Standard Methods for Estimating Greenhouse Gas Emissions from Forests and Peatlands in Indonesia

(Version 2)

Chapter 6:
Standard Method – Spatial Allocation of Regimes

MINISTRY OF ENVIRONMENT AND FORESTRY
RESEARCH, DEVELOPMENT AND INNOVATION AGENCY

Chapter 6: Standard Method – Spatial Allocation of Regimes

This chapter is taken from the complete publication from the following source:

Krisnawati, H., Imanuddin, R., Adinugroho, W.C. and Hutabarat, S. 2015. Standard Methods for Estimating Greenhouse Gas Emissions from Forests and Peatlands in Indonesia (Version 2). Research, Development and Innovation Agency of the Ministry of Environment and Forestry. Bogor, Indonesia.

The other chapters and full publication are also available on the INCAS website www.incas-indonesia.org

6 STANDARD METHOD – SPATIAL ALLOCATION OF REGIMES

6.1 PURPOSE

This standard method describes the process used by INCAS for defining the areas used for each management regime in modeling GHG emissions and removals from activities occurring on forest lands (including natural forests, timber plantations and selected estate crops (oil palm and rubber) on former forest land). This includes data collation, data analysis, quality control and quality assurance.

There are many factors that are critical in determining variations in emissions from different activities in Indonesia. The type and condition of forest and other land on which activities occur, as well as the type of management activities undertaken, need to be spatially identified to enable detailed modeling of GHG emissions and removals.

The best available spatial data that could inform the areas in which each activity could potentially occur was identified and sourced (see Table 6-1). These spatial data sets were created for a range of non-MRV GHG emissions related reasons. Consequently, the spatial and temporal quality was variable. This led to inconsistencies between data sets, which in turn necessitated decisions about how each data set was to be used for the purpose of carbon accounting.

The purpose of this standard method is to describe how the available spatial data can be used to consistently allocate management regimes to areas and to derive annual area statistics for use in INCAS modeling.

6.2 DATA COLLATION

Data were collated from national and provincial level government agencies and organizations involved in land management.

Spatial forest cover and forest cover change data was developed by LAPAN as part of the INCAS program.

Spatial data

Spatial data sets used to inform the possible areas in which activities can occur are shown in Table 6-1. These data are used to create a series of 'suites', which describe the conditions under which a land management regime can occur. By using biophysical and management data in the identification of individual suites, it is possible to allocate areas of land use and land-use change to model the impact on GHG emissions and removals.

Table 6-1. Source of spatial data.

Data	Description	Source
Land cover class	Primary or secondary dryland forest, swamp forest or mangrove forest, timber plantations (and all other land cover classes)	MoEF
Forest extent and change	Annual forest /non-forest data derived from Landsat data and the forest loss and forest gain events derived by differencing the annual forest extents	National Institute of Aeronautics and Space (LAPAN)
Burnt area	Annual area burnt	INCAS (MoEF)
Soil type	Organic (peat)	MoA
Soil IPCC class	Mineral soil IPCC class	Digital soil map of the world (FAOI)
Forest function	Production, protection, or conservation forest	MoEF
Forest utilization	Area of forest concessions	MoEF
Estate crops	Area of oil palm, rubber and other commodities of plantations	MoEF

The method used to derive forest extent and change data is described in Chapter 5 (*Standard Method – Forest Cover Change*).

A spatial layer showing the geographic extent of each suite was created for each simulation year (i.e. annually from 2001 to 2012) using the data in Table 6-1. Each suite was allocated a unique identifier (suite code) which links the spatial data to the management regimes produced as an output of the *Standard Method – Forest Management Events and Regimes* (Chapter 4).

The suite code is a common attribute for all areas that will constitute the area of each regime in each year. The area of each suite will vary over time as forests transition from primary to secondary forest to non-forest conditions.

Management regimes

Management regimes describe the type and combination of management events applied to a particular land use and the timing of events.

Once assigned to a management regime, an area continues to be managed according to that regime, in perpetuity, until a subsequent event is observed that causes a change in the management regime.

Suites for forest and cropland assessed in this standard method were produced using the *Standard Method – Forest Management Events and Regimes* (Chapter 4). Management regimes for quantifying peat emissions are described in the *Standard Method – Peatland GHG Emissions* (Chapter 7).

