break

11.00-12.30 *Simultaneous breakout groups for discussing draft conclusions and recommendations to be reported back to the plenary*

- Breakout group #1 (Lebanon room – D277bis): Emerging data needs for the AFOLU sector (Francesco N. Tubiello, FAO)
- Breakout group #2 (Mexico room – D273bis): Emerging methodological development needs for the AFOLU sector (Taka Hiraishi, IPCC TFI)

12.30-13.30 Lunch break

14:00-16.30 *Findings on emerging data and methodological development needs for the AFOLU sector* (chair: Thelma Krug, IPCC TFI)

- Moderated discussion of draft conclusions

15:30 Coffee break

16:30-17.00 Closing of the event