# Datasets for use in the IPCC Guidelines

**FAO data and how it can be used in the IPCC Agriculture and Land Use Guidelines**

IPCC Expert Meeting Report
20-22 October, 2009, IFAD, Rome, ITALY

Task Force on National Greenhouse Gas Inventories

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Meeting Report of the IPCC – FAO – IFAD Expert Meeting on FAO Data for LULUCF/AFOLU

Rome, Italy, 20-22 October, 2009

## ABBREVIATIONS

AFOLU: Agriculture Forestry and Other Land Use

FAO: Food and Agriculture Organization

FRA: Global Forest Resources Assessment

HWP: Harvested Wood Products

IFA: International Fertilizer Industry Association

IFAD: International Fund for Agricultural Development

IPCC: Intergovernmental Panel on Climate Change

IRRI: International Rice Research Institute

ITTO: International Tropical Timber Organization

LULUCF: Land Use Land Use Change and Forestry

NFMA: National Forest Monitoring and Assessment Programme

SIDA: Swedish International Development Agency

TFI: Task Force on National Greenhouse Gas Inventories

UNECE: United Nations Economic Commission for Europe

# CONTENTS

## FOREWORD

The IPCC's Task Force on National Greenhouse Gas Inventories 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.

In this case the expert meeting focused on using international, predominately FAO, dataset for estimating emissions and removals of greenhouse gases from the Agriculture and Land Use sectors. Many countries have reported difficulty in obtaining suitable data to make these estimates and so this report aims to make the FAO data more accessible to inventory compilers.

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


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## ACKNOWLEDGEMENTS

## 1. EXECUTIVE SUMMARY

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

The Food and Agriculture Organization (FAO) has long maintained global datasets on agriculture and forestry that constitute an extremely valuable resource for GHG inventories compilation for the AFOLU sector as noted in the IPCC Guidelines. However these datasets cater to a wide range of information needs besides GHG inventory compilation and may differ from the data required for GHG compilation in certain key respects. Therefore, some additional guidance on the access to, and use of, these datasets beyond what is available in the IPCC Guidelines is useful for inventory compilation especially for developing countries and those with limited resources. This point was recognised at the Expert Meeting titled "IPCC Guidance on estimating emissions and removals of greenhouse gases from land uses such as agriculture and forestry" on 13-15 May 2008 in Helsinki, Finland organized by the IPCC Task Force on National Greenhouse Gas Inventories (TFI) and further discussed a subsequent meeting between IPCC and FAO in Rome in June, 2008. This meeting was the result of these discussions.

This report was developed during the "IPCC-FAO-IFAD Expert Meeting on FAO data for AFOLU/LULUCF" held in IFAD HQ, Rome, 20-22 October, 2009 and finalized subsequently by the participants. It aims at providing advice on access to, and use of, the FAO datasets for making GHG inventories for the AFOLU sector. The authors also hope this report will help FAO fine-tune their data collection efforts to make them more compatible with the data needed for understanding GHG emissions and removals from the AFOLU sector.

This report provides additional guidance for each category in the AFOLU sector and is applicable to both users of the IPCC 2006 Guidelines and the earlier Revised 1996 IPCC Guidelines and Good Practice Guidance, For each source or sink category, the location of suitable data is identified, if available, and details on its use are provided.

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[1] In this document AFOLU will be used to denote any of the:

"*Agriculture Forestry and Other Land Use (AFOLU)*" of the 2006 IPCC Guidelines IPCC (2006)

"*Agriculture and the Land Use, Land Use Change and Forestry (LULUCF)*" of the GPG and GPG-LULUCF IPCC (2000, 2003)

"*Land Use Change and Forestry (LUCF)*" of the 1996 IPCC Guidelines IPCC (1997)

## 2. INTRODUCTION

IPCC Guidelines provide methodologies for estimating national inventories of anthropogenic emissions by sources and removals by sinks of greenhouse gases. The IPCC has so far developed:

- the Revised 1996 Guidelines for National Greenhouse Gas Inventories, IPCC (1997), known as the "*1996 IPCC Guidelines*",
- Good Practice Guidance and Uncertainty Management, IPCC (2000), known as the "*GPG2000*",
- Good Practice Guidance for Land-Use, Land-Use Change and Forestry, IPCC (2003) known as the "*GPG-LULUCF*"
- and the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, IPCC (2006) known as the "*2006 IPCC Guidelines*".

The 1996 IPCC Guidelines together with GPG2000 and GPG-LULUCF provide the methodologies that the countries use to report their national inventories of greenhouse gases not controlled by Montreal Protocol to the United Nations Framework Convention on Climate Change (UNFCCC).

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

$$Emissions\ or\ removals = AD*EF$$

This basic equation can be modified to include other estimation parameters than emission factors such as changes in C stocks in pools in AFOLU. The methods provided in the IPCC Guidelines vary in their degree of complexity from the simplest ones using the global or regional default values of EFs given in the IPCC Guidelines and AD either available locally or from global data sets (Tier 1) and those substituting country specific values of EFs and AD derived from national statistics as well as increasing stratification of the category (Tier 2) to more complex methods involving detailed inventory based measurements and modelling approaches using sub-national data at much finer resolution (Tier 3). Thus, along with complexity these methods vary greatly in their data needs. The IPCC guidelines also give guidance on the selection of method (Tier) with higher Tiers only needed for major sources and sinks.

Countries generally use data from a variety of sources such as national statistical agencies, industry or stake-holder organizations, national and other experts, scientific and technical publications and international organizations publishing statistics such as United Nations Agencies, World Bank, EUROSTAT and OECD etc. In the IPCC Guidelines, Tier 1 methods have been designed to make use of readily available national and international data to make them feasible for all countries. However, AFOLU sector presents a greater challenge in inventory compilation than most other sectors, especially for developing countries, due to a lack of reliable national data. IPCC Guidelines generally recommend, in the absence of reliable national statistics, the use of FAO datasets among others, for the simplest Tier 1 methods. However, sometimes inventory compilers from the developing countries face difficulties in using FAO data in inventory compilation both due to a lack of information on how to access FAO datasets and how to translate the data available from the FAO to that need by the guidelines.

Advice on access and use of FAO data in AFOLU inventories has been a long standing demand of the inventory developers. The IPCC Task Force on National Greenhouse Gas Inventories (TFI) held an Expert Meeting titled "IPCC Guidance on estimating emissions and removals of greenhouse gases from land uses such as agriculture and forestry" on 13-15 May 2008 in Helsinki, Finland that identified this need. At a subsequent meeting between the IPCC and FAO, the number and variety of useful datasets were noted, however it was agreed that integrating their use into greenhouse gas inventory compilation was not straightforward.

To address this important need, IPCC TFI, FAO and IFAD organized a joint meeting titled, "IPCC-FAO-IFAD Expert Meeting on FAO data for AFOLU/LULUCF" which was held at IFAD, Rome, on 20-22 October, 2009. The aim of the meeting was to provide advice on the access and use of FAO datasets for AFOLU sector GHG inventories. This effort enables the meeting to provide guidance to help FAO fine-tune their data

collection efforts to make them more compatible with the data needs for understanding GHG emissions and removals in the AFOLU sector.

The Expert Meeting was attended by 38 participants including IPCC Guidelines authors, other AFOLU experts, experts from FAO/IFAD, IPCC TFI Co-chairs and members of the Technical Support Unit (TSU) of IPCC TFI.

## 3. IPCC GUIDELINES METHODS AND DATA NEEDS FOR AFOLU/LULUCF

The GHG emissions and removals from the terrestrial ecosystem arise from carbon stock changes in the carbon pools and from non-$CO_2$ emissions from a variety of sources including biomass burning, soils, livestock enteric fermentation and manure management.

The IPCC Guidelines use six broad land-use categories to report emissions and removals from land use and land use conversions (strictly these are a mix of "land use" and "land cover"):

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

These categories have been selected in the IPCC guidelines as they provide a robust and complete way of classifying all the land area of countries. These top-level categories can further be subdivided (or "stratified") depending on national circumstances to capture the differences between climate, ecological zones or management practices etc. These six land uses can thus be considered top-level categories for representing land use area with subcategories describing the special circumstances affecting national emissions or removals. The IPCC Guidelines only provide very broad definitions for these six land use categories and allow the countries to use their national definitions depending upon national circumstances. Further as the IPCC Guidelines use "managed land"[2] as a proxy for identifying anthropogenic emissions and removals, therefore countries should distinguish managed from unmanaged land for which emissions and removals are not reported. These national definitions should be transparently defined and applied consistently over time. It is important to note here that the national definitions used by countries may be different from the internationally accepted definitions used by international organizations like FAO.

GHG emissions and removals from each land use include $CO_2$ (calculated from C stock changes) from biomass, dead organic matter and soils, and non-$CO_2$ emissions from biomass burning and certain land use specific emissions (e.g. methane from rice cultivation).

$CH_4$ and $N_2O$ from livestock management (enteric fermentation and manure management) are estimated by livestock types (e.g. dairy cows, other cattle, poultry, sheep, swine and other livestock).

Some emission estimates can be based on national level data, as the necessary data are often not disaggregated by the different land uses. $N_2O$ emissions from managed soils are based on the national data on nitrogen applied to managed soils in the form of synthetic fertilizers, animal manure and other organic amendments and crop residue and nitrogen from nitrogen mineralization from land use conversions. $CO_2$ emissions from urea and lime application to managed lands are similarly based on national-level statistics.

Harvested Wood Products (HWP) may form an important part of the global carbon cycle. The emissions/removals from HWP can be reported using different accounting approaches that are subject to policy negotiations at present. 2006 IPCC Guidelines provide guidance on the calculation of the parameters underlying any of these accounting approaches. The basic data requirements are the production, imports and exports of solid wood and paper products since 1900.

While the carbon stock changes are estimated by the area or area change multiplied by the carbon stock change per unit area, the non-$CO_2$ emissions are generally estimated from the emission factor for a specific gas (e.g.$CH_4$, $N_2O$) and source category multiplied by activity data generally in terms of area (e.g. area of biomass burnt), population (e.g. livestock) or mass (e.g. biomass or manure).

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[2] 2006 IPCC Guidelines define managed land as, "…land where human interventions and practices have been applied to perform production, ecological or social functions."

The methods contained in the IPCC Guidelines require information on activity data such as area and area changes of different land use categories, population (e.g. livestock), biomass (e.g. biomass burnt, amount of fertilizer applied) and emission factors or the data and parameters that are used for estimating these emission factors such as biomass stocks per unit area, growth rates, biomass losses per unit area, biomass expansion factors, and livestock parameters etc.

The countries may use different methods for obtaining area data such as annual census, periodic surveys and remote sensing. The 2006 IPCC Guidelines provide guidance on the three approaches that may be used for obtaining and representing information on area and area changes for national GHG inventories. Approach 1 identifies the total area under individual categories but does not provide information on land use conversions between land uses. Approach 2 allows for tracking of conversions between land-use categories while Approach 3 tracks on a spatially explicit basis. As opposed to the methodological tiers, these approaches are not hierarchical in nature and countries may use a mix of approaches for different regions over time.

**Box 1. FRAMEWORK OF TIER STRUCTURE FOR AFOLU DATA**

**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.

Source: 2006 IPCC Guidelines, Vol.4 (1), Ch.1

The IPCC Guidelines provide guidance on methodological choice as well as the methods of obtaining data for their GHG inventories for countries. The data should in general be: adequate for representing land use and land use conversions for estimating GHG emissions and removals, consistent over time, complete in its coverage of the country and transparent in the choice of its methods, definitions and assumptions etc.

## 3.1  IPCC Stratification scheme for AFOLU data

2006 IPCC Guidelines use a system of stratification based on climate, ecosystem, soil type and management practices in order to apply emission and stock change factors for estimating biomass, dead organic matter and soil C stock changes (Table 1). This default classification system is used to stratify the default parameters used for Tier 1 methods provided in the IPCC Guidelines. However, inventory compilers can employ a country-specific classification, along with country-specific emission and stock change factors

for using Tier 2 and 3 methods. The Guidelines mention that it is good practice [3] to apply the same classification, either default or country-specific, across all land-use types. Thus, stock change and emission factors are assigned to each pool in a national inventory using a uniform classification.

Typically international data sets like FAO data are used with the Tier 1 methods. So in order to facilitate use of FAO datasets for inventory compilation it is important to interpret the FAO data in terms of IPCC stratification scheme based on climate, ecosystem and soil type.

### 3.1.1 Climate

IPCC Climate classification is based on elevation, mean annual temperature (MAT), mean annual precipitation (MAP), mean annual precipitation to potential evapo-transpiration ratio (MAP:PET), and frost occurrence. The decision tree in Annex 2 can be used to classify global regions into IPCC climate zones.

### 3.1.2 Soil

IPCC Soil classification system divides soil into 7 major types. The decision trees in Annex 3 & 4 can be used to classify soils from other soil taxonomic systems like USDA and WRB into IPCC soil types.

### 3.1.3 Ecological zones

The IPCC Guidelines follow the FAO Global Ecological Zones, based on observed climate and vegetation patterns. Data for geographic information systems is available at: *http://www.fao.org*.

### 3.1.4 Management practices

The default management practices classification is used for classifying the default Soil C stock change factors. Decision trees in Annex 5 and 6 can be used to classify Cropland and Grassland according to management practices as given in the Table 1.

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[3] *GHG inventories consistent with* good practice *should contain* neither over nor underestimates as far as can be judged and the uncertainties in these estimates *be* reduced as far as practicable.

Table 1. IPCC STRATIFICATIONS WITH SUPPORTING DATA FOR TIER 1 EMISSIONS ESTIMATION METHODS

| Factor | Strata |
|---|---|
| CLIMATE | • Boreal<br>• Cold temperate dry<br>• Cold temperate wet<br>• Warm temperate dry<br>• Warm temperate moist<br>• Tropical dry<br>• Tropical moist<br>• Tropical wet |
| SOIL | • High activity clay<br>• Low activity clay<br>• Sandy<br>• Spodic<br>• Volcanic<br>• Wetland<br>• Organic |
| BIOMASS (ECOLOGICAL ZONE) | • Tropical rainforest<br>• Tropical moist deciduous forest<br>• Tropical dry forest<br>• Tropical shrubland<br>• Tropical desert<br>• Tropical mountain systems<br>• Subtropical humid forest<br>• Subtropical dry forest<br>• Subtropical steppe<br>• Subtropical desert<br>• Subtropical mountain systems<br>• Temperate oceanic forest<br>• Temperate continental forest<br>• Temperate steppe<br>• Temperate desert<br>• Temperate mountain systems<br>• Boreal coniferous forest<br>• Boreal tundra woodland<br>• Boreal mountain systems<br>• Polar |
| MANAGEMENT PRACTICES (more than one may be applied to any land area) | • Intensive tillage/Reduced till/No-till<br>• Long term cultivated<br>• Perennial tree crop<br>• Liming<br>• High/Low/Medium Input Cropping Systems<br>• Improved Grassland<br>• Unimproved Grassland |

Source: 2006 IPCC Guidelines, Vol.4 (1), Ch. 3

## 4. FAO DATABASES AND DATA COLLECTION PROCESS

### 4.1 Global Forest Resources Assessment (FRA)

FAO has been periodically collecting data about forest area and forest resources at 5 to 10 year intervals since 1946. Since 2005, data to the Global Forest Resources Assessments (FRA) are provided by countries in the form of comprehensive country reports. FAO then compiles and analyses this information and presents the current status of the world's forest resources and their changes over time.

In order to ensure the best possible quality of the information that countries provide to FRA, countries receive training through a series of workshops and a day-to-day contact with the FRA secretariat. The FRA secretariat undertakes a comprehensive review process in order to ensure that the information provided is internally consistent, well documented and that the methodology has been correctly applied. Before publishing, the data undergo a process of official validation by competent national authorities.

Since 2005, the methods for estimating biomass and carbon stocks are entirely built on the IPCC Guidelines and countries are suggested to use these guidelines whenever they lack country-specific data or conversion factors.

Data are available online at the FRA website (http://*www.fao.org/forestry/fra*). FRA definitions of relevant terms are presented in Annex 10.

### 4.2 FAOSTAT Database

The FAOSTAT database is the main FAO corporate repository for statistical data. 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 countries (Ministries of Agriculture or, Central Statistics Bureaus). Additional data is obtained from other international organizations that have collected from countries, or from other official sources. One of the important functions of the FAO Statistics Division (ESS) is to compile the respective data from countries through electronic questionnaires, national statistical publications and an array of other sources such as project reports, including studies available in other FAO Divisions, economic journals, etc.

FAOSTAT is available at *http://faostat.fao.org/*. FAOSTAT is currently available free for downloading up to 4000 records in a single extraction. From 1 July 2010 the FAOSTAT subscription service, will be replaced by a FAOSTAT registered users service offering the same facilities as the current subscription service.

#### 4.2.1 Forest Products Yearbook

FAO is annually collecting information on forest production and trade. Since 1998, this has been a joint effort between FAO, ITTO, UNECE and EUROSTAT. A joint questionnaire is sent out to all countries and each of the partners is responsible for the follow-up and collection from a set of countries. FAO then compiles the data collected by all partners and publishes the information.

In the case of a country not submitting the annual questionnaire, latest reported data are usually repeated in order to maintain a time series without data gaps. In the case of woodfuel and charcoal, many countries lack official data and FAO has made estimates based on consumption models.

Data are available online through the FAOSTAT database (*http://faostat.fao.org*) and when "data quality" is selected in the FAOSTAT interface it is possible to distinguish between official data and estimated and calculated data.

#### 4.2.2 Land use data

The land use data are required for making economic plans and policies for food security and for deriving environmental indicators. Data collection is based on a hierarchical structure and follows an approximate harmonized international land use classification system and definitions in order to ensure comparability and compatibility.

For example, the first attempt to construct at the first digit is to classify the land use categories into several classes. At the second digit level, the classification may go into details that are more relevant for land use

classification. Some areas of the main classes at the first digit level may even go further if necessary to the third digit level with respect to further details of specific land use.

