



UN-FCCC and KP reporting requirements related to the forestry sector

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Land-use, land use change and forestry (LULUCF part of AFOLU)

- Six land use categories under UN-FCCC (and land-use changes between these subcategories):
 - **Forest land**
 - Cropland
 - Grassland
 - Wetlands
 - Settlements
 - Other land
- Five pools (for UN-FCCC reporting compiled to three pools):
 - **Biomass** (aboveground, belowground)
 - **Dead organic matter** (Dead wood, Litter)
 - **Soil** (mineral, organic)

Accounting and reporting of LULUCF activities under Kyoto Protocol and EU Decision 529

„Accounting“ means emissions/removals of the activities are accounted against the emission reduction targets for the period

Mandatory activities:

- Af-/reforestation, deforestation (both involve a land-use change)
- Forest Management (including Harvested Wood Products)

Voluntary activities:

- Cropland Management (but mandatory reporting under the EU LULUCF decision)
 - Grazing land Management (but mandatory reporting under the EU LULUCF decision)
 - Wetland Drainage and Rewetting
 - Revegetation
-
- No accounting of LULUCF activities under EU in the 2nd commitment period

IPCC Reporting Principles “TACCC”

- **Transparent:**
sufficient and clear documentation for understanding the inventory.
- **Accurate:**
neither over nor underestimates;
uncertainties have been reduced as much as is possible.
- **Complete:**
estimates for all relevant activities and gases.
- **Consistent:**
results reflect real annual fluctuations in emissions;
using the same method and data sources for all years.
- **Comparable:**
reporting in a way that comparison with GHG inventories from other countries is possible.

The IPCC concept of tiers in reporting

Tier 1:

- Simple methods on basis of default values from the IPCC guidelines

Tier 2:

- Estimates are based on national or country specific data

Tier 3:

- Comprehensive methods including advanced models and/or **inventory measurement systems** with high temporal and spatial resolution

Typically, countries report LULUCF in a combination of methods at different tiers depending on the availability of data/resources and on the impact of the category, pool or parameter contributing to the emission factor

The IPCC concept of tiers in reporting (2)

Key categories:

- significant impact on a country's total inventory of GHGs in sense of absolute level, the trend, or the uncertainty in emissions and removals
- Regarding absolute level: all emission/removal categories that account for 95 % of the countries emissions

Significant pools:

- Representing >25–30 % of emissions/removals of key categories
- Higher tiers of reporting methods only needed for significant pools of key categories
- **Biomass in “Forest land remaining forest land” and in “Land-use change to forest land” are frequently significant pools of key categories**

Monitoring, Reporting and Verification needs for LULUCF

1) Activity data:

■ Annual assessment of

- areas subject to the six land-use categories and associated (land-use change) subcategories
- land subject to mandatory or elected KP activities;
- Stratifications according to soil types, management differences, climate

2) Emission factors:

- Annual C stock changes of biomass, dead wood, litter, soil at the areas of 1)

3) Verification on basis of defined QA/QC procedures

UN-FCCC land use and land-use change assessment, three approaches:

- **Approach 1:** total land-use area, no data on conversions between land uses
- **Approach 2:** total land-use area, including changes between categories (not spatially explicit)
- **Approach 3:** spatially-explicit land-use conversion data
- Frequently areas of the different subcategories are reported from different sources representing different approaches:
 - National Forest Inventories
 - Remote sensing like Corine Land Cover
 - Statistics

Assessment needs for lands of elected or mandatory activities

Decisions 2/CMP.7 and 2/CMP.8 state that those areas of land subject to Article 3.3 and 3.4 activities must be:

- identifiable
- adequately reported
- tracked over time

Spatially-explicit and (complete) geographical identification needed for:

- ARD lands (Art. 3.3 activities)
- Lands reported under Art. 3.4 activities

However, the lands may be also assessed on basis of statistical systems (randomized fixed grids representative for the country)

In addition, georeferenced location needed for:

- Lands for which the natural disturbance provision is used (emissions due to natural disturbances are not accounted...)
- Lands used for the Carbon-equivalent-forests provision

Forest land methods (focus on biomass and dead wood reporting)



Forest biomass

Gain-Loss Method

- Net change between differences in biomass increment and biomass loss (harvest and other drain)

Stock-Difference Method

- Differences between biomass stocks in two points of time

The Stock-Difference-Method for forest biomass

EQUATION 2.8
ANNUAL CHANGE IN CARBON STOCKS IN BIOMASS
IN LAND REMAINING IN THE SAME LAND-USE CATEGORY (STOCK-DIFFERENCE METHOD)

$$\Delta C_B = \frac{(C_{t_2} - C_{t_1})}{(t_2 - t_1)} \quad (a)$$

where

$$C = \sum_{i,j} \{A_{i,j} \cdot V_{i,j} \cdot BCEF_{S_{i,j}} \cdot (1 + R_{i,j}) \cdot CF_{i,j}\} \quad (b)$$

C stock change derived from the difference of C stocks in two points of time

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The estimates of C stock for forests require input data for:

The Stock-Difference-Method for forest biomass

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The estimates of C stock require input data for:

Area: e.g. from remote sensing, ground based forest inventories, cadaster

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The estimates of C stock require input data for:

