

# STANDARD OPERATING PROCEDURES FOR GREENHOUSE GAS EMISSIONS ESTIMATION

**Purpose:** These Standard Operating Procedures (SPO) Notes acts as a set of general Cheat-sheets, which in conjunction with a more general posterior white paper, aim to be the main support backbone documents for national staff working in area reporting for REDD+. The SPO will be modified to fit the particular protocols of each country and ensure that they are repeatable.

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# STANDARD OPERATING PROCEDURE (SOP): GREENHOUSE GAS EMISSIONS ESTIMATION

## Section 1 Overview

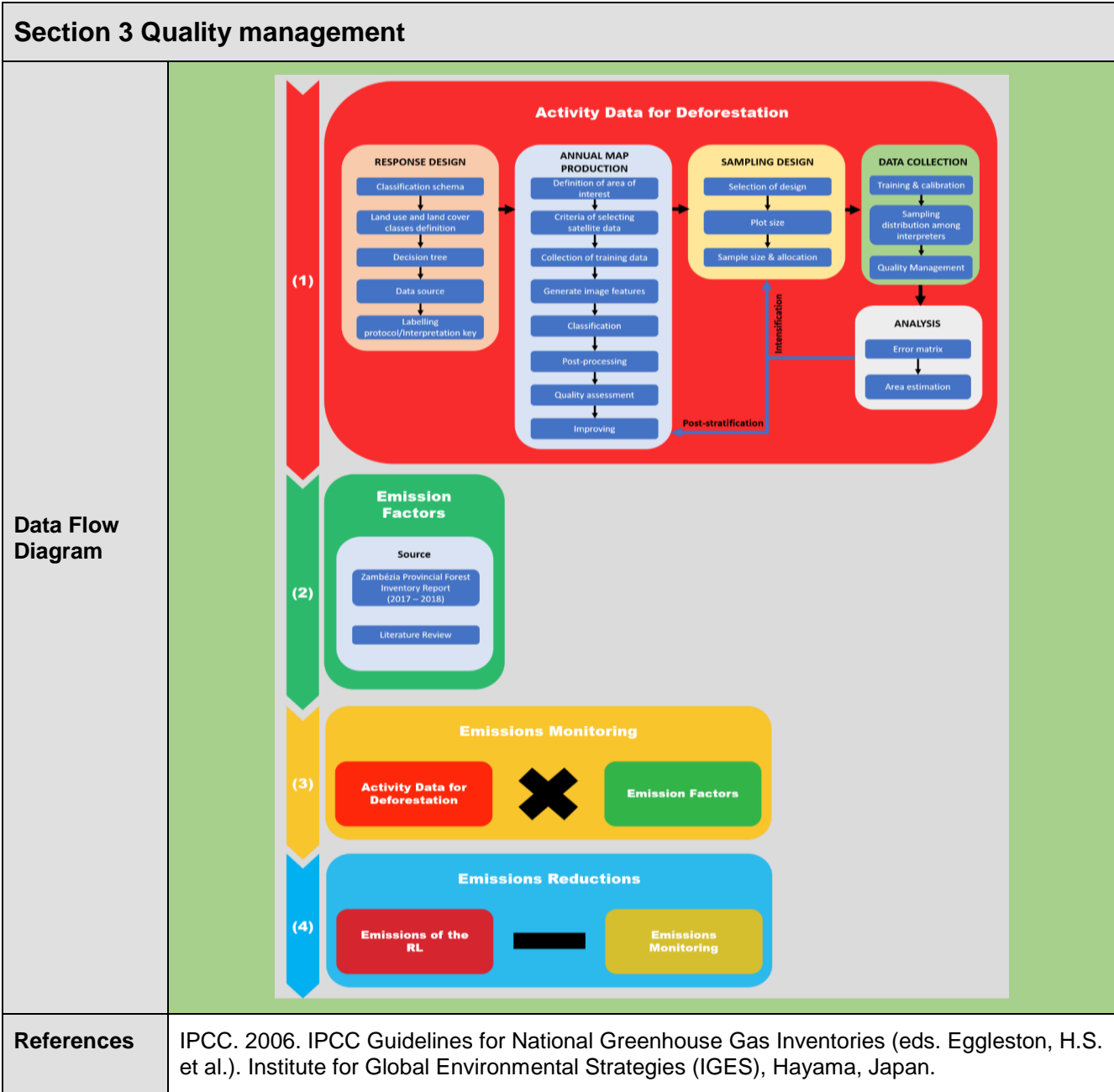
<b>Purpose</b>	Estimate greenhouse gases emissions from deforestation using methods and procedures described in the IPCC good practice guidance for national greenhouse gases inventories. Estimate biomass before and biomass after conversion and conversion carbon to CO <sub>2</sub>
<b>Scope</b>	Wall-to-wall mapping of the project area of forest cover change for each year of monitoring
<b>Responsibilities</b>	Technical decision and policy makers in REDD+ countries and international agencies, multilateral and bilateral programmes, in particular for the estimation of activity data (i.e., land use/land cover change) for emissions/removals in REDD+ activities.
<b>Prerequisites</b>	Activity Data and Emissions Factors available.
<b>Requirements</b>	<ul style="list-style-type: none"> <li>• Define included gases</li> <li>• Define Carbon reservoirs</li> <li>• Define Activities</li> <li>• Define Estimation Method</li> </ul> <p><b>Important Note:</b> Included gases: <b>CO<sub>2</sub></b> Carbon reservoirs included: <b>Above ground biomass (AGB) and Below ground biomass (BGB)</b></p>