Data on land use are compiled for the following categories: Country area (including area under inland water bodies), Land area (excluding area under inland water bodies), Agricultural area, Arable land and Permanent crops, Arable land, Temporary crops, Temporary meadows and pastures, Fallow land (temporary: less than 5 years), Permanent crops, Permanent meadows and pastures, Forest area, Other wooded land and Other land covering the country as a whole. Data are also available on 'Area equipped for irrigation etc.

Land use data is available on the FAO website at: *http://faostat.fao.org/site/377/default.aspx#ancor*.

### 4.3    Planted Forest Database

The Global Planted Forest Thematic Study was designed to supplement and complement the work undertaken by FRA 2005 by providing more detailed data on Planted Forests. It was conducted in 61 selected countries that accounted for an estimated 95% of global planted forest area. The countries selected included those with the 30 largest plantation forest areas reported in FRA 2000 and further selected countries in Europe and North America

Data was collected through a questionnaire that was sent to a network of national experts on planted forests and built on the FRA 2005 tables to obtain more detailed information on planted forests. Results, compiled and analysed into a database, aimed to provide a more realistic picture of the status and trends of forest products and services from planted forests

Planted Forest Database is available on a CD-ROM on request from Alberto Del Lungo, Forestry Officer (Alberto.DelLungo@fao.org).


### 4.4    National Forest Monitoring and Assessment Programme (NFMA)

Since the year 2000, the Forestry Department of FAO has invested substantial resources to develop a programme of support to National Forest Monitoring and Assessment (NFMA) with the mandate of quickly responding to country requests for enhanced forest data acquisition and assisting them in setting up and organising 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) and IPCC guidelines.

A total of nine countries have completed a National Forest Inventory with FAO support (Bangladesh, Cameroon, Costa Rica, Guatemala, Honduras, Lebanon, Philippines, Zambia and Nicaragua), while country projects are currently on-going in ten other countries.  Information on NFMA programme and countries involved can be found at the NFMA homepage: *http://www.fao.org/forestry/nfma/*

A key component of NFMA is to build country capacity to carry out successive inventories with their own resources. Upon completion of a National Forest Inventory, national staff is trained in the analysis of the data and assisted on how to extract information. While FAO facilitates the dissemination of the generated information, it remains the countries' responsibility to maintain the complete sets of data to be utilized for national purposes and for international reporting and to build country capacity to carry out successive inventories with their own resources.

### 4.5    Other relevant FAO data bases

The Harmonized World Soil Database contains soil information (including on soil carbon) at 1km resolution. It is a database developed by FAO with partners and made available from the IIASA website: *http://www.iiasa.ac.at/Research/LUC/luc07/External-World-soil-database/HTML/*.

Global Land Use Systems has information on land use (including livestock) at 5 minute resolution and is available at: *http://www.fao.org/nr/lada/index.php?/LUS-LADA-MAPS.html*

FAO Geonetwork portal (*http://www.fao.org/geonetwork/*) provides Internet access to interactive maps, satellite imagery and related spatial databases maintained by FAO and its partners. Its purpose is to

improve access to and integrated use of spatial data and information. Many UN agencies and other institutions have adopted GeoNetwork Opensource for their data dissemination strategy including:

*UN-OCHA: http://gisweb.ciat.cgiar.org:8080/geonetwork/srv/en/main.home*
*WFP-VAMSIE: http://geonetwork.unocha.org/geonetwork/srv/en/main.home*
*ICIMOD : http://arcsde.icimod.org.np:8080/geonetwork/srv/en/main.home*
*CGIAR-CIAT: http://vam.wfp.org/geonetwork/srv/en/main.home*
*CGIAR-IWMI: http://geonetwork.iwmi.org:8080/geonetwork/srv/en/main.home*

The FAO GeoNetwork portal allows the retrieval of metadata records from networked nodes. Currently, almost seven thousands metadata records can be found in the FAO GeoNetwork portal, of which almost five thousands were produced by FAO only. Digital maps as well as GIS and Remote Sensing data sets are available for display and download. For example, the FAO coarse resolution spatial datasets of different category (i.e. boundaries, agriculture, climate, fishery, forestry, environmental and socio-economic indicators, etc.) have been documented and uploaded.

## 5. THE DATASETS AND HOW THEY CAN BE USED

This chapter outlines each activity data item in the IPCC guidelines for AFOLU and gives details of the appropriate FAO dataset that can be used. For each source or sink category, detail of the appropriate FAO data are given and any conversion or issues that may be important are noted. When using the data attention must be paid to any conversion needed due to differences in definitions and/or units.

### 5.1 Forest Land

The 2006 IPCC Guidelines provide a broad definition of Forest Land as: "…all land with woody vegetation consistent with thresholds used to define Forest Land in the national greenhouse gas inventory. It also includes systems with a vegetation structure that currently falls below, but in situ could potentially reach the threshold values used by the a country to define the Forest Land category." The countries can choose their national definition incorporating land cover and use or both depending on national circumstances.

As mentioned earlier, the IPCC Guidelines advise the use of FAO datasets for information on activity data like area and area changes and the various parameters relating to Forestland. Many FAO datasets contain data relating to Forest Land. The Global Forest Resources Assessment (FRA) collects data on forest area at periodic (5 to 10 year) intervals for all countries and territories.  FRA data on forest area has been annualized by linear interpolation and incorporated in the FAOSTAT database on land use. In addition to the area of forest, FRA also collects information on the area of Other Wooded Land (basically bush- and shrubland) and the area of Other Land and Other Land with Tree Cover. Definitions used by FRA are given in Annex 10.

Some issues however need to be addressed in using these datasets for GHG inventories for AFOLU sector. Firstly, the national definitions of forestland used by countries for their GHG reporting may not correspond to the definitions used for reporting to FAO datasets such as Global Forest Resources Assessment (FRA). Further, the countries have to distinguish their managed forests from unmanaged forests using national definitions in their GHG reporting. FAO datasets typically do not separate the information on managed forests and some additional guidance such as that on the proxies that could be established may be needed to obtain the information on managed forests from the FAO datasets. There also are other general issues such as disaggregation of aggregate statistics (e.g. wood removals like industrial roundwood and fuelwood) into different land use sources (e.g. forestland, cropland etc.).

The following gives a brief description of the main parameters used in the IPCC Guidelines for Forest land and their relationship with the FAO datasets.

### 5.1.1   Area/Area changes

| | |
|---|---|
| Description | Information on areas of managed forests and areas of other land uses (e.g. Cropland and Grasslands) converted to managed forests disaggregated as feasible according to different climate zones, ecological zones, soil types, forest types, management systems, and regions of a country or other nationally relevant stratification systems. |
| Definition(s) in the IPCC Guidelines | See the "Description" above |
| Units in the IPCC Guidelines | Hectare |
| 2006 IPCC Guidelines | See Guidance in Chapter 4, Volume 4(1) and Equations 2.6, 2.9, 2.16, 2.18, 2.19, 2.21, 2.23 and 2.25 |
| GPG/GPG-LULUCF | Chapter 3, Equations 3.2.4, 3.2.11, 3.2.12, 3.2.13, 3.2.14, 3.2.15, 3.2.23, 3.2.26, 3.2.27, 3.2.29, 3.2.30 , 3.2.31 and 3.2.33 |
| 1996 IPCC Guidelines | Chapter 5, Reference Manual, Equation 2 |
| FAO Dataset(s) | <ul><li>FAOSTAT: Annualized forest area data</li><li>Global Forest Resources Assessment (FRA): other additional disaggregated forest-type information:</li><li>Country-specific information can be found in the country reports to FRA</li><li>Global Planted Forests Thematic Study: Results and Analysis</li><li>National Forest Monitoring and Assessment (NFMA)</li></ul> |
| URL | *http://faostat.fao.org*  (FAOSTAT data portal) <br><br>*www.fao.org/forestry/fra*  (FRA home page) <br><br>*http://www.fao.org/forestry/14119-1-0.pdf*  (FRA specifications and definitions) <br><br>*www.fao.org/forestry/12139-1-0.pdf* (planted forests, results and analysis) <br><br>*ftp://ftp.fao.org/docrep/fao/010/j9419e/j9419e.pdf*   (planted forests, country responses) <br><br>*http://www.fao.org/forestry/12140-1-0.pdf* (planted forests, desk studies) <br><br>http://www.fao.org/forestry/nfma/en/(NFMA) |
| Features of the datasets including definitions | <u>Forest</u>: <br><br>"Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use." <br><br><u>Other wooded land</u>: <br><br>"Land not classified as Forest, spanning more than 0.5 hectares; with trees higher than 5 meters and a canopy cover of 5-10 percent, or trees able to reach these thresholds in situ; or with a combined cover of shrubs, bushes and trees above 10 percent. It does not include land that is predominantly under agricultural or urban land use." <br><br><u>Other land with tree cover</u>: <br><br>"Land not classified as forest or other wooded  land, spanning more than 0.5 hectares with a canopy cover of more than 10 percent of trees able to reach a height of 5 meters at maturity." |

| | |
|---|---|
| | Notes:<br><br>• The FRA definition of Forest explicitly includes rubber plantations which in agricultural statistics are usually included as a permanent crop. Special care must therefore be taken in order to not double count the area of rubber plantations. FRA 2010 will contain information on the area of rubber plantations.<br>• The full definitions including a number of explanatory notes to the definitions are provided in Annex 10 |
| Units in the datasets | 1000 hectares |
| Availability (Years/country/region) | • FAOSTAT:<br>   o Data availability: 227 countries and territories<br>   o Reporting years: annual data since 1990<br>• FRA2005:<br>   o Data availability: 229 countries and territories<br>   o Reporting years: 1990, 2000 and 2005<br>• FRA2010 (data to be released in 2010):<br>   o Data availability: 233 countries and territories<br>   o Reporting years: 1990, 2000, 2005 and 2010<br>• Global Planted Forest Thematic Study<br>   o Data availability: 61 countries<br>   o Reporting years: 1990, 2000 and 2005 |
| Conversion if any required | The FRA data set from the country reporting process contains data at country or territory level on the total area of forest. It is not further subdivided into climate domains or ecological zones. Information is not collected on areas of managed forests. However, the FRA dataset contains information on supplementary variables, such as the area of primary forest, area of forest in protected areas and area under forest management plan which in some circumstances might be used to estimate the area of managed forest. |
| Remarks | FRA emphasizes consistent time series as more important than strictly applying FAO definitions. Therefore, FRA data commonly reflect national definitions of forest area. FRA data on forest area from two points in time can be used to assess the net change of forest area but this net change cannot be further subdivided into area of land converted to forest land and forest land converted to other land. |

*5.1.2    Above-ground biomass*

| | |
|---|---|
| Description | Information on above-ground biomass stocks of managed forests disaggregated as feasible according to different climate zones, ecological zones, soil types, forest types, management systems, and regions of a country or other nationally relevant stratification systems. |
| Definition(s) in the IPCC Guidelines | All biomass of living vegetation, both woody and herbaceous, above the soil including stems, stumps, branches, bark, seeds, and foliage. |
| Units in the IPCC Guidelines | tonnes d.m./ha |
| 2006 IPCC Guidelines | See guidance in Chapter 4, Volume 4(1) and Equation 2.14 (Parameter $B_w$), |
| GPG/GPG-LULUCF | GPG-LULUCF: Chapter 3, Equation 3.2.9 (Parameter $B_w$) |
| 1996 IPCC Guidelines | Chapter 5, Reference Manual, Equation 1 |
| FAO Dataset(s) | FRA2005, FRA2010, Country reports to FRA, National Forest Monitoring and Assessment(NFMA) and Global Planted Forests Thematic Study: Results and Analysis for 61 reported countries (only includes growth rates and harvested volumes in m3/ha by species) |
| URL | *www.fao.org/forestry/fra  (FRA home page)*<br>*www.fao.org/forestry/nfma  (NFMA home page)*<br>*www.fao.org/forestry/12139-1-0.pdf  (planted forests, results and analysis)*<br>*ftp://ftp.fao.org/docrep/fao/010/j9419e/j9419e.pdf*  (planted    forests,    country responses)<br>*http://www.fao.org/forestry/12140-1-0.pdf*  (planted forests, desk studies) |
| Features of the dataset(s) including definitions | • The FRA definition is identical to the IPCC definition.<br>• The FRA data set contains information on above-ground biomass disaggregated by forest and other wooded land. No further disaggregation is available in the FRA data set. The country reports to FRA provide further information on how the above-ground biomass was estimated, such as conversion factors used, etc. |
| Units in the dataset | FRA: Million metric tonnes (oven dry weight), NFMA: Country specific |
| Availability (Years/country/region) | • FRA 2005:<br>    o Data availability: 146 out of 229 countries and territories have reported data for all reporting years.<br>    o Reporting years: 1990, 2000 and 2005<br>• FRA 2010:<br>    o Data will be available in 2010<br>    o Reporting years: 1990, 2000, 2005 and 2010<br>• Global Planted Forests Thematic Study:<br>    o Data availability: 61 reported countries<br>    o Reporting years: 1990, 2000 and 2005<br>• NFMA: Country specific |
| Conversion if any required | • Total biomass has to be converted to t.d.m./ha using the appropriate area information.<br>• To convert merchantable volume growth/removals to above ground biomass growth the appropriate default values of biomass conversion and expansion (removal/increment) factor as given in table 4.5, Chapter 4, Vol. 4(1), 2006 IPCC Guidelines can be applied. |
| Remarks | • Biomass data reported by the countries to FRA are usually obtained by applying the IPCC default parameters.<br>• A majority of countries only have data on stocks per hectare for one point in time and in these cases the time series on biomass in the FRA data set only reflects the changes in forest area. |

### 5.1.3 Growing Stock

| | |
|---|---|
| Description | Information on growing stock of managed forests as feasible according to different climate zones, ecological zones, soil types, forest types, management systems, and regions of a country or other nationally relevant stratification systems. |
| Definition(s) in the IPCC Guidelines | Volume over bark of all living trees more than X cm in diameter at breast height. It includes the stem from ground level or stump height up to a top diameter of Y cm, and may also include branches to a minimum diameter of W cm. Countries indicate the three thresholds (X, Y, W in cm) and the parts of the tree that are not included in the volume. Countries also indicate whether the reported figures refer to volume above ground or above stump. The diameter is measured at 30cm above the end of the buttresses if these are higher than 1 meter. It includes wind-fallen living trees and excludes smaller branches, twigs, foliage, flowers, seeds, and roots. |
| Units in the IPCC Guidelines | $m^3$/ha |
| 2006 IPCC Guidelines | See guidance in Chapter 4, Volume 4(1), and Equation 2.8(b) (Parameter $V_{i,j}$) |
| GPG/GPG-LULUCF | GPG-LULUCF: Chapter 3, Equation 3.2.3 (Parameter V) |
| 1996 IPCC Guidelines | N.A. |
| FAO Dataset(s) | • FRA 2005<br>• FRA 2010<br>• Country reports to FRA<br>• National Forest Monitoring and Assessment(NFMA) |
| URL | *www.fao.org/forestry/fra* (FRA home page)<br><br>*www.fao.org/forestry/nfma* (NFMA home page) |
| Features of the data sets including definitions | The FRA definitions are the same as in the IPCC Guidelines.<br><br>**Note:** the FRA data set contain information on growing stock disaggregated by forest and other wooded land and in FRA 2010 also by coniferous and broadleaved species. No further disaggregation is available. The country reports to FRA provide additional information on how the growing stock was estimated. |
| Units in the dataset | FRA: Million cubic meters (over bark)<br><br>NFMA: harmonized with FRA |
| Availability (Years/country/region) | • FRA 2005:<br>    ○ Data availability: 146 out of 229 countries and territories. Data set contains some gaps and does not cover all 233 reporting units.<br>    ○ Reporting years: 1990, 2000, and 2005<br>• FRA 2010:<br>    ○ Data availability: not available yet<br>    ○ Reporting years: 1990, 2000, 2005 and 2010<br>• National Forest Monitoring and Assessment(NFMA): Available only for selected countries |
| Conversion if any required | • Total growing stock has to be converted to m3/ha using the appropriate area information.<br>• Volume(under-bark) has to be converted to Volume(over-bark) using the appropriate expansion factor. |
| Remarks | The methodology and consistency of methods across datasets and reporting years in terms of methods and definitions should be verified. |

### *5.1.4    Above-ground biomass growth*

| | |
|---|---|
| Description | Information on above-ground biomass growth of managed forest as feasible according to different climate zones, ecological zones, soil types, forest types, management systems, and regions of a country or other nationally relevant stratification systems. |
| Definition(s) in the IPCC Guidelines | Oven-dry weight of net annual increment (s.b.) of a tree, stand or forest plus oven-dry weight of annual growth of branches, twigs, foliage, top and stump |
| Units in the IPCC Guidelines | tonnes d.m./ha/yr |
| 2006 IPCC Guidelines | See guidance in Chapter 4, Volume 4(1) and Equations 2.10 & 2.21 (Parameter $G_W$) |
| GPG/GPG-LULUCF | GPG-LULUCF: Chapter 3, Equation 3.2.5 (Parameter $G_W$) |
| 1996 IPCC Guidelines | Chapter 5, Reference Manual, Equation 1 |
| FAO Dataset(s) | There is no data set that directly provides the biomass increment values but it could be derived from the net volume increment data from relevant FAO datasets. |
| URL | N.A. |
| Features of the dataset(s) including the definitions | N.A. |
| Units in the dataset | N.A. |
| Availability (Years/country/region) | N.A. |
| Conversion if any required | Volume increment can be converted to biomass increment by applying appropriate conversion and expansion factors as given in the IPCC Guidelines. |
| Remarks | Global Planted Forests Thematic Study provides the minimum and maximum annual volume increment (m³/ha/yr) by species. Increment refers to Mean Annual Increment (MAI). 31 countries out of 61 have provided increment data. This is available at:<br><br>• www.fao.org/forestry/12139-1-0.pdf (planted forests, results and analysis)<br>• ftp://ftp.fao.org/docrep/fao/010/j9419e/j9419e.pdf (planted forests, country responses)<br>• http://www.fao.org/forestry/12140-1-0.pdf (planted forests, desk studies) |