Volume of standing stemwood (in m³): e.g. from forest inventories, based on field measurements of tree diameters and height and volume models

The Stock-Difference-Method for forest biomass

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The estimates of C stock require input data for:

Conversion and expansion factors to convert stemwood volume to aboveground biomass: e.g. from ecosystem studies, models, wood density analyses, IPCC (2006) GL

The Stock-Difference-Method for forest biomass

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The estimates of C stock require input data for:

Root/shoot ratios to expand aboveground biomass to total biomass: e.g. from ecosystem studies, models, , IPCC (2006) GL

The Stock-Difference-Method for forest biomass

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The estimates of C stock require input data for:

C fraction to convert biomass to Carbon: e.g. C analyses, IPCC (2006) GL

The Gain-Loss-Method

EQUATION 2.7
ANNUAL CHANGE IN CARBON STOCKS IN BIOMASS
IN LAND REMAINING IN A PARTICULAR LAND-USE CATEGORY (GAIN-LOSS METHOD)

$$\Delta C_B = \Delta C_G - \Delta C_L$$

Where:

ΔC_B = annual change in carbon stocks in biomass (the sum of above-ground and below-ground biomass terms in Equation 2.3) for each land sub-category, considering the total area, tonnes C yr⁻¹

ΔC_G = annual increase in carbon stocks due to biomass growth for each land sub-category, considering the total area, tonnes C yr⁻¹

ΔC_L = annual decrease in carbon stocks due to biomass loss for each land sub-category, considering the total area, tonnes C yr⁻¹

The Gain-Loss-Method (2)

EQUATION 2.10

AVERAGE ANNUAL INCREMENT IN BIOMASS

Tier 1

$G_{TOTAL} = \sum \{G_W \cdot (1 + R)\}$ Biomass increment data (dry matter) are used directly

Tiers 2 and 3

$G_{TOTAL} = \sum \{I_V \cdot BCEF_I \cdot (1 + R)\}$ Net annual increment data are used to estimate G_W by applying a biomass conversion and expansion factor

EQUATION 2.12

ANNUAL CARBON LOSS IN BIOMASS OF WOOD REMOVALS

$$L_{wood-removals} = \{H \cdot BCEF_R \cdot (1 + R) \cdot CF\}$$

...requires at higher tiers usually also expansion/conversion factors to estimate biomass C increment and drain from stemwood increment and losses

Comparison of gain-loss method and stock change method

Due to the large stocks and small annual stock changes the gain-loss method provides more accurate results of the yearly C stock changes if based on results of an adequately designed monitoring system, e.g.:

- fixed NFI grid and plots
- Assessment of biomass drain and increment on basis of the remeasurement of biometric tree parameters at the same plots and trees

Forest biomass

represents a significant pool of a key category in most reporting countries

- Higher tiers of reporting are needed

Frequently, forest inventories and/or forest management plans are available in the countries which provide country specific values for stemwood stocks and/or stemwood growth/drain for several periods

- By that, higher Tier reporting is ensured (even if default expansion/conversion factors are used)

Dead wood in forests

- Part of the dead organic matter pool
- Dead wood may origin from mortality, disturbances and harvest residues left on site
- Standing and lying dead wood
- Tier 1 assumes no C stock change in dead wood
- Usually assessed within forest inventories (higher tier methods)

Litter and mineral soil in forests

- Due to high C stock variability per site and destructive sampling, short time soil C stock changes cannot be assessed on basis of repeated soil inventories, but only after at least two to three decades in between the soil inventories or with an unrealistic high number of sample plots
- Therefore, higher tier methods usually assess the litter/soil C stock changes in forest land rem. forest land on basis of models
- Appropriateness of models for the country-specific conditions need to be verified/validated with national data (e.g. data from long-time soil monitoring plots)
- The running of models requires at least input data for litterfall/harvest residues (can be estimated on basis of forest inventory information) and climatic parameters

Land-use change subcategories

- Land Converted to Forest Land
- Land Converted to ...
- ...
- Sub-sub-categories according to different previous land uses

- After land-use change land stays the whole transition period (default 20 years) in the land-use change subcategory

Land-use change subcategories are frequently key categories

Biomass in land-use change subcategories

- Biomass of previous land-use is assumed to be (partly) lost in year of land-use change and
- Biomass of new land-use is assumed to start growing in the year of land-use change
 - Annual biomass within the first year of land-use change
 - Perennial biomass growth each year of the transition period
- Information on biomass stocks/growth rates of the land-use change categories is needed

Information on biomass stocks/growth rates of the land-use change categories

- Default values from IPCC (2006) GL or literature values
- Country specific values, for instance:
 - Forest biomass losses/growth rates from forest inventories, forest management plans, monitoring plots, studies

Dead wood in land-use change subcategories

- Relevant in LUC categories involving forests
- Dead wood C stock information may be taken from IPCC (2006) GL or from forest inventories and other assessments

Typically, the GHG emissions/removals of forest land are estimated from a combination of input parameters based on

- Systematic randomized and representative assessments, e.g. National Forest Inventories
- Models
- Input data from local studies
- Literature and default values from IPCC GL ("Tier 1")
- Expert judgements

Thank you for your attention

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