

## REDD Methodological Module

### “Estimation of baseline emission from forest degradation caused by extraction of wood for fuel” – BL-DFW

Version – April 2010

#### I. SCOPE, APPLICABILITY AND PARAMETERS

##### Scope

This module allows for estimating GHG emissions related to degradation from fuel wood collection and charcoal production in the baseline case.

##### Applicability

The module is applicable for estimating the baseline emissions on forest lands from degradation caused by the collection of wood for fuel or for production of charcoal.

##### *Required conditions*

- Fuel wood collection and charcoal production must be “non-renewable”<sup>1</sup> in the baseline period.
- The individuals / households involved in collecting firewood / producing charcoal in the project area must be identifiable and must be willing to share information

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<sup>1</sup> **Non-Renewable biomass (NRB)**

Forest biomass<sup>1</sup> is “non-renewable” if the following two conditions apply:

1. The biomass is originating from the project area where:
  - a. Sustainable management practices are **not** undertaken on these land areas to ensure, in particular, that the level of carbon stocks on these land areas does not systematically decrease over time (carbon stocks may temporarily decrease due to harvest); and
  - b. Any relevant national or regional forestry and nature conservation regulations are **not** complied with.
2. The biomass is **biomass residue**<sup>1</sup> and the use of that biomass residue in the project activity involves a decrease of carbon pools, in particular dead wood, litter or soil organic carbon, on the land areas where the biomass residues are originating from.

This definition follows the CDM: EB 23, Annex 18

on fuel wood consumption and/or charcoal production. If not the module can not be used.

### Exclusionary conditions

- This module is not applicable to situations where fuel wood collection and charcoal production in project area are decreasing or are likely to decrease in the near-future due to a lack of available stocks
- If degradation is caused by either illegal or legal tree extraction for timber, this module can not be used

### Parameters

This module provides procedures to determine the following parameter:

Parameter	SI Unit	Description
$\Delta C_{BSL,degrad-FW/C}$	t CO <sub>2</sub> -e	Baseline net greenhouse gas emissions through degradation caused by fuelwood collection and charcoal making
$FG_{BSL,i,t}$	m <sup>3</sup> yr <sup>-1</sup>	Average projected annual volume of fuel wood to be gathered in the project area in the baseline scenario in stratum <i>i</i> at time <i>t</i>
$C_{BSL,i}$	t CO <sub>2</sub> -e ha <sup>-1</sup>	Carbon stock in all pools in the baseline in stratum <i>i</i>

## II. PROCEDURE

Annual emissions from degradation are calculated from the likely annual volume removed from the forest for fuel wood or for charcoal production in the baseline scenario. This volume will be determined through local surveys and interviews. Volume is multiplied by wood density and divided by 0.9 to give the biomass of the tree from which the fuels were cut. The assumption is made here that all biomass is collected for fuels apart from leaves, smallest twigs/branches, and debris from felling activity (90% of total).

The baseline net GHG emissions for degradation will be determined as:

$$\Delta C_{BSL,degrad-FW/C} = \left( \sum_{t=1}^{t^*} \sum_{i=1}^{M_B} \frac{FG_{BSL,i,t} * D_{mn} * CF * \frac{44}{12}}{0.9} \right) + GHG_{BSL,E} \quad (1)$$

Where:

$\Delta C_{BSL,degrad-FW/C}$	Baseline net greenhouse gas emissions through degradation; t CO <sub>2</sub> -e
$FG_{BSL,i,t}$	Average projected annual volume of wood gathered in the project area for fuel and/or charcoal production in the baseline scenario in stratum i at time t; m <sup>3</sup> yr <sup>-1</sup>
$D_{mn}$	Mean wood density of species harvested for fuel wood or charcoal production; t d.m.m <sup>-3</sup>
$CF$	Carbon fraction of dry matter; t C t d.m. <sup>-1</sup>
$GHG_{BSL,E}$	Greenhouse gas emissions as a result of degradation activities within the project boundary in the baseline; t CO <sub>2</sub> -e
$i$	1, 2, 3 ... $M_B$ strata in the baseline scenario
$t$	1, 2, 3, ... $t^*$ years elapsed since the projected start of the REDD project activity

Regrowth following degradation is conservatively not included as it is expected that the growth of trees, and thus rate of carbon sequestration, will be higher in the with-project case than in the baseline (degradation) case. Degradation results from the removal of trees which would be sequestering carbon in the baseline. This conservative assumption requires that credit not be taken for the continued growth of trees within the area of likely degradation in the project case.