### 5.1.5    Average Net Annual Increment (Growing stock)

| | |
|---|---|
| Description | Information on the net annual increment of managed forest land as feasible according to different climate zones, ecological zones, soil types, forest types, management systems, and regions of a country or other nationally relevant stratification systems. |
| Definition(s) in the IPCC Guidelines | Average annual volume of gross increment over the given reference period minus mortality (s.a.), of all trees to a specified minimum diameter at breast height. As used here, it is not net of losses due to disturbances (s.a.). |
| Units in the IPCC Guidelines | $m^3$/ha/yr |
| 2006 IPCC Guidelines | See guidance in Chapter 4, Volume 4(1) and  Equation 2.10 (Parameter $I_V$) |
| GPG/GPG-LULUCF | GPG-LULUCF: Chapter 3, Equation 3.2.5(B) (Parameter $I_V$) |
| 1996 IPCC Guidelines | Chapter 5, Reference Volume |
| FAO Dataset(s) | • National Forest Monitoring and Assessment(NFMA)) <br> • Global Planted Forests Thematic Study: Results and Analysis |
| URL | • *www.fao.org/forestry/nfma*  (NFMA home page) <br> • *www.fao.org/forestry/12139-1-0.pdf* (Planted forests, results and analysis) <br> • *ftp://ftp.fao.org/docrep/fao/010/j9419e/j9419e.pdf*   (planted forests, country responses) <br> • *http://www.fao.org/forestry/12140-1-0.pdf*  (planted forests, desk studies) |
| Features of the dataset(s) including the definitions | Global Planted Forest Thematic Study provides data on maximum and minimum values for mean annual increment (MAI) by species. |
| Units in the dataset | • NFMA:  Country specific <br> • Planted forest thematic study:  $m^3$/ha/yr |
| Availability (Years/country/region) | • NFMA: Country specific <br> • Global Planted Forest Thematic Study:  Available for 31 out of 61 countries that have provided increment data. |
| Conversion if any required | Additional information may be needed for conversion of the data from the datasets. |
| Remarks | The UNECE State of Europe´s Forests 2007 (*http://w3.unece.org/pxweb/DATABASE/STAT/Timber.stat.asp*) is another dataset providing data for European forests. |

### 5.1.6 Annual industrial round-wood removal

| | |
|---|---|
| Description | Information on industrial round-wood removals (H) from managed forests as feasible according to different climate zones, ecological zones, soil types, forest types, management systems, and regions of a country or other nationally relevant stratification systems. |
| Definition(s) in the IPCC Guidelines | Annual volume of industrial round-wood removal (H) from managed forests (overbark) |
| Units in IPCC Guidelines | $m^3$/yr |
| 2006 IPCC Guidelines | See guidance in Chapter 4, Volume 4(1) and Equation 2.12 (Parameter H) |
| GPG/GPG-LULUCF | GPG-LULUCF: Chapter 3, Equation 3.2.7(Parameter H) |
| 1996 IPCC Guidelines | Chapter 5, Reference Volume, Equation 1 |
| FAO Dataset(s) | FAOSTAT |
| URL | *http://faostat.fao.org/site/626/default.aspx#ancor* |
| Features of the datasets including definitions | Data in FAOSTAT is under-bark volume disaggregated by coniferous and broadleaved species but not by land-use types and regions. |
| Units in the dataset | $m^3$/yr (underbark) |
| Availability (Years/country/region) | FAOSTAT data is available from 1961 onwards for all countries and regions. |
| Conversion if any required | • Under-bark volume data needs to be converted to over-bark volume using the appropriate factors as given in the IPCC Guidelines/country-specific factors.<br>• FAOSTAT does not disaggregate the data on wood removals based on land-use source. |
| Remarks | Additional information can be found in:<br><br>• Global Planted Forests Thematic Study: Results and Analysis(for 61 reported countries; only includes growth rates and harvested volumes in $m^3$/ha by species)<br>• FRA country reports |

## 5.1.7    Annual fuel-wood removal

| | |
|---|---|
| Description | Data on fuel-wood removals from managed forests as feasible according to different climate zones, ecological zones, soil types, forest types, management systems, and regions of a country or other nationally relevant stratification systems. |
| Definition(s) in the IPCC Guidelines | The wood removed (overbark) for energy production purposes, regardless of whether for industrial, commercial, or domestic use. Fuel wood includes wood collected or removed directly from forest or other wooded land for energy purposes only. It excludes fuel-wood which is produced as a by-product or residual matter from the industrial processing of round wood. It includes removal from fellings in an earlier period and from trees killed or damaged by natural causes. It also includes removal by local people or owners for their own use. |
| Units  in IPCC Guidelines | $m^3$/yr |
| 2006 GL | See guidance in Chapter 4, Volume 4(1) and  Equation 2.13 (Parameters $FG_{tree}$ and $FG_{part}$) |
| GPG/GPG-LULUCF | GPG-LULUCF: Chapter 3, Equation 3.2.8 (Parameter FG) |
| 1996 GL | Chapter 5, Reference Volume, Equation 1 |
| FAO Dataset(s) | FAOSTAT |
| URL | *http://faostat.fao.org/site/626/default.aspx#ancor* |
| Features of  FAO dataset including definitions | Wood Fuel, including Wood for Charcoal<br><br>Roundwood that will be used as fuel for purposes such as cooking, heating or power production. It includes: wood harvested from main stems, branches and other parts of trees (where these are harvested for fuel) and wood that will be used for charcoal production (e.g. in pit kilns and portable ovens). The volume of roundwood used in charcoal production, is estimated by using a factor of 6.0 to convert from the weight (MT) of charcoal produced to the solid volume (m3) of roundwood used in production. It is reported in cubic metres underbark (i.e. excluding bark). |
| Units in the dataset | $m^3$ (underbark) |
| Availability (Years/country/region) | Available from 1961 onwards for all countries and regions |
| Conversion if any required | • Under-bark volume data needs to be converted to over-bark volume  using the appropriate factors as given in the IPCC Guidelines/country-specific factors.<br>• FAOSTAT data does not separate the fuel-wood data based on the land-use source.  To obtain data on proportion of fuel-wood coming from forests additional information and expert judgment may be used based on national circumstances. |
| Remarks | • FAOSTAT does not separate the fuelwood coming from forest land and forest land converted to other land-uses.<br>• Wood burnt for energy purposes is to be reported in energy sector as an 'information item'. |

### 5.1.8 Area affected by disturbance

| | |
|---|---|
| Description | Information on areas of managed forests affected by disturbances as feasible according to different climate zones, ecological zones, soil types, forest types, management systems, and regions of a country or other nationally relevant stratification systems. |
| Definition(s) in the IPCC Guidelines | Annual area of forests affected by disturbances. A disturbance is defined as an environmental fluctuation and destructive event that disturbs forest health, structure, and/or changes resources or physical environment at any given spatial or temporal scale. Disturbances that affect health and vitality include biotic agents such as insects and diseases, and abiotic agents such as fire, pollution, and extreme weather conditions. |
| Units in the IPCC Guidelines | Hectare /yr |
| 2006 IPCC Guidelines | See guidance in Chapter 4, Volume 4(1) & Equation 2.1 4 (Parameter $A_{disturbance}$) |
| GPG/GPG-LULUCF | GPG-LULUCF: Chapter 3, Equation 3.2.9 (Parameter $A_{disturbance}$ ) |
| 1996 IPCC Guidelines | N.A. |
| FAO and other Dataset(s) | FRA 2005, FRA 2010 and Country reports to FRA |
| URL | *http://www.fao.org/docrep/008/a0400e/a0400e00.HTM* |
| Features of the dataset including definitions | FRA defines disturbance as damage caused by any factor (biotic or abiotic) that adversely affects the vigour and productivity of the forest and which is not a direct result of human activities. Disturbance categories:<br>• Fire, whenever possible disaggregated by forest, other wooded land and other land.<br>• Insects<br>• Diseases attributable to pathogens, such as bacteria, fungi, phytoplasma or virus.<br>• Biotic agents other than insects or diseases, such as wildlife browsing, grazing, physical damage by animals, etc.<br>• Abiotic factors such as air pollution, snow, storm, drought, etc.<br>• The FRA data set does not contain any information on the intensity of fires and other disturbances.<br>Data in the FRA dataset refer to 5-year averages, in order to reduce the impact of annual variations. |
| Units in the dataset | 1000 hectares/year |
| Availability (Years/country/region) | • FRA 2005:<br>   o Data availability: Data set contains gaps - out of 229 countries and territories, 112 reported on fire, 66 on insects and 57 on diseases.<br>   o Reporting years**:** 1990, 2000<br>• FRA 2010:<br>   o Data will be available in 2010.<br>   o Reporting years**:** 1990, 2000, 2005<br>• Country reports to FRA: Country-specific |
| Conversion if any required | • Area figures have to be multiplied by 1000 to get the area in hectare/year.<br>• Additional information is required in case no disaggregated data is available by land-use categories. |
| Remarks | • UNEP database on global burnt area: http://www.grid.unep.ch/<br>• A database on rate and impact of natural disturbances by type, for all European countries is available at: http://www.efi.fi/ |

## 5.2 **Cropland**

The 2006 IPCC Guidelines define Cropland as , "…arable and tillable land, rice fields, and agro-forestry systems where the vegetation structure falls below the thresholds used for Forest Land category, and is expected not to exceed those thresholds at a later time." It includes:

- Annual crops such as cereals, oils seeds, vegetables root crops etc.
- Perennial crops including agro-forestry systems, orchards, vineyards and plantations such as cocoa, coffee, rubber, oil palm etc.
- Temporary fallow[4] lands and arable land which are normally used for cultivation of annual crops but have been temporarily used for forage crop and grazing as part of annual crop-pasture rotation system.

The main FAO datasets relevant for cropland category are FRA and FAOSTAT. The important thing to note here is that FRA specifically includes rubber plantations under the forest category, while rubber generally is also included as a permanent crop. The FRA 2010 will contain data on the area of rubber plantations so necessary adjustments can be made.

A brief description of the relevant FAO datasets for various parameters in Cropland is given below.

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[4] Land set at rest for one or more years before being cultivated again.

### *5.2.1   Area/area changes*

| | |
|---|---|
| Description | Information on area of  annual and perennial crops remaining as cropland and conversion to cropland from other land uses disaggregated as feasible according to   different climate zones, ecological zones, soil types, crop-types, management systems, and regions of a country or   other nationally relevant stratification systems |
| Definition(s) in the IPCC Guidelines | See the "Description" above |
| Units in the IPCC Guidelines | Hectare |
| 2006 IPCC Guidelines | See guidance in Chapter 5, Volume 4(1) and  Equations 2.6, 2.9, 2.18, 2.19, 2.21, 2.23 and 2.25 |
| GPG/GPG-LULUCF | GPG-LULUCF: Chapter 3 |
| 1996 IPCC Guidelines | Chapter 5, Reference Manual |
| FAO Dataset(s) | • FAOSTAT<br>• FRA |
| URL(s) | *http://faostat.fao.org/*<br>*http://www.fao.org/forestry/fra* |
| Features of the  dataset including definitions | • FAOSTAT:<br>  o  Annual crops are those that are planted and harvested during the same production season.<br>  o  Perennial crops are plants that live for more than two years.<br>• FRA 2010 will include information on the area of rubber plantations to ensure that these areas are not double-counted. |
| Units in the dataset | 1000 hectares |
| Availability (Years/country/region) | • FAOSTAT:<br>  o  Data availability**:** Available for all countries<br>  o  Reporting years**:** Annual data from 1961 onwards<br>• FRA 2010:<br>  o  Data availability**:** It will cover 233 countries and territories and data will be available in 2010.<br>  o  Reporting years**:** 1990, 2000, 2005 and 2010. |
| Conversion if any required | Area should be multiplied by 1000. |
| Remarks | • FAOSTAT uses "area harvested" for production purposes.<br>• Although FRA includes "Other land with tree cover", it may not be equivalent to perennial cropland.<br>• Other relevant datasets are:<br>  o  Country reports to FRA<br>  o  Agro-maps<br>  o  LADA(one-time assessment of land use systems) |

### 5.2.2 *Above-ground woody biomass in perennial croplands*

| | |
|---|---|
| Description | Information on above ground biomass in perennial cropland disaggregated as feasible according to different climate zones, ecological zones, soil types, crop-types, management systems, and regions of a country or other nationally relevant stratification systems. |
| Definition(s) in the IPCC Guidelines | Perennial croplands include trees and shrubs, in combination with herbaceous crops (e.g. agroforestry) or as orchards, vineyards and plantations such as cocoa, coffee, tea, oil palm, coconut, rubber trees and bananas, except where these lands meet the criteria for categorization as Forest Land. |
| Units in Guidelines | Tonnes dry matter /ha |
| 2006 IPCC Guidelines | See guidance in Chapter 5, Volume 4(1) and Equations 2.10 and 2.21 (Parameter $G_W$) |
| GPG/GPG-LULUCF | GPG-LULUCF: Chapter 3 |
| 1996 IPCC Guidelines | N.A. |
| FAO Dataset(s) | No FAO dataset contains this information directly. |
| URL | N.A. |
| Features of the datasets including the definitions | N.A. |
| Units in the dataset | N.A. |
| Availability (Years/country/region) | N.A. |
| Conversion if any required | N.A. |
| Remarks | • FAOSTAT contains data on area harvested, total production and yield for various permanent crops.<br>• FRA2010 will contain the information on the area of rubber plantations.<br>• Expert knowledge on planting densities and biomass of trees etc. will have to be applied to make estimates of the above ground biomass.<br>• Area of perennial crops can be used for validation. |

### 5.2.3 Biomass losses from removal, fuel-wood and disturbance

| | |
|---|---|
| Description | Information on biomass losses from removal, fuel-wood and disturbance in perennial cropland disaggregated as feasible according to different climate zones, ecological zones, soil types, crop-types, management systems, and regions of a country or other nationally relevant stratification systems |
| Definition(s) in the IPCC Guidelines | See the "Description" above |
| Units in Guidelines | tonnes.d.m/ha |
| 2006 IPCC Guidelines | See guidance in Chapter 5, Volume 4(1) and, Equation 2.12 (Parameter H), 2.13 (Parameters $FG_{trees}$, $FG_{part}$) |
| GPG/GPG-LULUCF | GPG-LULUCF: Chapter 3 |
| 1996 IPCC Guidelines | Chapter 5, Reference Manual |
| FAO Dataset(s) | FAO does not collect the data on biomass loss due to removal, fuel-wood and disturbance by land use type. |
| URL | N.A. |
| Definition in the dataset | N.A. |
| Units in the dataset | N.A. |
| Availability (Years/country/region) | N.A. |
| Conversion if any required | N.A. |
| Remarks | FAO provides total roundwood and fuelwood removals data (see tables 3.6, 3.7 for details), but these are not separated by source (e.g., Cropland, Forest Land, etc.). |

### 5.2.4  Annual crop area planted

| | |
|---|---|
| Description | Information on areas of annual crops planted disaggregated as feasible according to different climate zones, ecological zones, soil types, crop-types, management systems, and regions of a country or other nationally relevant stratification systems |
| Definition(s) in the IPCC Guidelines | See the "Description" above |
| Units in Guidelines | Hectare |
| 2006 IPCC Guidelines | Chapter 5, Volume 4(1) |
| GPG/GPG-LULUCF | GPG-LULUCF: Chapter 3 |
| 1996 IPCC Guidelines | Chapter 5, Reference Volume |
| FAO Dataset(s) | FAOSTAT |
| URL | *http://faostat.fao.org/* |
| Features of the dataset including definitions | <ul><li>This is equivalent to area of temporary crops in the land use section of the FAOSTAT.</li><li>Temporary crops is all land used for crops with a less than one-year growing cycle and which must be newly sown or planted for further production after the harvest..</li><li>Fallow land (temporary) is the cultivated land that is not seeded for one or more growing seasons. The maximum idle period is usually less than five years. Land remaining fallow for too long may acquire characteristics requiring to be reclassified, such as "permanent meadows and pastures" (if used for grazing), "forest or wooded land" (if overgrown with trees), or "other land" (if it becomes wasteland).</li></ul> |
| Units in the dataset | 1000 hectares |
| Availability (Years/country/region) | <ul><li>Data availability: Available for all countries</li><li>Reporting years: Annual data from 1961 onwards</li></ul> |
| Conversion if any required | Area should be multiplied by 1000. |
| Remarks | This area includes the fallow lands. |

### 5.2.5 Average productivity per hectare

| | |
|---|---|
| Description | Information on average productivity per hectare disaggregated as feasible according to different climate zones, ecological zones, soil types, crop-types, management systems, and regions of a country or other nationally relevant stratification. |
| Definitions in the IPCC Guidelines | See the "Description" above |
| Units in IPCC Guidelines | Tonnes dry matter ./hectare |
| 2006 IPCC Guidelines | Chapter 5, Volume 4(1) |
| GPG/GPG-LULUCF | GPG-LULUCF: Chapter 3 |
| 1996 IPCC Guidelines | N.A. |
| FAO Dataset(s) | FAOSTAT |
| URL | *http://faostat.fao.org/* |
| Features of the dataset including definitions | • All yields are per hectare for single countries<br>• All major crops are covered |
| Units in the dataset | Hg/ha  (1 Hg = 1 hectogram = 0.1 kg) |
| Availability (Years/country/region) | • Data availability**:** Available for all countries<br>• Reporting years: Annual data from 1961 onwards |
| Conversion if any required | Appropriate conversion may be applied using area information. |
| Remarks | • Data on yields of permanent crops are not as reliable as those for temporary crops  either because most of the area information may correspond to planted area, as for grapes, or because of the scarcity and unreliability of the area figures reported by the countries , as for example for cocoa and coffee<br>• The exact unit in the dataset is crop-specific. |

### 5.2.6 Annual harvested area for rice cultivation

| | |
|---|---|
| Description | Information on annual harvested area for rice cultivation disaggregated as feasible by climate, soil type, cultivation period, water regime, agronomic practices, and cultivar types. |
| Definition(s) in the IPCC Guidelines | See the "Description" above |
| Units in the IPCC Guidelines | Hectare |
| 2006 IPCC Guidelines | Chapter 5, Volume 4(1), Equation 5.1 (Parameter $A_{i,j,k}$) |
| GPG/GPG-LULUCF | GPG2000: Chapter 4, Equation 4.41 (Parameter $A_{ijk}$) |
| 1996 IPCC Guidelines | Chapter 5, Reference Volume, Equation 1 |
| FAO and other Dataset(s) | FAOSTAT |
| URL | *http://faostat.fao.org/* |
| Definition in the dataset(s) | Area harvested refers to the area from which rice paddy is gathered, excluding the area from which, although sown or planted, there was no harvest due to damage or failure. Rice paddy is grain after threshing and winnowing. It is also known as "rice-in-the-husk" or "rough rice" and is mainly used as food for humans. |
| Units in the dataset | Hectare |
| Availability (Years/country/region) | • Data availability**:** Available for all countries<br>• Reporting years**:** Annual data from 1961 onwards |
| Conversion if any required | None |
| Remarks | • In case of multiple (successive) cropping during the same year, 'harvested area' is equal to the sum of the area cultivated for each cropping.<br>• Other relevant dataset is the IRRI World Rice statistics (*http://www.irri.org/science/ricestat/*) |

## 5.3    Grassland

Grasslands are defined in the 2006 IPCC Guidelines as rangelands and pasture land that are not considered Cropland. Grasslands are generally dominated by perennial grasses but may include systems with woody vegetation and other non-grass vegetation such as herbs and brushes that fall below the thresholds used to define forests. They may include agricultural and silvi-pastoral systems consistent with national definitions.