## Section 2 Procedure

<b>Forest reference emissions level (FREL)</b>	<p>The current SOP procedure focuses on greenhouse gases estimation. FREL was estimated for ER program. The FREL is based on a historical average during the defined reference period. Based on the collected data, there is no trend observed in terms of deforestation. And it is expected that national circumstances will not change significantly in relation to the reference period. Therefore, the historical average is considered a good indicator of future emissions of greenhouse gases.</p> <p>The activity data used to construct the Reference Level is a subset of the National FREL Data, for the Program Area. The Emission Factors for the Reference Level and the FREL also come from the National Forest Inventory. For the Reference Level only data from NFI plots from Zambézia Province were used, whereas the FREL used data from the entire dataset.</p> <p>For entire area of program 3,322 sampling points (the regular national 4 x 4 km grid) were collected (Land use, land-use change, and forestry) using medium and high-resolution image in the open source plataform such as Sentinel, Landsat, MODIS, Google image and Bing. The period of analyze was from 2005 to 2015.</p>
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<b>Estimating</b>	<p>Annual gross GHG emissions over the monitoring period in the Accounting Area (<math>GHG_t</math>) are estimated as the sum of annual change in total biomass carbon stocks (<math>\Delta C_{B_t}</math>).</p> $GHG_t = \sum_t^T \Delta C_{B_t} \quad \text{Equation 1}$ <p>Where:</p> <p><math>\Delta C_{B_t}</math> = Annual change in total biomass carbon stocks at year <math>t</math>; <math>tC \cdot year^{-1}</math></p> <p><u>Changes in total biomass carbon stocks</u></p> <p>Following the 2006 IPCC Guidelines, the annual change in total biomass carbon stocks forest land converted to other land-use category (<math>\Delta C_B</math>) would be estimated through the following equation:</p> $\Delta C_B = \Delta C_G + \Delta C_{CONVERSION} - \Delta C_L \quad \text{Equation 2}$ <p>Where:</p> <p><math>\Delta C_B</math> Annual change of total biomass carbon stocks during the period, in tC per year;</p> <p><math>\Delta C_G</math> Annual increase in carbon stocks in biomass due to growth on land converted to another land-use category, in tC per hectare and year;</p> <p><math>\Delta C_{CONVERSION}</math> Initial change in carbon stocks in biomass on land converted to other land-use category, in tC per hectare and year; and</p> <p><math>\Delta C_L</math> Annual decrease in biomass carbon stocks due to losses from harvesting, fuel wood gathering and disturbances on land converted to other land-use category, in tC per hectare and year.</p> <p>Following the recommendations set in chapter 2.2.1 of the GFOI Methods Guidance Document for applying IPCC Guidelines and guidance in the context of REDD+<sup>1</sup>, the above equation will be simplified and it will be assumed that:</p> <p>The annual change in total biomass carbon stocks (<math>\Delta C_B</math>) is equal to the initial change in carbon stocks (<math>\Delta C_{CONVERSION}</math>);</p> <p>Considering equation 2.16 of the 2006 IPCC GL for estimating (<math>\Delta C_{CONVERSION}</math>) and considering 2.8b for the estimation of carbon stocks, the change of biomass carbon stocks could be expressed with the following equation:</p> $\Delta C_B = \sum_{j,i} (B_{Before,j} - B_{After,i}) \times CF \times \frac{44}{12} \times A(j,i) \quad \text{Equation 3}$
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	<p><i>Where:</i></p> <p><math>A(j, i)</math> Area converted/transited from forest type <math>j</math> to non-forest type <math>i</math> during the monitoring period, in hectare per year. In this case, three forest land conversions are possible: (Semi-)deciduous forest to Non-forest type <math>i</math>; (Semi-)evergreen forest to Non-forest type <math>i</math>; and Mangrove forest to Non-forest type <math>i</math>.</p> <p>Five types of non-forest land are considered: Cropland (C); Grassland (P); Wetland (A); Settlement (U); and Other lands (O).</p> <p><math>B_{Before,j}</math> Total biomass of forest type <math>j</math> before conversion/transition, in tons of dry matter per ha. This is equal to the sum of aboveground and belowground biomass.</p> <p><math>B_{After,i}</math> Total biomass (above- and belowground) of non-forest type <math>i</math> after conversion, in tons of dry matter per ha.</p> <p><math>CF</math> Carbon fraction of dry matter in tC per ton dry matter. The value used is: <b>0.47</b> is the default for (sub)tropical forest as per IPCC AFOLU guidelines 2006, Table 4.3.</p> <p>44/12 Conversion of C to CO<sub>2</sub></p>
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- Mozambique MRV website: <https://www.fnds.gov.mz/mrv/>

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