### Step 1: Determine rate of fuel-wood collection and/or charcoal production

Where fuel-wood collection and/or charcoal production activities exist in the baseline case, it is necessary to estimate the baseline consumption of fuel-wood in different strata within the project area. The conservative assumption that the rate of fuel wood collection and/or charcoal production will remain constant from the historic period through the baseline period shall be made.

1. Quantify baseline consumption of fuel wood ( $V_{BSL,FW,i,t}$ ): Baseline consumption of fuel-wood shall be estimated by interviewing households or implementing a Participatory Rural Appraisal (PRA).

Sampling techniques can be used where multiple households/communities involved in fuelwood removal/charcoal production exist. Others sources of information, such as local studies on fuel-wood consumption and/or charcoal production can also be used. When using

other sources of information, average data from a 5 to 10 years time period preceding the starting date of the project activity shall be used whenever possible.

Interviewees shall be asked to describe fuel wood consumption for their household and the number of people in the household. Mean consumption will be the household total divided by the number of people in the household. For charcoal production by teams or groups, the mean annual per capita production will be the total divided by the number of people in the production team.

It is unlikely that interviewed households will know their fuel wood consumption in terms of volumes of timber. Consequently verifiable measurements will be necessary to allow correlation between stated units (e.g. logs or trees) and volumes.

Mobile/commercial charcoal producers shall be considered as a separate stratum. In this case, estimates will be generated from interviews and official statistics to attain mean annual production of charcoal per producer.

The results from the interviews or PRAs must demonstrate that fuel wood collection and charcoal production in the project area are stable or increasing and are unlikely to decrease in the near-future due to a lack of available stocks. If a decrease or likely future decrease are demonstrated then the module can not be used for baseline determination.

2. Enumerate the total population impacting or potentially impacting the project area (TotPopn): The total population impacting or potentially impacting the project area shall be enumerated.

For mobile/commercial charcoal producers TotPopn should be equal to the number of producers impacting the project area in the baseline period. This number should either be enumerated directly or sampled statistically.

## Step 2: Determine the available forest area for fuel wood collection / charcoal production by focal populations

During interviews with local populations identify the maximum distance that would be traveled to collect fuel wood or fuel for charcoal production. Using this distance identify the total area of forest around each community available for fuel wood collection or charcoal production (TAF). A subset of this total area will be within the project boundaries, identify the area of forest within the project boundaries around each community that is available for fuel wood collection or charcoal production (PAF).

## Step 3: Calculate the likely baseline rate of fuel wood collection / charcoal production

$$FG_{BSL,i,t} = \frac{PAF_i}{TAF_i} * V_{BSL,FW,i,t} * TotPopn_{BSL,i} \quad (2)$$

Where:

$FG_{BSL,i,t}$	Average projected annual volume of fuel wood to be gathered in the project area in the baseline scenario in stratum $i$ at time $t$ ; $m^3 \text{ yr}^{-1}$
$PAF_i$	The area of forest available for fuel wood collection and/or charcoal production that is located in stratum $i$ within the project boundaries; ha
$TAF_i$	The total area of forest in stratum $i$ inside and outside the project boundaries available for fuel wood collection and/or charcoal production; ha
$V_{BSL,FW,i,t}$	The mean annual per capita consumption of fuel wood and/or mean annual production of charcoal per mobile/commercial charcoal producer in the baseline period in stratum $i$ ; $m^3 \text{ yr}^{-1}$
$TotPopn_{BSL,i}$	The total population impacting or potentially impacting the project area in stratum $i$ during the baseline period and/or the number of mobile/commercial charcoal producers in stratum $i$ impacting the project area; number
$i$	1, 2, 3 ... $M_B$ strata in the baseline scenario
$t$	1, 2, 3, ... $t^*$ years elapsed since the projected start of the REDD project activity