### *5.3.1    Area and area changes*

| | |
|---|---|
| Description | Information on areas of managed grasslands and conversion of other land uses to managed grasslands disaggregated as feasible according to different climate zones, ecological zones, soil types, crop-types, management systems, and regions of a country or other nationally relevant stratification. |
| Definition(s) in the IPCC Guidelines | See the "Description" above |
| Units in Guidelines | Hectare |
| 2006 IPCC Guidelines | See guidance in Chapter 5, Volume 4(1) and, Equations 2.6, 2.9, 2.18, 2.19, 2.21, 2.23  and 2.25 |
| GPG/GPG-LULUCF | GPG-LULUCF: Chapter 3, Equation 3.4.4 |
| 1996 IPCC Guidelines | Chapter 5, Reference Volume, Equation 1 |
| FAO Dataset(s) | FAOSTAT |
| URL | *http://faostat.fao.org/* |
| Features of the dataset including definitions | N.A. |
| Units in the dataset | 1000 hectare |
| Availability (Years/country/region) | • Data availability**:** Available for all countries<br>• Reporting years**:** Annual data from 1961 onwards |
| Conversion if any required | Area should be multiplied by 1000. |
| Remarks | NONE |

## 5.4    Wetlands, Settlements & Other land

FAO Datasets do not contain data on these land use categories at present. Please see Annex 11 for a list of other relevant international datasets.

## 5.5 Emissions from Livestock and Manure Management

The IPCC 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 (see Annex 9) for the higher tier methods. Accordingly the Tier 1 methods require only the annual average population (AAP) of the basic subcategories along with the IPCC default emission factors while higher tier methods require the AAP 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.

The main data requirement for livestock emissions estimations and their relationship with relevant FAO datasets are summarized below.

### *5.5.1    Annual Average Population ( AAP)*

| | |
|---|---|
| Description | Annual average populations of the livestock category disaggregated as feasible by gender (males/females/castrates), age (mature/growing), purpose (dairy/ breeding/draft-power) etc. and climate zone. |
| Definition(s) in the IPCC Guidelines | AAP = Days _alive*(NAPA/365) <br> AAP = annual average population <br> NAPA = number of animals produced annually |
| Units in the IPCC Guidelines | Number |
| 2006 IPCC Guidelines | Chapter 10, Volume 4(2), Equations 10.19, 10.22, 10.25, 10.26, 10.28 and 10.34, (Parameter $N_{(T)}$) |
| GPG/GPG-LULUCF | GPG2000: Equation 4.12, 4.18 ( parameter $N_{(T)}$) |
| 1996 IPCC Guidelines | Chapter 4, Reference Manual |
| FAO Dataset(s) | FAOSTAT |
| URL | *http://faostat.fao.org/* |
| Features of the dataset including definitions | Total stocks of animals refer to the number of live animals of the species present in the country at the time of enumeration. Livestock population is given by gender (males/females). |
| Units in the dataset | Livestock data are reported in number of heads except for poultry, rabbits which are reported in thousands ('000). |
| Availability (Years/country/region) | • Data availability**:** Available for all countries <br> • Reporting years: Annual data from 1961 onwards |
| Conversion if any required | Conversion may be required to take into account the production cycle within a year. (e.g., seasonal variation, fattening, etc.) |
| Remarks | Most of the data from developing countries are on a highly aggregated basis. (i.e., They do not differentiate age, gender, production system, etc.) |

### 5.5.2 Live-weight

| | |
|---|---|
| Description | Live-weight of the livestock category disaggregated as feasible by gender (males/females/castrates), age (mature/growing), purpose (dairy/ breeding/draft-power) etc. and climate zone. |
| Definition(s) in the IPCC Guidelines | Live-weight data should be collected for each animal sub-category, and the data should be based on weight measurements of live animals. |
| Units in the IPCC Guidelines | kg |
| 2006 IPCC Guidelines | Chapter 10, Volume 4(2), Equations 10.3, 10.5, 10.6 & 10.7 |
| GPG/GPG-LULUCF | GPG2000: Chapter 4, Equations 4.1, 4.2b, 4.3a & 4.3b (Parameter 'Weight') |
| 1996 IPCC Guidelines | Chapter 4, Reference Manual, Equations 1, 3, 6 & 7 |
| FAO Dataset(s) | Data on live-weight are available on request (by sending an e-mail to *Pierre.gerber@fao.org*), but it is very likely that some countries' data are more complete because FAO data are based exclusively on public information. |
| URL(s) | N.A. |
| Features of the dataset including definitions | N.A. |
| Units in the dataset | N.A. |
| Availability (Years/country/region) | Depend on the public information consulted by FAO, but in general it covers the last 10 years. |
| Conversion if any required | N.A. |
| Remarks | Slaughter-weight data are available from FAO. However they should not be used in place of live-weight data as it fails to account for the complete weight of the animal. Additionally, it should be noted that the relationship between live-weight and slaughter-weight varies with breed, body condition and production system. For cattle, buffalo and mature sheep, the yearly average weight for each animal category (e.g., mature beef cows) is needed. |

### 5.5.3 Mature-weight

| Description | Mature-weight of the livestock category |
|---|---|
| Definition(s) in the IPCC Guidelines | The mature weight is the potential body weights of an adult animal were it to reach 28% body fat (NRC 1996). |
| Units in the IPCC Guidelines | kg |
| 2006 IPCC Guidelines | Chapter 10, Volume 4(2), Equation 10.6 (Parameter MW) |
| GPG/GPG-LULUCF | GPG2000: Chapter 4, Equation 4.3a (Parameter MW) |
| 1996 IPCC Guidelines | |
| FAO Dataset(s) | Data on mature-weight are available on request (by sending an e-mail to *Pierre.gerber@fao.org*), but it is very likely that some countries' data are more complete because FAO data are based exclusively on public information. |
| URL(s) | N.A. |
| Features of the dataset including definitions | N.A. |
| Dimension in the dataset | N.A. |
| Availability (Years/country/region) | Depends on the public information consulted by FAO, but in general it covers the last 10 years. |
| Conversion if any required | N.A. |
| Remarks | The mature weight will vary among breeds and should reflect the animal's weight when in moderate body condition. This is termed 'reference weight' (ACC, 1990) or 'final shrunk body weight' (NRC, 1996). Estimates of mature weight are typically available from livestock specialists and producers. |

### 5.5.4 Average weight gain per day

| | |
|---|---|
| Description | Average weight gain per day of the livestock category |
| Definition(s) in the IPCC Guidelines | No specific definition given either in GPG or 2006 IPCC Guidelines |
| Units in the IPCC Guidelines | kg/day |
| 2006 IPCC Guidelines | Chapter 10, Volume 4(2), Equations 10.6 & 10.7 (Parameters WG & WG$_{lamb}$) |
| GPG/GPG-LULUCF | GPG2000: Chapter 4, Equations 4.3a, 4.3b, 4.5c (parameters WG & WG$_{lamb}$) |
| 1996 IPCC Guidelines | Chapter 4, Reference Manual, Equation 3 (Parameter WG) |
| FAO Dataset(s) | Data on average weight gain are available on request (by sending an e-mail to *Pierre.gerber@fao.org*), but it is very likely that some countries' data are more complete because FAO data are based exclusively on public information. |
| URL(s) | N.A. |
| Features of the dataset including definitions | N.A. |
| Units in the dataset | N.A. |
| Availability (Years/country/region) | Depends on the public information consulted by FAO, but in general it covers the last 10 years. |
| Conversion if any required | N.A. |
| Remarks | Data on average weight gain are generally collected for feedlot animals and young growing animals. Mature animals are generally assumed to have no net weight gain or loss over an entire year. |

### 5.5.5 Average daily milk production

| | |
|---|---|
| Description | Average daily milk production for dairy animals (milking ewes, dairy cows and buffalo). |
| Definition(s) in the IPCC Guidelines | The average daily production should be calculated by dividing the total annual production by 365, or reported as average daily production along with days of lactation per year, or estimated using seasonal production divided by number of days per season. |
| Units in the IPCC Guidelines | Kg/day |
| 2006 IPCC Guidelines | Chapter 10, Volume 4(2), Equations 10.8 & 10.9 (Parameter 'Milk') |
| GPG/GPG-LULUCF | GPG2000: Chapter 4, Equation 4.5a & 4.5b |
| 1996 IPCC Guidelines | Chapter 4, Reference Manual, Equation 4 |
| FAO Dataset(s) | FAOSTAT |
| URL | *http://faostat.fao.org/* |
| Features of the dataset including definition | Annual milk production |
| Units in the dataset | tonne |
| Availability (Years/country/region) | • Data availability: Available for all countries<br>• Reporting years: Annual data from 1961 onwards |
| Conversion if any required | Annual/seasonal milk production in tonne has to be converted to daily milk production based on the period of production (see 'Remarks' below). |
| Remarks | The average daily production data are for milking ewes, dairy cows and buffalo and other cows or non-dairy buffalo nursing calves. If using seasonal production data, the emission factor must be developed for that seasonal period. FAO data do not include milk consumed by suckling young animals. |

### 5.5.6    Fat content

| | |
|---|---|
| Description | Average fat content of milk for lactating cows, buffalo, and sheep producing milk for human consumption |
| Definition(s) in the IPCC Guidelines | No specific definition |
| Units in the IPCC Guidelines | % |
| 2006 IPCC Guidelines | Chapter 10, Volume 4(2), Equation 10.8 (Parameter 'Fat') |
| GPG/GPG-LULUCF | GPG2000: Chapter 4, Equation 4.5a (Parameter 'Fat') |
| 1996 IPCC Guidelines | Chapter 4, Reference Manual, Equation 4 (Parameter 'Fat') |
| FAO Dataset(s) | Data on fat content are available on request (by sending an e-mail to Pierre.gerber@fao.org), but it is very likely that some countries' data are more complete because FAO data are based exclusively on public information. |
| URL(s) | N.A. |
| Features of the datasets including definitions | N.A. |
| Units  in the dataset | % |
| Availability (Years/country/region) | Depend on the public information consulted by FAO, but in general it covers the last 10 years. |
| Conversion if any required | N.A. |
| Remarks | NONE |

### 5.5.7    *Percent of females that give birth in a year*

| | |
|---|---|
| Description | Percent of females that give birth in a year for mature cattle, buffalo, and sheep. |
| Definition(s) in the IPCC Guidelines | See "Description" above |
| Units in the IPCC Guidelines | % |
| 2006 IPCC Guidelines | Chapter 10, Volume 4(2)<br>[This parameter is not directly used in any specific equations, but it is used to select the value for $NE_p$ which is used in Equation 10.16.  (See page 10.20.)] |
| GPG/GPG-LULUCF | GPG2000: Chapter 4[This parameter is not directly used in any specific equations, but it is used to select the value for $NE_p$ which is used in Equation 4.9  (See page 4.19)] |
| 1996 IPCC Guidelines | Chapter 4, Reference Manual[This parameter is not directly used in any specific equations, but it is used to select the value for $NE_{pregnancy}$ which is used in Equation 13  (See page 4.21)] |
| FAO Dataset(s) | Data on calving intervals and replacement rates (infertility) are available on request (by sending an e-mail to *Pierre.gerber@fao.org*), but it is very likely that some countries' data are more complete because FAO data are based exclusively on public information. |
| URL(s) | N.A. |
| Features of the dataset including definitions | N.A. |
| Units in the dataset | N.A. |
| Availability (Years/country/region) | Depend on the public information consulted by FAO, but in general it covers the last 10 years. |
| Conversion if any required | Data on calving intervals and replacement rates (infertility) can be used to estimate percent of females that give birth in a year:<br><br>F = (365/CI) * (100-i) ,<br><br> Where F = percent of females that give birth in a year (%)<br><br>CI = calving intervals (days)<br><br>i= infertility (%), obtained from the percentage of culled cows per year |
| Remarks | NONE |

### *5.5.8 Wool production from sheep*

| | |
|---|---|
| Description | The amount of wool produced (after drying out but before scouring) per sheep |
| Definition(s) in the IPCC Guidelines | See "Description" above |
| Units in the IPCC Guidelines | kg/yr |
| 2006 IPCC Guidelines | Chapter 10, Volume 4(2), Equation 10.16 |
| GPG/GPG-LULUCF | GPG2000: Chapter 4, Equation 4.7 |
| 1996 IPCC Guidelines | Chapter 4, Reference Manual |
| FAO Dataset(s) | No data available from FAO |
| URL(s) | N.A. |
| Features of the dataset including definitions | N.A. |
| Units in the dataset | N.A. |
| Availability (Years/country/region) | N.A. |
| Conversion if any required | N.A. |
| Remarks | It should be noted that wool may be produced not only from sheep but also from other fibre-producing animals (e.g., goat, llama, alpaca), although the IPCC Guidelines refer only to sheep. |

### 5.5.9  Number of offspring

| | |
|---|---|
| Description | Number of offspring for livestock species that have multiple births per year |
| Definition(s) in the IPCC Guidelines | See 'Description' above |
| Units in the IPCC Guidelines | Number /year |
| 2006 IPCC Guidelines | Chapter 10, Volume 4(2) [This parameter is not directly used in any equations (See page 10.12).] |
| GPG/GPG-LULUCF | GPG2000: Chapter 4 [This parameter is not directly used in any equations.] |
| 1996 IPCC Guidelines | Chapter 4, Reference Manual [This parameter is not directly used in any equations.] |
| FAO Dataset(s) | Data on number of offspring are available on request (by sending an e-mail to *Pierre.gerber@fao.org*), but it is very likely that some countries' data are more complete because FAO data are based exclusively on public information. |
| URL(s) | N.A. |
| Features of the dataset including definitions | N.A. |
| Units in the dataset | N.A. |
| Availability (Years/country/region) | Depend on the public information consulted by FAO, but in general it covers the last 10 years. |
| Conversion if any required | N.A. |
| Remarks | NONE |

### *5.5.10 Manure Management System Usage Data*

| Parameter | Manure management system usage |
|---|---|
| Description | The portion of manure managed in each manure management system for each representative animal species |
| Definition(s) in the IPCC Guidelines | See "Description" above |
| Units in the IPCC Guidelines | Fraction |
| 2006 IPCC Guidelines | Chapter 10, Volume 4(2), Equations 10.25, 10.26, 10.28 & 10.34 (Parameter $MS_{(T,S,k)}$) |
| GPG/GPG-LULUCF | GPG2000: Chapter 4, Equation 4.17 & 4.18 (Parameter $MS_{ijk}$) |
| 1996 Guidelines | Chapter 4, Reference Manual, Equation 16 |
| FAO Dataset(s) | Data based on best guesses are available on request (by sending an e-mail to *Pierre.gerber@fao.org*). Guesses by FAO are built on, for example, the information found in national communications to the UNFCCC. |
| URL | N.A. |
| Features of the dataset including definitions | N.A. |
| Units in the dataset | N.A. |
| Availability (Years/country/region) | Depends on the public information consulted by FAO, but in general it covers the last 10 years. |
| Conversion if any required | N.A. |
| Remarks | NONE |

## 5.6 N2O Emissions from Managed Soils, and CO2 Emissions from Lime and Urea Application

The IPCC Guidelines provide methods for the estimation of direct and indirect[5] $N_2O$ from managed soils, and $CO_2$ emissions from application of lime and urea[6] to the soils. The activity data required for $N_2O$ 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.

Many FAO datasets like FAOSTAT contain such information but typically this information is not sufficiently disaggregated as required for compiling GHG inventories using the IPCC Guidelines. Further, data on liming is not collected by FAO as it is not considered a fertilizer.

The following gives a description of data requirement for this category and the relevant FAO datasets:

---

[5] Indirect N2O emissions take place due to volatilization/re-deposition, leaching and runoff.

[6] Methods provided only in 2006 IPCC Guidelines in AFOLU sector.