All data described in this standard method were collated from existing sources held by Government of Indonesia agencies and other organizations, with the exception of the burnt area and mineral soil map from IPCC. The burnt area data was produced by the INCAS team using the approach developed by Ballhorn et al. (2014) for Central Kalimantan province.

6.3 ANALYSIS

The objective of the analysis was to calculate the area of land managed according to each management regime for every year of the simulation period. These areas form part of the inputs for the GHG emissions and removals estimation models described in the *Standard Method – Data Integration and Reporting* (Chapter 8).

Areas were allocated to a management regime based on suite characteristics and repeated for each year of the simulation period (i.e. 2001 to 2012). Areas subject to observed change (i.e. change detected from the LAPAN forest cover change analysis) were assigned to regimes based on the location, timing and direction of change in conjunction with the other suite characteristics.

For an area to be allocated to a forest management regime it must meet the minimum forest area definition for Indonesia of 0.25 ha (according to the Forestry Ministerial Decree No. P.14/2004). As the analysis was completed on the change (activity) data, as opposed to forest extent, the area threshold was applied to the aggregate of all years of change. This allows for accounting of annual change of areas less than 0.25 ha, while ensuring that the cleared land meets the definition of forest.

All spatial data that was related to the location and extent of a regime in the carbon account was collated, converted to shape files and projected to a consistent coordination system.

Each activity reported by INCAS was modelled as a separate estate – i.e. a file with the area and timing of each regime assigned by this standard method. REDD+ activities modeled in INCAS were deforestation, forest degradation, enhancement of forest carbon stocks and sustainable management of forest.

The criteria used to define each activity are presented in Table 4-5 of the *Standard Method – Forest Management Events and Regimes* (Chapter 4). Each regime can be determined from the unique combinations of these spatial data values and the area provided for modelling directly from the GIS outputs.

While there are a total of 1,152 different regimes requiring different areas, the deforestation and reforestation activities were identifiable directly from combinations of the source data. However, some additional processing was required to deliver appropriate areas to model SMF and forest degradation.

Sustainable management of forest (SMF): This REDD+ activity fits within the forest land remaining forest land category of UNFCCC. It occurs when forest cover loss is not observed within primary or secondary forest as shown on the land-cover map, but forest concession data indicated that a harvesting event has occurred using RIL technique. It assumes that in the SMF there will be regrowth back to initial forest conditions.

The annual forest change data is only relevant to forest management activities that result in a discernible change in the forest canopy (i.e. harvesting does not result in removal of enough trees to reduce the forest canopy to below the 30% threshold that defines a forest).

The process to allocate area to these activities relied on forest type, forest function, concession boundaries, the absence of forest change and the proportion of forest available for harvesting, as follows.

- If the forest type was mapped as dryland forest, the usual SMF practice was assumed to be to harvest 40.6% of the forests over a 30-year period. This was calculated by assuming the effective area harvested in each concession area was 70%, corrected by average annual actual timber production of 0.58.
- If the forest type was mapped as swamp forest, the usual SMF practice was assumed to be to harvest 52.2% of the forests over a 40-year period. This was calculated by assuming the effective area harvested in each concession area was 90%, corrected by average annual actual timber production of 0.58.

Forest degradation: The determination of areas to assign to forest degradation activities required the creation of unique combinations of all the forest change data.

The year of forest loss and the year of forest gain were determined for each polygon. Polygons that recorded both loss and gain were subjected to a statistical analysis.

If the intervening non-forest period was 3 or more years, this met the criteria of temporarily unstocked, which resulted in the polygon being assigned to a forest degradation event.

This analysis was conducted for areas of forest that were cleared and subsequently regrown and allocated to the year in which the forest was lost. ('clearreveg')

Conversely, polygons of multiple changes where the first event was a forest gain were identified as a degradation event beginning in the year of first forest gain. ('revegclear'). The assumption was that the land was temporarily unstocked prior to the availability of the first year of forest extent data (2000).

Forest degradation was when:

- there was a change from primary to secondary forest on the land-cover map;
- there was a change from either primary or secondary forest to timber plantation on the land-cover map;
- forest cover loss was not observed within secondary forest as shown on the land-cover map, but forest concession data indicated that a harvesting event had occurred using the conventional technique.