#### Step 4: Greenhouse gas emissions

The GHG emissions in the baseline within the project boundary must be estimated as:

$$GHG_{BSL,E} = \sum_{t=1}^{t^*} (ET_{BSL,FC,t} + E_{BSL,BiomassBurn,t}) \quad (3)$$

Where:

$GHG_{BSL,E}$	Greenhouse gas emissions as a result of degradation activities within the project boundary in the baseline; t CO <sub>2</sub> -e
$ET_{BSL,FC,t}$	CO <sub>2</sub> emission from fossil fuel combustion during year $t$ in the baseline; t CO <sub>2</sub> -e
$E_{BSL, BiomassBurn,t}$	Non-CO <sub>2</sub> emissions due to biomass burning as part of degradation activities during the year $t$ in the baseline; t CO <sub>2</sub> -e
$t$	1, 2, 3 ... $t^*$ years elapsed since the start of the REDD project activity

GHG emission sources excluded from the project boundary can be neglected, i.e. accounted as zero. Use Module T-SIG to determine which sources of emissions must be included in the calculations as a minimum.

#### Step 5: Baseline carbon stocks

Baseline carbon stocks shall be calculated for the purpose of allowing ex-post comparison of stocks (ex-post monitoring of deforestation).

(4)

Where:

$C_{BSL,i}$	Carbon stock in all pools in the baseline in stratum $i$ ; t CO <sub>2</sub> -e ha <sup>-1</sup>
$C_{BSL,AB\_tree,i}$	Carbon stock in aboveground biomass in the baseline in stratum $i$ ; t CO <sub>2</sub> -e ha <sup>-1</sup>
$C_{BSL,BB\_tree,i}$	Carbon stock in belowground biomass in the baseline in stratum $i$ ; t CO <sub>2</sub> -e ha <sup>-1</sup>
$C_{BSL,DW,i}$	Carbon stock in dead wood in the baseline in stratum $i$ ; t CO <sub>2</sub> -e ha <sup>-1</sup>
$C_{BSL,LI,i}$	Carbon stock in litter in the baseline in stratum $i$ ; t CO <sub>2</sub> -e ha <sup>-1</sup>
$C_{BSL,SOC,i}$	Carbon stock in soil organic carbon in the baseline in stratum $i$ ; t CO <sub>2</sub> -e ha <sup>-1</sup>

Carbon pools excluded from the project can be accounted as zero. For the determining which carbon pools must be included in the calculations as a minimum, see Module **T-SIG** and the framework module - **REDD-MF**.

### III. DATA AND PARAMETERS NOT MONITORED (DEFAULT OR MEASURED ONE TIME)

Data / parameter:	$CF$
Data unit:	t C t d.m. <sup>-1</sup>
Used in equations:	1
Description:	Carbon fraction of dry matter
Source of data:	Default value 0.47 t C t <sup>-1</sup> d.m. can be used, or species specific values from the literature (e.g. IPCC 2006 INV GLs AFOLU Chapter 4 Table 4.3)
Measurement procedures (if any):	
Any comment:	

Data / parameter:	$D_{mn}$
Data unit:	t d.m.m <sup>-3</sup>
Used in equations:	4
Description:	Mean wood density of commercially harvested species

Source of data:	The source of data shall be chosen with priority from higher to lower preference as follows: (a) Averaged national and commercial species-specific (e.g. from National GHG inventory or site specific measurements); (b) Averaged commercial species-specific from neighboring countries with similar conditions. Sometimes (b) may be preferable to (a). (c) Averaged regional commercial species-specific (e.g. Table 4.13 IPCC National Guidance for Greenhouse Gas Inventories AFOLU Section). (d) Regional average (0.58 t d.m.m-3- tropical Africa; 0.60 t d.m.m-3- tropical America; 0.57 d.m.m-3- tropical Asia) from Brown, S. 1997. Estimating Biomass and Biomass Change of Tropical Forests: a Primer. For the Food and Agriculture Organization of the United Nations. Rome, 1997. FAO Forestry Paper - 134. ISBN 92-5-103955-0.
Measurement procedures (if any):	
Any comment:	