### 5.6.1 Applied synthetic fertilizer [or Applied mineral fertilizer – see the remark.]

| | |
|---|---|
| Description | The annual amount of mineral Nitrogen (N) fertilizer, applied to soils disaggregated as feasible by fertilizer type, crop-type and climatic regime for major crops |
| Definition(s) in the IPCC Guidelines | Mass of nitrogen in synthetic fertiliser applied nationally in specific years |
| Units in the IPCC Guidelines | kg N/yr |
| 2006 IPCC Guidelines | Chapter 11, Volume 4(2), Equations 11.1, 11.2, 11.9, 11.10, 11.11 (Parameter $F_{SN}$) |
| GPG/GPG-LULUCF | GPG2000: Chapter 4, Equations 4.20 and 4.21; GPG-LULUCF: Chapter 3, Equation 3.2.18 (Parameter $F_{SN}$) |
| 1996 IPCC Guidelines | Chapter 4, Reference Manual, Equation 1(Parameter $F_{SN}$) |
| FAO Datasets | FAOSTAT |
| URL(s) | Definitions: *http://faostat.fao.org/site/386/default.aspx* <br><br> Data: *http://faostat.fao.org/site/575/default.aspx#ancor* |
| Features of the dataset including definitions | Mineral fertilizers may be naturally occurring or manufactured (synthetic). The FAOSTAT database does not make the distinction between the origin of the fertilizers and therefore includes both naturally occurring and manufactured (synthetic). |
| Units in the dataset | Total mass of chemical (tonnes/year) |
| Availability (Years/country/region) | 2002-onwards, by country and by country aggregates |
| Conversion if any required | See the units above |
| Remarks | It should be noted that the "synthetic fertilizers" used in the IPCC Guidelines corresponds to "mineral fertilizers" defined by FAO and IFA (i.e., include those from natural sources (e.g., potassium nitrates) and manufactured fertilizers (e.g., urea)). <br><br> • Fertilizer consumption is often obtained from sales data. <br> • Most data sources (including FAO) might limit reporting to agricultural N uses, although applications may also occur on Forest Land, Settlements, or other uses this unaccounted N is likely to account for a small proportion of the overall emissions. <br> • Other relevant international dataset is statistics from International Fertilizer Industry Association (IFA): *http://www.fertilizer.org/ifa/statistics.asp* |

### 5.6.2 Harvested annual dry matter yield for different crops

| | |
|---|---|
| Description | Harvested annual dry matter yield for different crop-types for major crops |
| Definition(s) in the IPCC Guidelines | No specific definitions |
| Units in the IPCC Guidelines | kg dry matter./ha |
| 2006 IPCC Guidelines | Chapter 11, Volume 4(2), Equation 11.6 (Parameter $Crop_{(T)}$) |
| GPG/GPG-LULUCF | GPG2000: Chapter 4, Equation 4.28 & 4.29 (Parameters $Crop_O$ & $Crop_{BF}$ ) |
| 1996 IPCC Guidelines | Chapter 4, Reference Manual, Equation 1(Parameters $Crop_O$ & $Crop_{BF}$ ) |
| FAO Dataset(s) | FAO does not collect these data on total dry matter yield. |
| URL(s) | N.A. |
| Features of the dataset including definitions | N.A. |
| Units in the dataset | N.A. |
| Availability (Years/country/region) | N.A. |
| Conversion if any required | N.A. |
| Remarks | FAO has yield statistics for many crops that are reported as field-dry or fresh weight. Inventory compilers can obtain annual dry matter yield from yield statistics with appropriate correction factors. |

### 5.6.3    Total area harvested for different crops

| | |
|---|---|
| Description | The annual area harvested for different crops by crop-type |
| Definition(s) in the IPCC Guidelines | In case of multiple cropping during the same year, 'harvested area' is equal to the sum of the area cultivated for each cropping. |
| Units in the IPCC Guidelines | ha/yr |
| 2006 IPCC Guidelines | Chapter 11, Volume 4(2), Equation 11.6 (Parameter $A_{(T)}$) |
| GPG/GPG-LULUCF | N.A. |
| 1996 IPCC Guidelines | N.A. |
| FAO Dataset(s) | FAOSTAT |
| URL(s) | *http://faostat.fao.org/* |
| Features of the dataset including definitions | Data refer to the area from which a crop is gathered.  Area harvested, therefore, excludes the area from which, although sown or planted there was no harvest due to damage, failure, etc. It is usually net for temporary crops and gross for permanent crops. Net area differs from gross area as the latter includes uncultivated patches, footpaths, ditches, headlands, shoulders, shelterbelts, etc. If the crop under consideration is harvested more than once during the year as a consequence of successive cropping (i.e., the same crop is sown or planted more than once in the same field during the year), the area is counted as many times as harvested. On the contrary, area harvested will be recorded only once in the case of successive gathering of the crop during the year from the same standing crops. |
| Units in the dataset | ha/yr |
| Availability (Years/country/region) | • Data availability: Available for all countries, regions and crops<br>• Reporting years: Annual data from 1961 onwards |
| Conversion if any required | See the 'Features of the dataset including definitions' |
| Remarks | NONE |

### 5.6.4 Total annual area of crop burnt

| Description | The annual area of crop burnt for different crops by crop-type |
|---|---|
| Definition(s) in the IPCC Guidelines | See the "Description" above |
| Units in the IPCC Guidelines | ha/yr |
| 2006 GL | Chapter 11, Volume 4(2), Equations 11.6, 11.7A (Parameter $\text{Areaburnt}_{(T)}$) |
| GPG/GPG-LULUCF | N.A. |
| 1996 GL | NA |
| FAO Dataset(s) | FAO does not collect these data because this is a national practice that is not uniformly done across countries. |
| URL(s) | N.A. |
| Features of the dataset | N.A. |
| Dimension in the dataset | N.A. |
| Availability (Years/country/region) | N.A. |
| Conversion if any required | N.A. |
| Remarks | NONE |

### 5.6.5 Total annual amount of limestone and dolomite applied to soils within a country

| | |
|---|---|
| Description | Liming (e.g. the addition of calcic limestone ($CaCO_3$), or dolomite ($CaMg(CO_3)_2$) is used to reduce soil acidity and improve plant growth in managed systems, particularly agricultural lands and managed forests. It is reported under LULUCF sector in the 1996 IPCC GLs and GPG |
| Definition(s) | See the "Description' above |
| Units in the IPCC Guidelines | tonnes/yr |
| 2006 Guidelines | Chapter 11, Volume 4(2), Equation 11.12 (Parameters $M_{dolomite}$/$M_{limestone}$) |
| GPG/GPG-LULUCF | GPG-LULUCF: Chapter 3, Equation 3.3.6 |
| 1996 IPCC Guidelines | Chapter 5, Reference Volume |
| FAO Dataset(s) | FAO does not collect these data because these are not considered as fertilizers. |
| URL(s) | N.A. |
| Definition in the dataset | N.A. |
| Units in the dataset | N.A. |
| Availability (Years/country/region) | N.A. |
| Conversion if any required | N.A. |
| Remarks | N.A. |

### 5.6.6 Annual amount of urea fertilization in the country

| | |
|---|---|
| Description | Total amount of urea applied annually to a soil in the country |
| Definition(s) in the IPCC Guidelines | See the "Description" field above |
| Units in Guidelines | Tonne/yr |
| 2006 IPCC Guidelines | Chapter 11, Volume 4(2), Equation 11.13 (Parameter M) |
| GPG/GPG-LULUCF | N.A. |
| 1996 IPCC Guidelines | N.A. |
| FAO Dataset(s) | FAOSTAT |
| URL(s) | *http://faostat.fao.org/* |
| Features of the dataset including definitions | Urea, CO ($NH_2$) $_2$, is produced from synthetic ammonia and carbon dioxide ($CO2$) and contains 46% nitrogen in carbamide form. Urea may be in granular, prilled or crystalline form. |
| Units in the dataset | Tonne/yr |
| Availability (Years/country/region) | • Urea consumption in Metric Tons of nutrients is available for 1961-2002 in the archive at: *http://faostat.fao.org/site/422/default.aspx#ancor*.<br>• Urea consumption in Metric Tons of products is available for 2002-onwards at: *http://faostat.fao.org/site/575/default.aspx#ancor* |
| Conversion if any required | NONE |
| Remarks | Please note that the two series in the archive and in the fertilizers actual domain are not comparable. |

## 5.7 Harvested Wood Products

There are several different accounting approaches for estimation of the Harvested Wood Products contribution to the annual AFOLU emissions/removals (HWP contribution). The 2006 IPCC Guidelines give guidance on estimation of the variables required for using any of these approaches. The main data requirements for estimation of these parameters using the methods given in the Guidelines are: a) the data on production of solid wood products and paper and pulp from 1900 onwards; and b) data on import and export of the solid wood and pulp and paper products from 1900 onwards.

FAOSTAT gives these data from 1961 onwards. Data from 1900 to 1961 are estimated by extrapolation using the method given in the IPCC Guidelines.

The main data requirement and the relevant FAO datasets for HWP are described below.

### 5.7.1 Annual production of solid wood products (other industrial round wood, sawn wood, wood panels) in the country

| | |
|---|---|
| Description | Annual production of solid wood products (other industrial round wood, sawn wood, wood panels) in the country |
| Definition(s) in the IPCC Guidelines | See the "Description" field above |
| Units in Guidelines | Gg (1000 tonnes) |
| 2006 IPCC Guidelines | Chapter 12, Volume 4(2), Equations 12.2 and 12.3 |
| GPG/GPG-LULUCF | GPG-LULUCF: Chapter 3, Appendix 3a.1 |
| 1996 IPCC Guidelines | N.A. |
| FAO Dataset(s) | FAOSTAT |
| URL(s) | *http://faostat.fao.org/site/626/default.aspx#ancor* |
| Features of the datasets including definitions | Available at: *http://faostat.fao.org/site/626/default.aspx#ancor* |
| Dimension in the dataset | $m^3$ |
| Availability (Years/country/region) | Available from 1961 onwards for all countries and regions |
| Conversion if any required | In all cases data need to be converted from $m^3$ to Gg. For other industrial round-wood it is necessary to convert volume underbark to volume overbark |
| Remarks | NONE |

### 5.7.2 Annual Production of paper, paperboard and other fibre pulp in the country

| | |
|---|---|
| Description | Annual Production of paper, paperboard and other fibre pulp in the country |
| Definition(s) in the IPCC Guidelines | See the "Description" field above |
| Units in Guidelines | Gg (1000 tonnes) |
| 2006 IPCC Guidelines | Chapter 12, Volume 4(2), Equations 12.2 and 12.3 |
| GPG/GPG-LULUCF | GPG-LULUCF: Chapter 3, Appendix 3a.1 |
| 1996 IPCC Guidelines | N.A. |
| FAO Dataset(s) | FAOSTAT |
| URL(s) | *http://faostat.fao.org/site/626/default.aspx#ancor* |
| Features of the datasets including definitions | Available at: http://faostat.fao.org/site/626/default.aspx#ancor |
| Units in the dataset | Tonnes |
| Availability (Years/country/region) | from 1961 onwards / all countries and regions |
| Conversion if any required | Data need to be converted from tonnes to Gg.by dividing by 1000. |
| Remarks | NONE |

### 5.7.3 Annual imports and exports of solid wood products (other industrial roundwood, sawnwood, wood panels etc.)

| | |
|---|---|
| Description | Annual imports and exports of solid wood products (other industrial roundwood, sawnwood, wood panels etc.) |
| Definition(s) in the IPCC Guidelines | See the "Description" field above |
| Units in Guidelines | Gg (1000 tonnes) |
| 2006 IPCC Guidelines | Chapter 12, Volume 4(2), Equations 12.2, 12.3, 12.4 and 12.5 |
| GPG/GPG-LULUCF | GPG-LULUCF: Chapter 3, Appendix 3a.1 |
| 1996 IPCC Guidelines | N.A. |
| FAO Dataset(s) | FAOSTAT |
| URL(s) | *http://faostat.fao.org/site/626/default.aspx#ancor* |
| Features of the datasets including definitions | Available at: <br> *http://faostat.fao.org/site/626/default.aspx#ancor* |
| Units in the datasets | $m^3$ (quantity) and US$ (value) |
| Availability (Years/country/region) | • Data available from 1961 onwards for all countries and regions <br> • Data on other industrial roundwood are available up to 1989 |
| Conversion if any required | In all cases data need to be converted from $m^3$ to Gg. For other industrial roundwood it is necessary to convert volume(underbark) to volume(overbark). |
| Remarks | NONE |

### 5.7.4 Annual imports and exports other fibre pulp, chips and particles

| | |
|---|---|
| Description | Annual imports and exports other fibre pulp, chips and particles |
| Definition(s) in the IPCC Guidelines | See the "Description" field above |
| Units in Guidelines | Gg (1000 tonnes) |
| 2006 IPCC Guidelines | Chapter 12, Volume 4(2), Equations 12.2, 12.3, 12.4 and 12.5 |
| GPG/GPG-LULUCF | GPG-LULUCF: Chapter 3, Appendix 3a.1 |
| 1996 IPCC Guidelines | N.A. |
| FAO Dataset(s) | FAOSTAT |
| URL(s) | *http://faostat.fao.org/site/626/default.aspx#ancor* |
| Definition in the dataset | Available at: *http://faostat.fao.org/site/626/default.aspx#ancor* |
| Units in the dataset | $m^3$ (quantity) for chips and particles, metric ton (quantity) for other fibre pulp |
| Availability (Years/country/region) | from 1961 onwards for all countries and regions |
| Conversion if any required | Volume for chips and particles need to be converted from $m^3$ to Gg. |
| Remarks | NONE |

## 5.8    Waste Sector Data

2006 IPCC Guidelines provide a methodology for estimating $N_2O$ emissions from wastewater treatment effluent that is discharged into aquatic environments. The activity data that are needed for estimating $N_2O$ emissions are nitrogen content in the wastewater effluent, country population and average annual per capita protein generation (kg/person/yr). Per capita protein generation consists of intake (consumption) which is available from the FAO, multiplied by factors to account for additional 'non-consumed' protein and for industrial protein discharged into the sewer system.

The main data requirement and the relevant FAO datasets for HWP are described below.

### 5.8.1    Annual per capita protein consumption

| | |
|---|---|
| Description | Annual per capita protein consumption |
| Definition | See the "Description" field above |
| Units in Guidelines | kg/person/yr |
| 2006 IPCC Guidelines | Chapter 6, Volume 5, Equation 6.8 |
| GPG/GPG-LULUCF | N.A. |
| 1996 IPCC Guidelines | Chapter 6, Reference Manual, Equation 15 |
| FAO Dataset(s) | FAOSTAT |
| URL | *http://faostat.fao.org/* |
| Features of the dataset including definitions | N.A. |
| Units in the dataset | g/person/day |
| Availability (Years/country/region) | • Data available from 1961 onwards for all countries and regions |
| Conversion if any required | Conversion is required to convert the FAO data given in gram/person/year to kilogram/person/year. |
| Remarks | NONE |

# 6. PROPOSED REFINEMENTS TO DATA COLLECTION EFFORTS BY FAO

FAO datasets are some of the best international datasets for AFOLU sector GHG inventories. However there are certain information gaps and harmonization needs that should be addressed to make them more compatible with the data requirements of AFOLU GHG inventories. The IPCC-FAO-IFAD Expert Meeting on FAO data for AFOLU/LULUCF came up with many suggestions regarding the FAO data collection efforts that could be summarized as follows:

## 6.1    Harmonization of IPCC and FAO definitions and categories

The reporting categories and definitions used in FAO datasets sometimes are not the same as those in IPCC Guidelines. This document identifies, under the appropriate parameter, where there are significant definitional and categorisation differences between the FAO datasets and the IPCC Guidelines. While, from an inventory compilers point of view, it is desirable to have common definitions or reporting categories as far as possible, in some cases it is not possible to do so. In these cases, it would be useful to provide additional information in the FAO datasets to make them easy to interpret in terms of the definitions followed in the IPCC Guidelines. In cases where it is possible, it would also be very helpful to users if the FAO data collection efforts could try and address these differences.

## 6.2    Coverage and disaggregation of information

The FAO datasets for land use and land use change such as FRA and FAOSTAT contain a wealth of information on area and various parameters for the different land use categories. There are several areas however where they could be made more useful for GHG inventory compilation by collecting additional information at suitable disaggregation.

For the data relating to land use and land use change, the FAO datasets like FRA do not separately contain information on managed land. They also do not generally have disaggregated information for several parameters such as wood removals (e.g. industrial round-wood, fuel wood etc.) by land use categories (e.g. forestland, cropland etc.). Further, they also do not have sufficient information on land use conversions to derive a land use change matrix. It will be extremely useful if the FAO datasets include the following information:

- Separate information for managed land
- Disaggregated information on the source of wood removals (industrial round wood and  fuelwood) by land use categories
- Information on land use conversions to develop land use change matrices
- Data on area and biomass lost from disturbances by different land use categories
- Data on preceding land use and time since afforestation of planted forests
- Data on the area of natural expansion of forest land
- Data on area and biomass of crop residues and grasslands burnt and burning in different land use categories
- Data on area under perennial crops and annually planted and harvested cropland areas at a more disaggregated level suitable for preparing good practice inventories
- Data on area of histosols under cultivation
- Data on managed wetlands and settlements

For some aggregate source categories such as livestock and emissions from soils etc., the major issues are lack of information or sufficiently disaggregated information on several key parameters such as:

- Information on annual-average livestock population at a more disaggregated level suitable for preparing good practice inventories
- Data on the live weights of livestock
- Data on various livestock parameters such as annual weight gain, number of offspring, percentage of pregnant livestock, annual wool production, fat content of milk etc.
- Information on manure management systems
- Information on livestock feeding systems
- Data on application of limestone and dolomite

Apart from these, uncertainty or the confidence level of the data will be very valuable information for inventory compilation.

## 6.3 Improvement in presentation and access to information

Most of the FAO datasets are very easily accessible through their websites. However, a few general problems were encountered in accessing and using FAO datasets such as: a) multiplicity of datasets on the same topic and the variations and occasional inconsistencies in the data categories and collection processes among different datasets; and b) the large amount of data that is in the form of unpublished/offline documents. The main suggestions for improvement in this area were:

- Making all the unpublished/offline data directly available through the internet
- Preparation of a webpage (one-stop website) listing all the data available for inventory compilation with the information on how they can be accessed.