6.4 QUALITY CONTROL AND QUALITY ASSURANCE

All data are assumed to be correct from the data supplier.

All data were spatially complete for all of Indonesia (province by province).

All data were combined into a single polygon data set for each year.

The resultant GIS table was then exported to Excel and each regime assigned based on the selection of the relevant attributes of each input data set.

All records that had an area less than 0.25 ha were deleted. These small polygons were visually inspected and determined to be the result of unintentional overlapping areas of differently derived spatial data. Thus, the filtering of thousands of rows of the database was used as a proxy for cleaning the input data to ensure that each combination of land-use activity and function was logical.

The other main logic filter that was undertaken as part of the statistical analysis (as a proxy for a rigorous spatial analysis filter) was to ensure that all clearing and revegetation events were separated by a length of time determined to be suitable by the description of the defined regimes.

The analysis relied on a strong understanding of statistics, spatial analysis, vegetation dynamics, forest management practices and the impact of a time series of events on the resultant carbon account.

6.5 OUTPUTS

Outputs from this standard method are expressed in hectares, by regime, by year and documented in INCAS Regime Area Database (see the description in Appendix 1).

A Unique Feature Identifier (FID) from the GIS data was maintained throughout this process so that the newly calculated "suite" field for each year could be joined back to the spatial data.

The QA/QC processes and decision rules around minimum areas would have the effect of reducing uncertainty of the areas where each of the input data sources is assigned to the same area of land. In the uncertainty analysis, area was varied by +/-10%.

6.6 LIMITATIONS

Due to the known confusion between forest and estate crop species in the remotely sensed regrowth data, there are likely to be some areas of forest loss and gain that contain errors.

Spatial analysis tools were not fully developed when this analysis was undertaken, which resulted in a large amount of data being processed using manual processes. The efficiency of this process should be improved to reduce potential for errors and to reduce processing time, particularly for spatial allocation of regimes across all of Indonesia.

6.7 IMPROVEMENT PLAN

All input data can be characterized as the best available.

For the continuous improvement plan, it is recommended that each of the data sets supplied for this analysis is subjected to more rigorous preprocessing and standardization.

As new versions and updates to each of the input data sets are created, the modelling team will need to have access, permission and resources to repeat this methodology to update the areas for subsequent modelling of emissions and removals.

The improvement plan associated with the generation of the modelling and reporting requirements will also lead to a repetition of this spatial allocation to match any new suites.

Activities relying on the detection of conversion from non-forest to forest land (afforestation, reforestation and revegetation) could not be determined using satellite data without additional interpretation of the outputs. For example, palm trees meet the crown cover, height and area parameters given in the national definition of "forest", but the policy parameters require these to be identified as estate crop species.

The detailed spatial analysis of forest cover change from LAPAN combined with spatial data about forest types and management practices have greatly improved the identification of forest change events. This can be further improved by greater collaboration between forest cover mapping and spatial analysis processes. Development of a spatial analysis tool would improve the efficiency of the spatial allocation of regimes described in this standard method.

Results would be enhanced through a more detailed understanding of land management events prior to 2000, as this influences the estimation of forest biomass and the degree of peat degradation modelled during the period 2001 to 2012. This could be achieved by extending the annual forest cover change analysis back to 1990 and extracting more detailed information from historical land management records.

This publication describes in detail the standard methods of the Indonesian National Carbon Accounting System (INCAS) to quantify net greenhouse gas (GHG) emissions from forests and peatlands in Indonesia in a transparent, accurate, complete, consistent and comparable manner. The standard methods describe the approach and methods used for data collation, data analysis, quality control, quality assurance, modelling and reporting. The standard methods cover (i) Initial Conditions, (ii) Forest Growth and Turnover, (iii) Forest Management Events and Regimes, (iv) Forest Cover Change, (v) Spatial Allocation of Regimes, (vi) Peatland GHG Emissions, and (vii) Data Integration and Reporting. This second version of the standard methods includes improvements implemented in preparing the first comprehensive national GHG inventory for forests and peatlands, the results of which are reported in *National Inventory of Greenhouse Gas Emissions and Removals on Indonesia's Forests and Peatlands*. This publication has been prepared and published by the Indonesian Ministry of Environment and Forestry, under the Research, Development and Innovation Agency.

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ISBN 978-979-8452-65-9
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