**Figure 3A.5.1    Delineation of major climate zones, updated from the *1996 IPCC Guidelines*.**
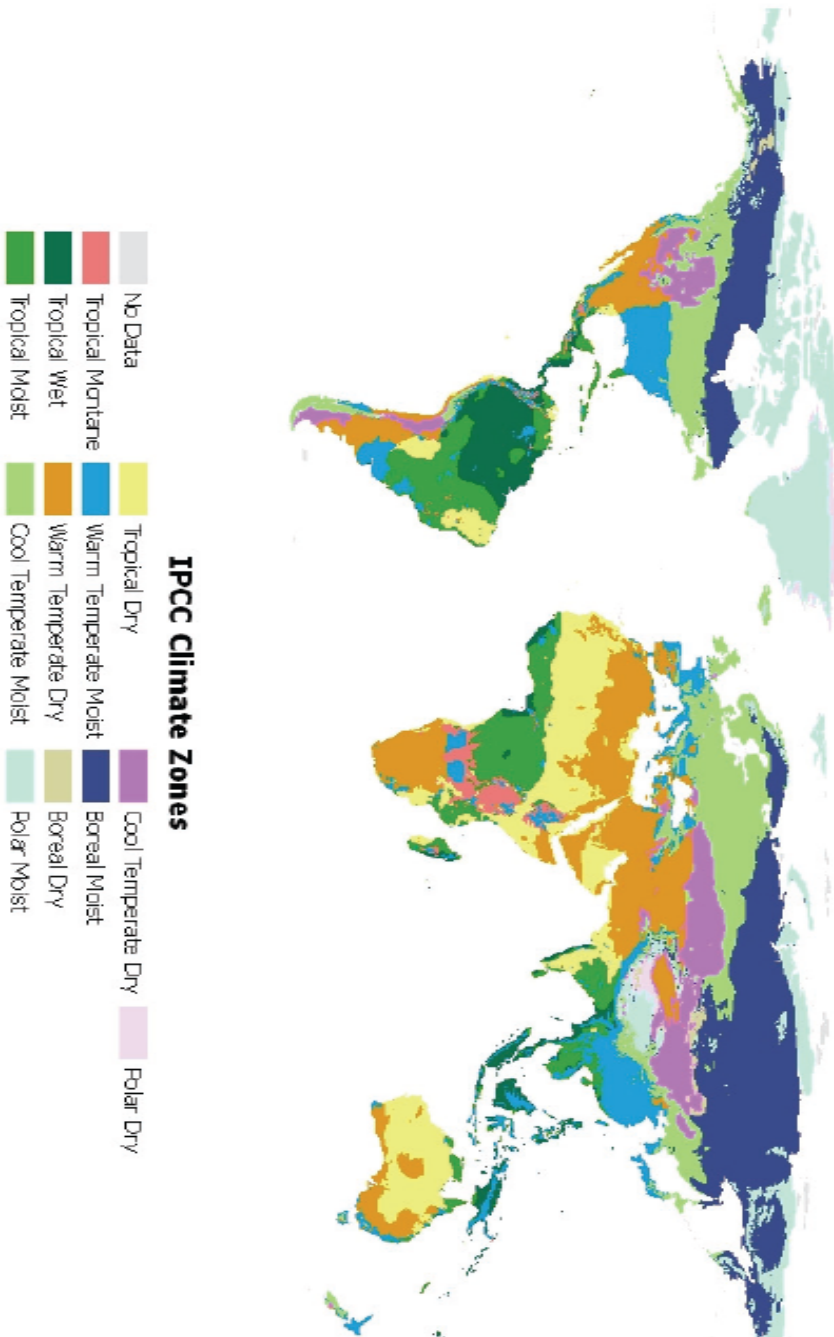
Source: 2006 IPCC Guidelines, Vol.4 (1), Ch.3

# Annex 2. Classification scheme for default climate regions

Figure 3A.5.2   Classification scheme for default climate regions.   The classification is based on elevation, mean annual temperature (MAT), mean annual precipitation (MAP), mean annual precipitation to potential evapotransporation ratio (MAP:PET), and frost occurrence.
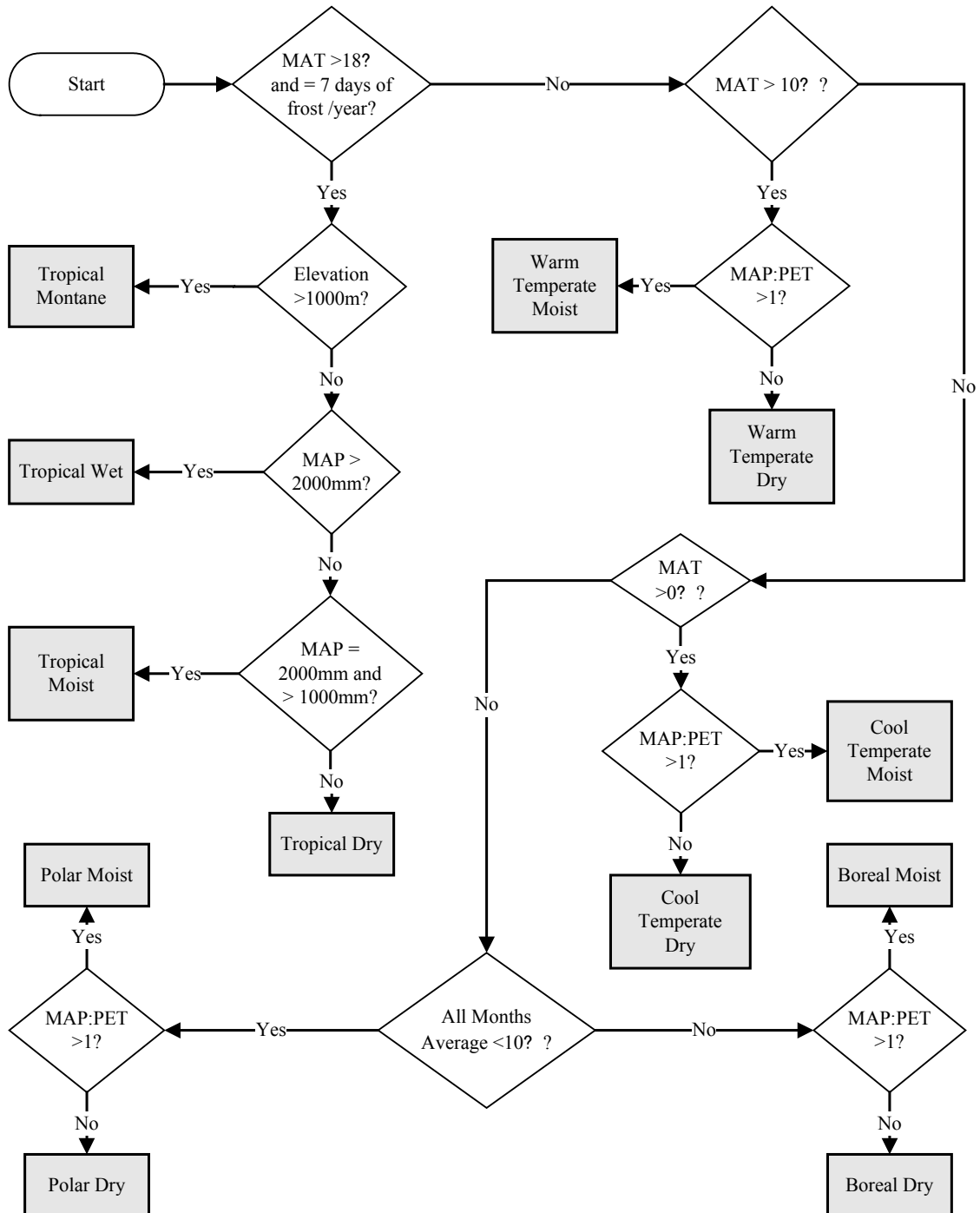


Source: 2006 IPCC Guidelines, Vol.4 (1), Ch.3

# Annex 3.    Classification scheme for mineral soil types based on USDA taxonomy

Figure 3A.5.3    Classification scheme for mineral soil types based on USDA taxonomy
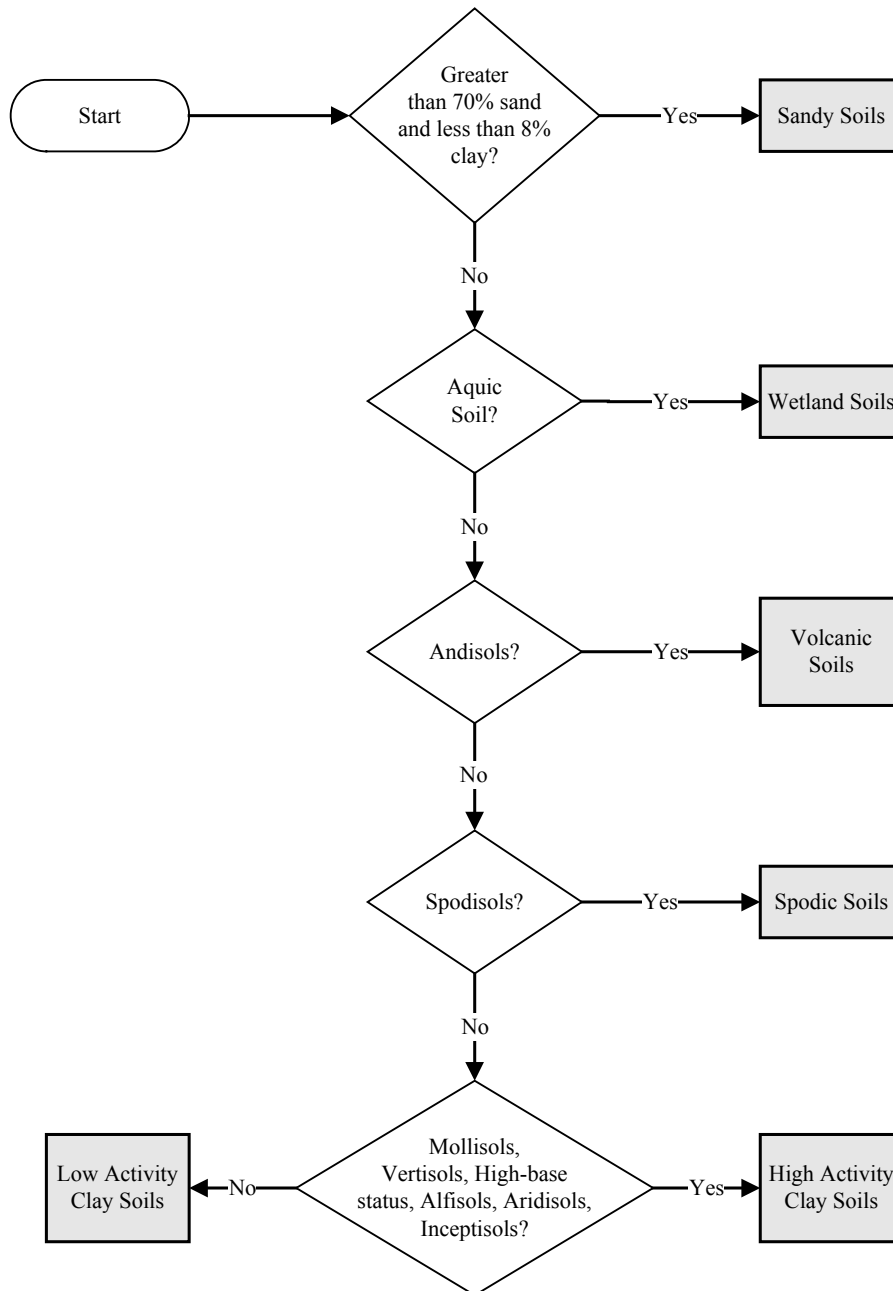
# Annex 4. **Classification scheme for mineral soil types based on WRB classification**

Figure 3A.5.4    Classification scheme for mineral soil types based on World Reference Base for Soil Resources (WRB) classification.

```
                              ◇ Greater
                                than 70% sand
   ( Start ) ─────────────▶     and less than 8%  ──Yes──▶ [ Sandy Soils ]
                                clay?
                                   │
                                   No
                                   ▼
                              ◇ Gleysols?  ──Yes──▶ [ Wetland Soils ]
                                   │
                                   No
                                   ▼
                              ◇ Andisols?  ──Yes──▶ [ Volcanic Soils ]
                                   │
                                   No
                                   ▼
                              ◇ Podzols?   ──Yes──▶ [ Spodic Soils ]
                                   │
                                   No
                                   ▼
                    ◇ Leptosols,
                      Vertisols, Kastanozems,
 [ Low Activity ◀─No─  Chernozems, Phaeozems,
   Clay Soils ]        Luvisols, Alisols, Albeluvisols, Solonetz,  ──Yes──▶ [ High Activity Clay Soils ]
                       Calcisols, Gypsisols,
                       Umbrisols, Cambisols,
                       Regosols?
```
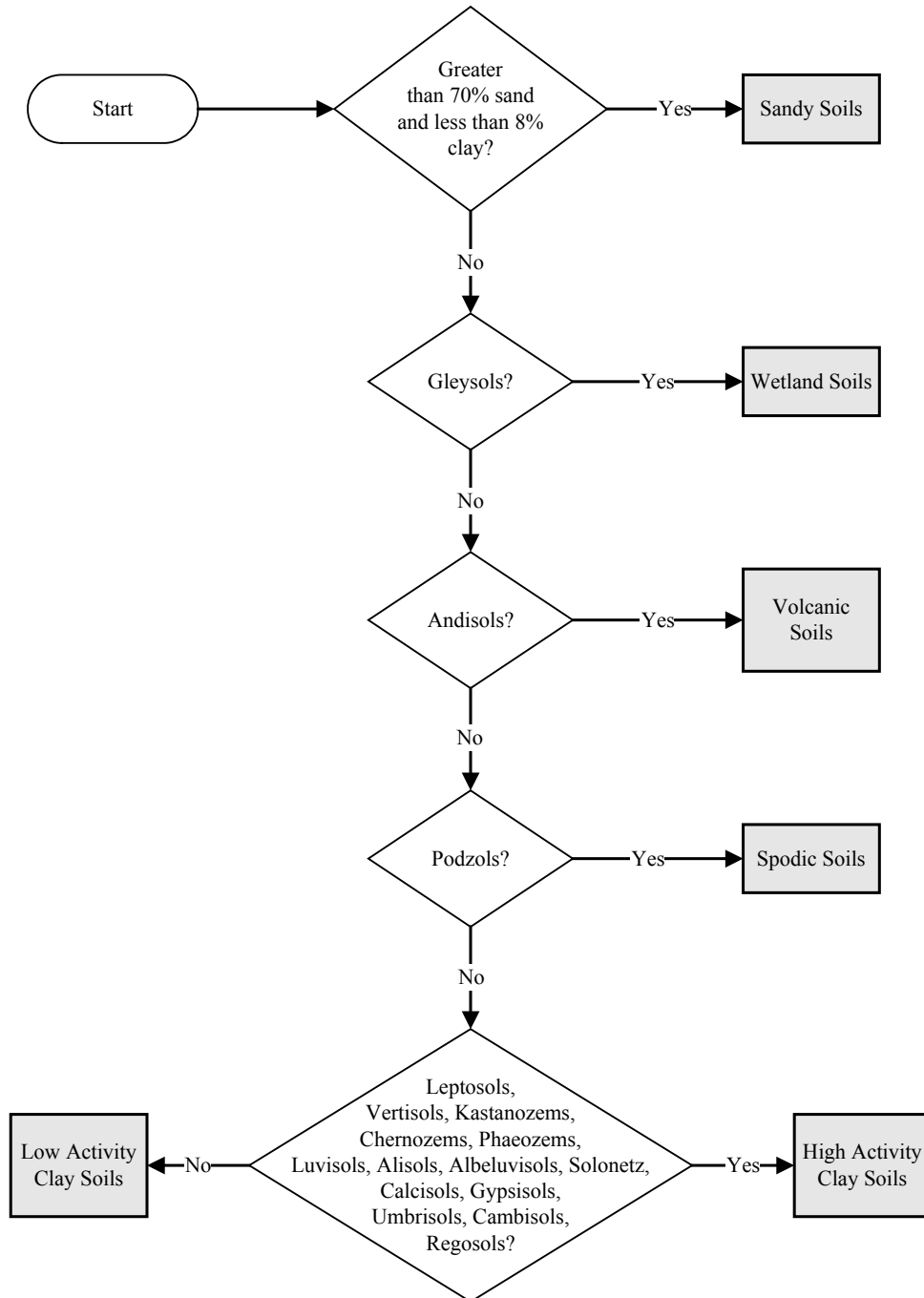
Source: 2006 IPCC Guidelines, Vol.4 (1), Ch.3

Figure 4.1    Global ecological zones, based on observed climate and vegetation patterns (FAO, 2001). Data for geographic information systems available at http://www.fao.org.
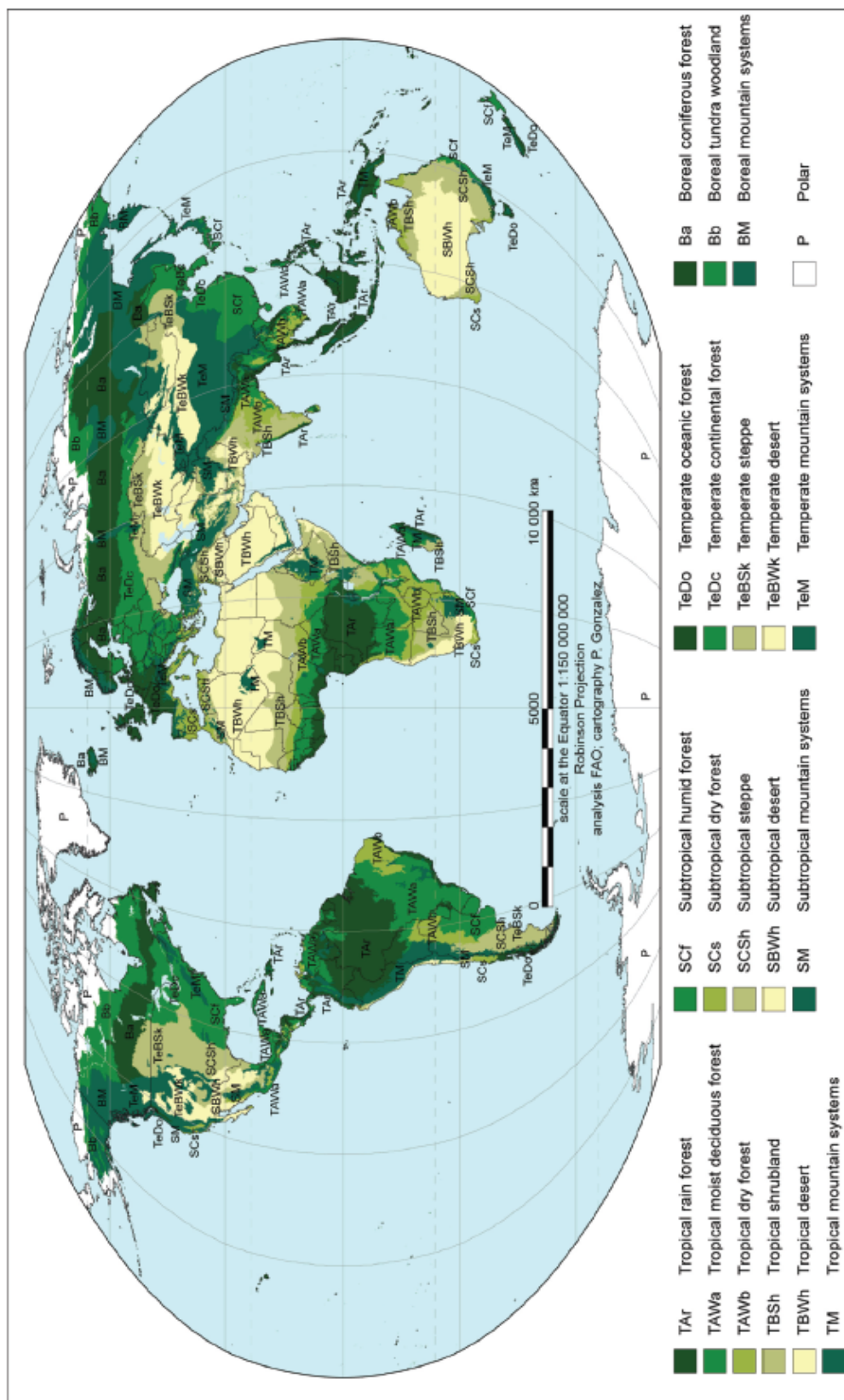


Source: 2006 IPCC Guidelines, Vol.4 (1), Ch.4

# Annex 6. Classification scheme for cropland management systems

Figure 5.1 Classification scheme for cropland systems. In order to classify cropland management systems, the inventory compiler should start at the top and proceed through the diagram answering questions (move across branches if answer is yes) until reaching a terminal point on the diagram. The classification diagram is consistent with default stock change factors in Table 5.5. C input classes (i.e., low, medium, high and high with organic amendment) are further subdivided by tillage practice.
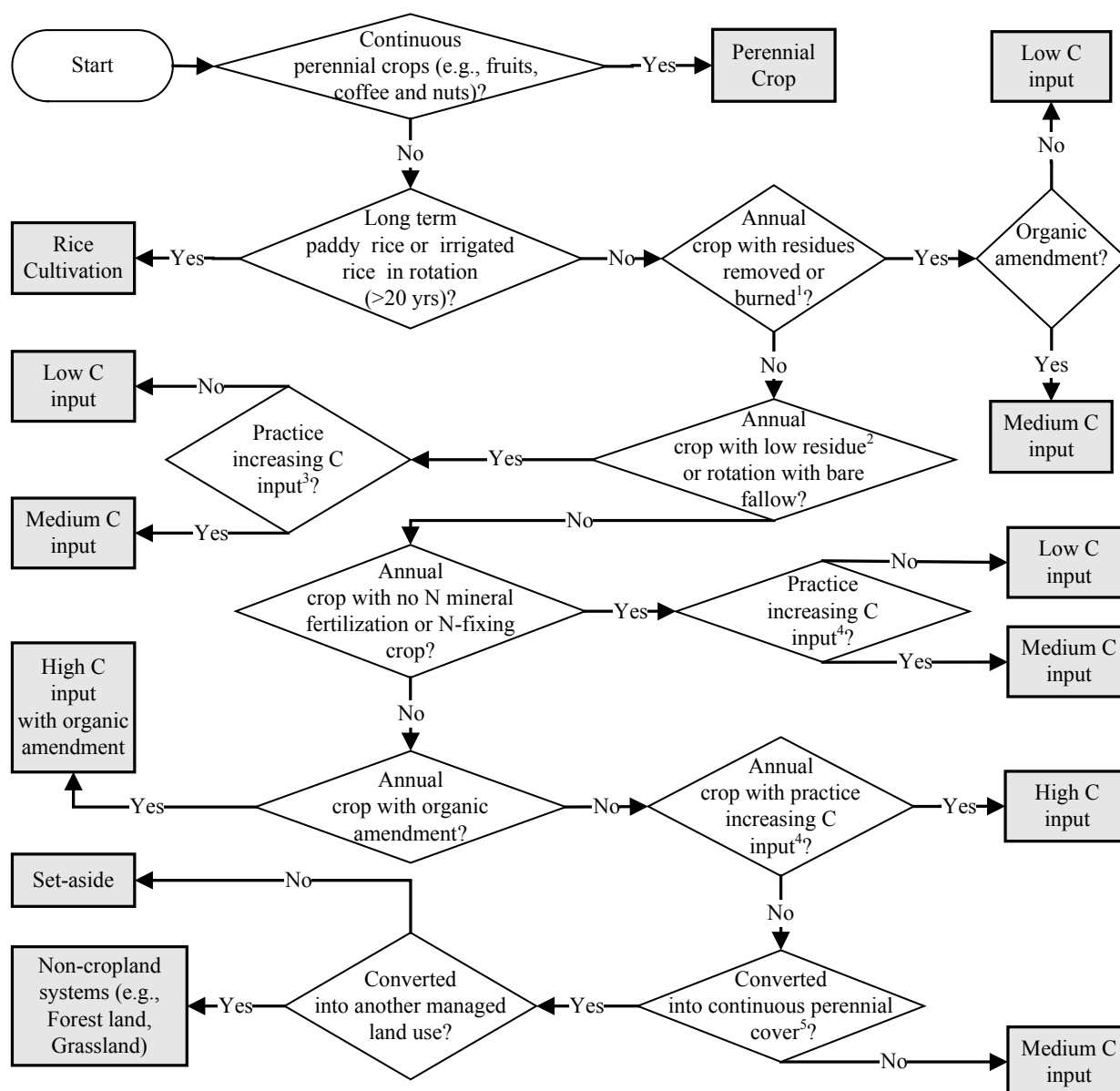


Note:

1: Does not typically include grazing of residues in the field.

2: e.g. cotton, vegetables and tobacco.

3: Practices that increase C input above the amount typically generated by the low residues yielding varieties such as using organic amendments, cover crops/green manures, and mixed crop/grass systems.

4: Practices that increase C input by enhancing residue production, such as using irrigation, cover crops/green manures, vegetated fallows, high residue yielding crops, and mixed crop/grass systems.

5 Perennial cover without frequent harvest.

Note: Only consider practices, such as irrigation, residue burning/removal, mineral fertilizers, N-fixing crops, organic amendment, cover crops/green manures, low residue crop, or fallow, if used in at least 1/3 of cropping rotation sequence.

Source: 2006 IPCC Guidelines, Vol.4 (1), 5

## Annex 7. **Classification scheme for grassland management systems**

Figure 6.1     Classification scheme for grassland/grazing systems.  In order to classify grassland management systems, the inventory compiler should start at the top and proceed through the diagram answering questions (move across branches if answer is yes) until reaching a terminal point on the diagram.  The classification diagram is consistent with default stock change factors in Table 6.2.
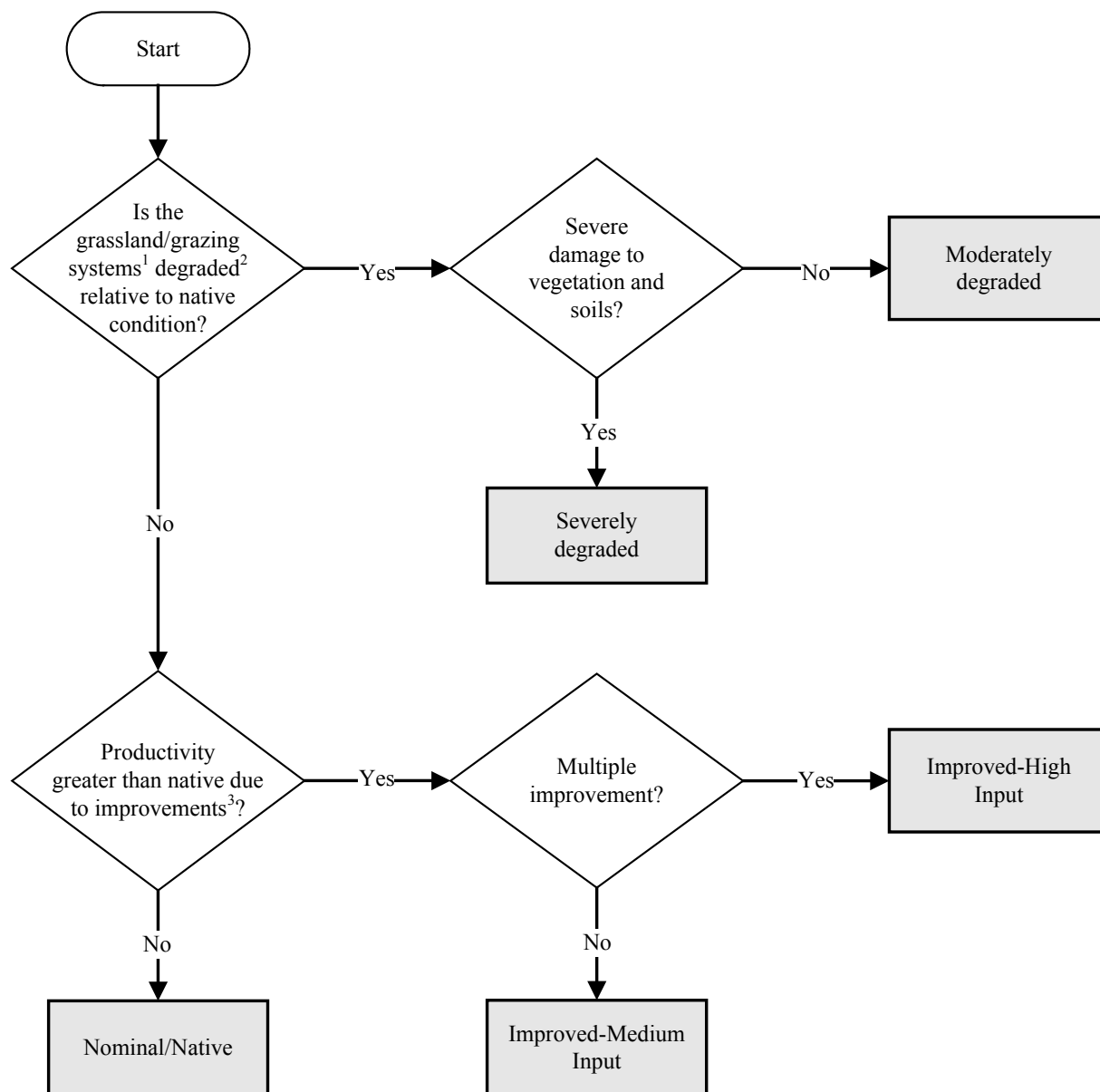


Note:

1: Includes continuous pasture, hay lands and rangelands.

2: Degradation is equated with C input to the soil relative to native conditions, which may be caused by long-term heavy grazing or planting less productive plants relative to native vegetation.

3: Productivity refers explicitly to C input to soil (management improvements that increase input e.g., fertilization, organic amendment, irrigation, planting more productive varieties, liming, and seeding legumes).

Source: 2006 IPCC Guidelines, Vol.4 (1), Ch.6

## Annex 8. Perennial cropland categories

<table>
<tr><td colspan="2" align="center"><strong>TABLE 5.4</strong><br><strong>EXAMPLES OF PERENNIAL CROPLAND SUBCATEGORIES WHICH A COUNTRY MAY HAVE</strong></td></tr>
<tr><td><strong>Broad subcategories</strong></td><td align="center"><strong>Specific subcategories</strong></td></tr>
<tr><td>Fruit orchards</td><td>Mango, Citrus, Apple</td></tr>
<tr><td>Plantation crops</td><td>Rubber, Coconut, Oil palm, Coffee, Cacao</td></tr>
<tr><td>Agroforestry systems</td><td>Hedgerow cropping (alley cropping), Improved fallow, Multi-storey systems, Home gardens, Boundary planting, Windbreaks</td></tr>
</table>

Source: 2006 IPCC Guidelines, Vol.4 (1), Ch.5

## Annex 9. **Representative livestock categories**

<table>
<tr><td colspan="2" align="center"><b>TABLE 10.1</b><br><b>REPRESENTATIVE LIVESTOCK CATEGORIES</b>[1,2]</td></tr>
<tr><td><b>Main categories</b></td><td align="center"><b>Subcategories</b></td></tr>
<tr>
<td>Mature Dairy Cow or Mature Dairy Buffalo</td>
<td>
• High-producing cows that have calved at least once and are used principally for milk production<br>
• Low-producing cows that have calved at least once and are used principally for milk production
</td>
</tr>
<tr>
<td>Other Mature Cattle or Mature Non-dairy Buffalo</td>
<td>
Females:<br>
• Cows used to produce offspring for meat<br>
• Cows used for more than one production purpose: milk, meat, draft<br>
Males:<br>
• Bulls used principally for breeding purposes<br>
• Bullocks used principally for draft power
</td>
</tr>
<tr>
<td>Growing Cattle or Growing Buffalo</td>
<td>
• Calves pre-weaning<br>
• Replacement dairy heifers<br>
• Growing / fattening cattle or buffalo post-weaning<br>
• Feedlot-fed cattle on diets containing > 90 % concentrates
</td>
</tr>
<tr>
<td>Mature Ewes</td>
<td>
• Breeding ewes for production of offspring and wool production<br>
• Milking ewes where commercial milk production is the primary purpose
</td>
</tr>
<tr>
<td>Other Mature Sheep (>1 year)</td>
<td>• No further sub-categorisation recommended</td>
</tr>
<tr>
<td>Growing Lambs</td>
<td>
• Intact males<br>
• Castrates<br>
• Females
</td>
</tr>
<tr>
<td>1.    Mature Swine</td>
<td>
• Sows in gestation<br>
• Sows which have farrowed and are nursing young<br>
• Boars that are used for breeding purposes
</td>
</tr>
<tr>
<td>2.    Growing Swine</td>
<td>
• Nursery<br>
• Finishing<br>
• Gilts that will be used for breeding purposes<br>
• Growing boars that will be used for breeding purposes
</td>
</tr>
<tr>
<td>3.    Chickens</td>
<td>
• Broiler chickens grown for producing meat<br>
• Layer chickens for producing eggs, where manure is managed in dry systems (e.g., high-rise houses)<br>
• Layer chickens for producing eggs, where manure is managed in wet systems (e.g., lagoons)<br>
• Chickens under free-range conditions for egg or meat production
</td>
</tr>
<tr>
<td>4.    Turkeys</td>
<td>
• Breeding turkeys in confinement systems<br>
• Turkeys grown for producing meat in confinement systems<br>
• Turkeys under free-range conditions for meat production
</td>
</tr>
<tr>
<td>5.    Ducks</td>
<td>
• Breeding ducks<br>
• Ducks grown for producing meat
</td>
</tr>
<tr>
<td>6.    Others (for example)</td>
<td>
• Camels<br>
• Mules and Asses<br>
• Llamas, Alpacas<br>
• Fur bearing animals<br>
• Rabbits<br>
• Horses<br>
• Deer<br>
• Ostrich<br>
• Geese
</td>
</tr>
<tr>
<td colspan="2">
[1] Source IPCC Expert Group<br>
[2] Emissions should only be considered for livestock species used to produce food, fodder or raw materials used for industrial processes.
</td>
</tr>
</table>

Source: 2006 IPCC Guidelines, Vol.4 (2), Ch. 10

## Annex 10. Definitions of selected variables used in the Global Forest Resources Assessment 2010

Extent of forest and other wooded land

---

**FOREST**

Land spanning more than 0.5 hectares with <u>trees</u> higher than 5 meters and a <u>canopy cover</u> of more than 10 percent, or <u>trees</u> able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use.

**Explanatory notes**

Forest is determined both by the presence of trees and the absence of other predominant land uses. The trees should be able to reach a minimum height of 5 meters in situ.

Includes areas with young trees that have not yet reached but which are expected to reach a canopy cover of 10 percent and tree height of 5 meters. It also includes areas that are temporarily unstocked due to clear-cutting as part of a forest management practice or natural disasters, and which are expected to be regenerated within 5 years. Local conditions may, in exceptional cases, justify that a longer time frame is used.

Includes forest roads, firebreaks and other small open areas; forest in national parks, nature reserves and other protected areas such as those of specific environmental, scientific, historical, cultural or spiritual interest.

Includes windbreaks, shelterbelts and corridors of trees with an area of more than 0.5 hectares and width of more than 20 meters.

Includes abandoned shifting cultivation land with a regeneration of trees that have, or is expected to reach, a canopy cover of 10 percent and tree height of 5 meters.

Includes areas with mangroves in tidal zones, regardless whether this area is classified as land area or not.

Includes rubber-wood, cork oak and Christmas tree plantations.

Includes areas with bamboo and palms provided that land use, height and canopy cover criteria are met.

<u>Excludes</u> tree stands in agricultural production systems, such as fruit tree plantations, oil palm plantations and agroforestry systems when crops are grown under tree cover. <u>Note:</u> Some agroforestry systems such as the "Taungya" system where crops are grown only during the first years of the forest rotation should be classified as forest.

---

**OTHER WOODED LAND**

Land not classified as <u>Forest</u>, spanning more than 0.5 hectares; with <u>trees</u> higher than 5 meters and a <u>canopy cover</u> of 5-10 percent, or trees able to reach these thresholds in situ; or with a combined cover of <u>shrubs</u>, <u>bushes</u> and <u>trees</u> above 10 percent. It does not include land that is predominantly under agricultural or urban land use.

**Explanatory notes**

The definition above has two options:

The canopy cover of trees is between 5 and 10 percent; trees should be higher than 5 meters or able to reach 5 meters in situ.

or

The canopy cover of trees is less than 5 percent but the combined cover of shrubs, bushes and trees is more than 10 percent. Includes areas of shrubs and bushes where no trees are present.

Includes areas with trees that will not reach a height of 5 meters in situ and with a canopy cover of 10 percent or more, e.g. some alpine tree vegetation types, arid zone mangroves, etc.

Includes areas with bamboo and palms provided that land use, height and canopy cover criteria are met.

---

**OTHER LAND**

All land that is not classified as Forest or Other wooded land.

**Explanatory notes**

Includes agricultural land, meadows and pastures, built-up areas, barren land, land under permanent ice, etc.

Includes all areas classified under the sub-category "Other land with tree cover".

---

**OTHER LAND WITH TREE COVER (sub-category of OTHER LAND)**

Land classified as Other land, spanning more than 0.5 hectares with a canopy cover of more than 10 percent of trees able to reach a height of 5 meters at maturity.

**Explanatory notes**

The difference between Forest and Other land with tree cover is the land use criteria.

Includes groups of trees and scattered trees in agricultural landscapes, parks, gardens and around buildings, provided that area, height and canopy cover criteria are met.

Includes tree stands in agricultural production systems, for example in fruit tree plantations and agroforestry systems when crops are grown under tree cover. Also includes tree plantations established mainly for other purposes than wood, such as oil palm plantations.

Excludes scattered trees with a canopy cover less than 10 percent, small groups of trees covering less than 0.5 hectares and tree lines less than 20 meters wide.

**Forest designation and management**

---

**FOREST AREA WITHIN PROTECTED AREAS**

Forest area within formally established protected areas independently of the purpose for which the protected areas were established.

**Explanatory notes**

Includes  IUCN Categories I – IV

Excludes IUCN Categories V-VI

---

**FOREST AREA UNDER SUSTAINABLE FOREST MANAGEMENT**

To be defined and documented by the country.

Countries should apply their own national definition or description of sustainable forest management and document in the country report the definition, criteria and process applied for estimating the area under sustainable forest management.

If no national definition or criteria exist, countries may use the following  (ITTO, 2006):

Forest areas that fulfil any of the following conditions:

have been independently certified or in which progress towards certification is being made;

have fully developed, long-term (ten years or more) forest management plans with firm information that these plans are being implemented effectively;

are considered as model forest units in their country and information is available on the quality of management;

are community-based forest management units with secure tenure for which the quality of management is known to be of high standard;

are protected areas with secure boundaries and a management plan that are generally considered in the country and by other observers to be well managed and that are not under significant threat from destructive agents.

---

**FOREST AREA WITH MANAGEMENT PLAN**

Forest area that has a long-term (ten years or more) documented management plan, aiming at defined management goals, which is periodically revised.

**Explanatory notes**

A forest area with management plan may refer to forest management unit level or aggregated forest management unit level (forest blocks, farms, enterprises, watersheds, municipalities, or wider units).

A management plan may include details on operations planned for individual operational units (stands or compartments) but may also be limited to provide general strategies and activities planned to reach the management goals.

Includes forest area in protected areas with management plan.

---

**Forest Characteristics**

**NATURALLY REGENERATED FOREST**

Forest predominantly composed of trees established through natural regeneration.

**Explanatory notes**

In this context, predominantly means that the trees established through natural regeneration are expected to constitute more than 50% of the growing stock at maturity.

Includes coppice from trees established through natural regeneration.

Includes naturally regenerated trees of introduced species.

**PRIMARY FOREST**

Naturally regenerated forest of native species, where there are no clearly visible indications of human activities and the ecological processes are not significantly disturbed.

**Explanatory notes**

Some key characteristics of primary forests are:

they show natural forest dynamics, such as natural tree species composition, occurrence of dead wood, natural age structure and natural regeneration processes;

the area is large enough to maintain its natural characteristics;

there has been no known significant human intervention or the last significant human intervention was long enough ago to have allowed the natural species composition and processes to have become re-established.

**OTHER NATURALLY REGENERATED FOREST**

Naturally regenerated forest where there are clearly visible indications of human activities.

**Explanatory notes**

Includes selectively logged-over areas, areas regenerating following agricultural land use, areas recovering from human-induced fires, etc.

Includes forests where it is not possible to distinguish whether planted or naturally regenerated.

Includes forests with a mix of naturally regenerated trees and planted/seeded trees, and where the naturally regenerated trees are expected to constitute more than 50% of the growing stock at stand maturity.

**PLANTED FOREST**

Forest predominantly composed of trees established through planting and/or deliberate seeding.

**Explanatory notes**

In this context, predominantly means that the planted/seeded trees are expected to constitute more than 50% of the growing stock at maturity.

Includes coppice from trees that were originally planted or seeded.

Excludes self-sown trees of introduced species.

**RUBBER PLANTATIONS**

Forest area with rubber tree plantations.

**MANGROVES**

Area of forest and other wooded land with mangrove vegetation.

**BAMBOO**

Area of forest and other wooded land with predominant bamboo vegetation.

**Forest establishment and reforestation**

| |
|---|
| **AFFORESTATION**<br><br>Establishment of <u>forest</u> through planting and/or deliberate seeding on land that, until then, was not classified as forest.<br><br>**Explanatory note**<br><br>Implies a transformation of land use from non-forest to forest. |
| **REFORESTATION**<br><br>Re-establishment of <u>forest</u> through planting and/or deliberate seeding on land classified as forest.<br><br>**Explanatory notes**<br><br>Implies no change of land use.<br><br>Includes planting/seeding of temporarily unstocked forest areas as well as planting/seeding of areas with forest cover.<br><br>Includes coppice from trees that were originally planted or seeded.<br><br><u>Excludes</u> natural regeneration of forest. |
| **NATURAL EXPANSION OF FOREST**<br><br>Expansion of <u>forests</u> through natural succession on land that, until then, was under another land use (e.g. forest succession on land previously used for agriculture).<br><br>**Explanatory note**<br><br>Implies a transformation of land use from non-forest to forest. |

**Growing stock**

---

**GROWING STOCK**

Volume over bark of all living <u>trees</u> more than X cm in diameter at breast height (or above buttress if these are higher). Includes the stem from ground level or stump height up to a top diameter of Y cm, and may also include branches to a minimum diameter of W cm.

**Explanatory notes**

Countries must indicate the three thresholds (X, Y, W in cm) and the parts of the tree that are not included in the volume. They must also indicate whether the reported figures refer to volume above ground or above stump. These specifications should be applied consistently through the time series.

Includes windfallen living trees.

<u>Excludes</u> smaller branches, twigs, foliage, flowers, seeds, and roots.

---

**GROWING STOCK OF COMMERCIAL SPECIES**

<u>Growing stock</u> (see def. above) of commercial species.

**Explanatory notes**

Commercial species are all species that currently are being commercialized for domestic and/or international markets.

Includes all trees of commercial species within the threshold limits given for growing stock, regardless whether they have reached commercial dimensions or not.

---

**Biomass stock**

---

**ABOVE-GROUND BIOMASS**

All living biomass above the soil including stem, stump, branches, bark, seeds, and foliage.

**Explanatory note**

In cases where forest understorey is a relatively small component of the aboveground biomass carbon pool, it is acceptable to exclude it, provided this is done in a consistent manner throughout the inventory time series.

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**BELOW-GROUND BIOMASS**

All biomass of live roots. Fine roots of less than 2mm diameter are excluded because these often cannot be distinguished empirically from soil organic matter or litter.

**Explanatory notes**

Includes the below-ground part of the stump.

The country may use another threshold value than 2 mm for fine roots, but in such a case the threshold value used must be documented.

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**DEAD WOOD**

All non-living woody biomass not contained in the litter, either standing, lying on the ground, or in the soil. Dead wood includes wood lying on the surface, dead roots, and stumps larger than or equal to 10 cm in diameter or any other diameter used by the country.

**Explanatory note**

The country may use another threshold value than 10 cm, but in such a case the threshold value used must be documented.

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**Carbon stock**

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**CARBON IN ABOVE-GROUND BIOMASS**

Carbon in all living biomass above the soil, including stem, stump, branches, bark, seeds, and foliage.

**Explanatory note**

In cases where forest understorey is a relatively small component of the aboveground biomass carbon pool, it is acceptable to exclude it, provided this is done in a consistent manner throughout the time series.

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**CARBON IN BELOW-GROUND BIOMASS**

Carbon in all biomass of live roots. Fine roots of less than 2 mm diameter are excluded, because these often cannot be distinguished empirically from soil organic matter or litter.

**Explanatory notes**

Includes the below-ground part of the stump.

The country may use another threshold value than 2 mm for fine roots, but in such a case the threshold value used must be documented.

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**CARBON IN DEAD WOOD**

Carbon in all non-living woody biomass not contained in the litter, either standing, lying on the ground, or in the soil. Dead wood includes wood lying on the surface, dead roots, and stumps larger than or equal to 10 cm in diameter or any other diameter used by the country.

**Explanatory note**

The country may use another threshold value than 10 cm, but in such a case the threshold value used must be documented.

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**CARBON IN LITTER**

Carbon in all non-living biomass with a diameter less than the minimum diameter for dead wood (e.g. 10 cm), lying dead in various states of decomposition above the mineral or organic soil.

**Explanatory note**

Fine roots of less than 2 mm (or other value chosen by the country as diameter limit for below-ground biomass) above the mineral or organic soil are included in the litter where they cannot be distinguished from it empirically.

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**SOIL CARBON**

Organic carbon in mineral and organic soils (including peat) to a specified depth chosen by the country and applied consistently through the time series.

**Explanatory note**

Fine roots of less than 2 mm (or other value chosen by the country as diameter limit for below-ground biomass) are included with soil organic matter where they cannot be distinguished from it empirically.

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**Forest fires**

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|---|
| **NUMBER OF FIRES**<br><br>Number of vegetation fires per year. |
| **AREA AFFECTED BY FIRE**<br><br>Area affected by vegetation fires per year. |
| **VEGETATION FIRE (supplementary term)**<br><br>Any vegetation fire regardless of ignition source, damage or benefit. |
| **WILDFIRE**<br><br>Any unplanned and/or uncontrolled vegetation fire.<br><br>**Explanatory notes**<br><br>Includes management-ignited vegetation fires that exceed the restrictions in the fire plan and require suppression actions.<br><br>Excludes unplanned vegetation fires that burn in accordance with management objectives. |
| **PLANNED FIRE**<br><br>A vegetation fire regardless of ignition source that burns according to management objectives and requires limited or no suppression action.<br><br>**Explanatory notes**<br><br>Includes unplanned vegetation fires that burn in accordance with management objectives (e.g. "let burn") and therefore not subject to suppression measures.<br><br>Excludes management-ignited vegetation fires that exceed the restrictions in the fire plan. |

**Other disturbances affecting forest health and vitality**

| |
|---|
| **DISTURBANCE**<br><br>Damage caused by any factor (biotic or abiotic) that adversely affects the vigour and productivity of the forest and which is not a direct result of human activities.<br><br>**Explanatory note**<br><br>For the purpose of this reporting table, disturbances exclude forest fires as these are reported on in a separate table. |
| **DISTURBANCE BY INSECTS**<br><br>Disturbance caused by insect pests. |
| **DISTURBANCE BY DISEASES**<br><br>Disturbance caused by diseases attributable to pathogens, such as bacteria, fungi, phytoplasma or virus. |
| **DISTURBANCES BY OTHER BIOTIC AGENTS**<br><br>Disturbance caused by biotic agents other than insects or diseases, such as wildlife browsing, grazing, physical damage by animals, etc. |
| **DISTURBANCES CAUSED BY ABIOTIC FACTORS**<br><br>Disturbances caused by abiotic factors, such as air pollution, snow, storm, drought, etc. |

**Additional terms and definitions**

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**FOREST MANAGEMENT**

The processes of planning and implementing practices for the stewardship and use of <u>forests</u> and <u>other wooded land</u> aimed at achieving specific environmental, economic, social and /or cultural objectives.

**Explanatory note**

Includes management at all scales such as normative, strategic, tactical and operational level management.

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**SHRUB**

Woody perennial plant, generally more than 0.5 meters and less than 5 meters in height at maturity and without a definite crown. The height limits for trees and shrubs should be interpreted with flexibility, particularly the minimum tree and maximum shrub height, which may vary between 5 meters and 7 meters.

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**TREE**

A woody perennial with a single main stem, or in the case of coppice with several stems, having a more or less definite crown.

**Explanatory note**

Includes bamboos, palms, and other woody plants meeting the above criteria.

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## Annex 11.  Other international datasets relevant to AFOLU inventories

The United Nations Economic Commission for Europe(UNECE) forestry databases for European countries:
- o *http://w3.unece.org/pxweb/DATABASE/STAT/Timber.stat.asp*

United Nations Enironment Programme(UNEP) database on global burnt area:
- o http://www.grid.unep.ch/

European Forest Institute(EFI) databases on forestry for European countries:
- o http://www.efi.int/

Joint Research Centre(JRC) of the European Commission databases pertaining to AFOLU for European countries:
- Allometric, Biomass and Carbon factors Database:
  - o http://afoludata.jrc.ec.europa.eu/DS_Free/abc_intro.cfm
- Biomass Compartments:
  - o http://afoludata.jrc.ec.europa.eu/index.php/public_area/biomass_compartments
- Tree Species Distribution for Europe:
  - o http://afoludata.jrc.ec.europa.eu/index.php/public_area/tree_species_distribution
- European Forest Yield Tables:
  - o http://afoludata.jrc.ec.europa.eu/DS_Free/YT_intro.cfm
- National European Forest Inventories:
  - o http://fi.jrc.ec.europa.eu/Frameset.cfm
- European Forest Fire information System:
  - o http://effis.jrc.ec.europa.eu/
- European Soils Datasets:
  - o http://eusoils.jrc.ec.europa.eu/

International Fertilizer Industry Association (IFA) database on international fertilizer statistics:
- o http://www.fertilizer.org/ifa/statistics.asp

International Rice Research Institute(IRRI) database on rice statistics:
- o www.irri.org

Data on peat production:
- World Energy Council Survey of Energy Resources:
  - o *http://www.worldenergy.org/publications/survey_of_energy_resources_2007/default.asp*
- United States Geological Survey:
  - o *http://minerals.usgs.gov/minerals/pubs/commodity/peat/*
- *International Peat Society:*
  - o *www.peatsociety.org*
- International Mire Conservation Group:
  - o *http://www.imcg.net*

Data on area of wetlands:

- International Commission on Large Dams(ICOLD) publications on flooded land area accessible at:
  - o *http://www.icold-cigb.net/*
- Wetlands International:
  - o *www.wetlands.org*

Some data on cereal yield, fertilizer consumption and cropland is also available at

- World Bank statistics website :
  - o *http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/*

## Annex 12.    **References**

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## Annex 14.   **Agenda**

| | 8:45 | Registration and welcome coffee | |
|---|---|---|---|
| Tuesday 20th October | 9:50 | Welcome by IFAD (Elwyn Grainger-Jones, Executive Co-ordinator Global Environment and Climate Change. IFAD)<br>Welcome by FAO (Peter Holmgren, Director, Environment, Climate Change and Bioenergy Division)<br>Welcome IPCC (Thelma Krug and Takahiko Hiraishi, IPCC TFI Co-Chairs) | IFAD, FAO, IPCC TFI Co-Chairs |
| | 10:20 | Plenary 1 – Introduction and Background | |
| | | Aims and Background | TSU |
| | | Data needs of IPCC Guidelines (LULUCF & AFOLU) | TSU |
| | | Presentations on FAO Data (10 minutes + 5 minutes of questions):<br>FAO statistics (Robert Mayo, Dominic Ballayan and Nic Sakoff)<br>EcoCrop and IPNIS (Philippe Dugast and Wolfgang Prante)<br>Global Forest Resources Assessment data (Lars Gunnar Marklund)<br>Planted forests database (Alberto Del Lungo)<br>National Forest Monitoring Assessment (Marco Piazza)<br>Wood products (Arvydas Lebedys)<br>Example of application of FAO datasets on Tier 1 IPCC methods (Ricardo Villani) | FAO |
| | 12:30 | LUNCH | |
| | 13:30 | Presentations on FAO Data (continued)<br>Livestock data (Pierre Gerber and Theun Vellinga)<br>Land cover data, geonetwork, LCCS, ECVs fire (Renato Cumani)<br>Global land use map and harmonized world soil database and AgroMaps (Freddy Nachtergaele) | FAO |
| | 14:40 | Presentation of Draft report | TSU |
| | 15:00 | Summary and instructions for BOGs | TSU |
| | 15:10 | Break | |
| | 15:30 | 4 BOGs.<br>Initial discussion to determine exact topics of each group and how to split up the participants. Each group will review draft, make changes as necessary, consider if guidance is sufficient, and if there are additional data sources that could be added (inside and outside the FAO).<br><br>Current proposed BOGs: BOG 1: Forestland, BOG 2: Cropland and Grasslands, BOG 3: Livestock, BOG 4: Wetlands, Settlements, Otherland, HWP and others. | |
| | 17:00 | Close | |
| | 18:00 | Reception – IFAD HQ (floor -1) | |
| Wednesday 21st October | 09:00 | BOGs Continue | |
| | 12:30 | LUNCH | |
| | 13:30 | BOGs Continue | |
| | 17:00 | Close | |
| Thursday 22nd October | 09:00 | BOGs Continue | |
| | 12:30 | LUNCH | |
| | 13:30 | Plenary 2 – review and consolidate.<br>Outputs<br>    An agreed revised draft report.<br>    A summary of outstanding data needs that are not covered by data identified in the report | |
| | 17:00 | Close | |

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