<b>Data / parameter:</b>	$PAF_i$
Data unit:	ha
Used in equations:	2
Description:	The area of forest available for fuel wood collection and/or charcoal production that is located in stratum $i$ within the project boundaries
Source of data:	Determination of maximum distance of travel from communities for fuel wood collection / charcoal production and subsequent assessment of available forest within project boundaries
Measurement procedures (if any):	
Any comment:	

<b>Data / parameter:</b>	$TAF_i$
Data unit:	ha
Used in equations:	2
Description:	The total area of forest in stratum $i$ both inside and outside the project boundaries available for fuel wood collection and/or charcoal production
Source of data:	Determination of maximum distance of travel from communities for fuel wood collection / charcoal production and subsequent assessment of

	available forest both inside and outside project boundaries
Measurement procedures (if any):	
Any comment:	

<b>Data / parameter:</b>	$TotPopn_{BSL,i}$
Data unit:	number
Used in equations:	2
Description:	The total population impacting or potentially impacting the project area in stratum $i$ during the baseline period
Source of data:	Interviews / official statistics
Measurement procedures (if any):	
Any comment:	

<b>Data / parameter:</b>	$V_{BSL,FW,i,t}$
Data unit:	$m^3 \text{ yr}^{-1}$
Used in equations:	2
Description:	The mean annual per capita consumption of fuel wood and/or production of charcoal in stratum $i$ in the baseline period
Source of data:	Interviews / Participatory Rural Appraisals, field measurement and literature data
Measurement procedures (if any):	
Any comment:	Verifiable information attained from passing comments, gossip and rumours may be used especially in situations where people are afraid to disclose information on illegal harvesting

#### IV. DATA AND PARAMETERS MONITORED

<b>Data / parameter:</b>	$PAF_i$
Data unit:	ha
Used in equations:	2



Description:	The area of forest available for fuel wood collection and/or charcoal production that is located in stratum $i$ within the project boundaries
Source of data:	Determination of maximum distance of travel from communities for fuel wood collection / charcoal production and subsequent assessment of available forest within project boundaries
Measurement procedures (if any):	
Any comment:	Monitoring not necessary for ex-post project accounting but will be necessary to update the baseline in subsequent baseline periods

<b>Data / parameter:</b>	$TAF_i$
Data unit:	ha
Used in equations:	2
Description:	The total area of forest in stratum $i$ available for fuel wood collection and/or charcoal production
Source of data:	Determination of maximum distance of travel from communities for fuel wood collection / charcoal production and subsequent assessment of available forest both inside and outside project boundaries
Measurement procedures (if any):	
Any comment:	Monitoring not necessary for ex-post project accounting but will be necessary to update the baseline in subsequent baseline periods

<b>Data / parameter:</b>	$TotPopn_{BSL,i}$
Data unit:	number
Used in equations:	2
Description:	The total population impacting or potentially impacting the project area in stratum $i$ during the baseline period
Source of data:	Interviews / official statistics
Measurement procedures (if any):	
Any comment:	Monitoring not necessary for project accounting but will be necessary to update the baseline in subsequent baseline periods

<b>Data / parameter:</b>	$V_{BSL,FW,i,t}$
<b>Data unit:</b>	$m^3 yr^{-1}$
<b>Used in equations:</b>	2
<b>Description:</b>	The mean annual per capita consumption of fuel wood and/or production of charcoal in stratum $i$ in the baseline period
<b>Source of data:</b>	Interviews / Participatory Rural Appraisals, field measurement and literature data
<b>Measurement procedures (if any):</b>	
<b>Any comment:</b>	Verifiable information attained from passing comments, gossip and rumours may be used especially in situations where people are afraid to disclose information on illegal harvesting  Monitoring not necessary for project accounting but will be necessary to update the baseline in subsequent baseline periods

## V. TERMS ORIGINATING IN OTHER MODULES

<b>Data / parameter:</b>	$C_{BSL,AB,tree,i}$
<b>Data unit:</b>	$t CO_2-e ha^{-1}$
<b>Used in equations:</b>	4,5
<b>Description:</b>	Carbon stock in aboveground biomass in trees in the baseline in stratum $i$
<b>Module parameter originates in:</b>	CP-AB
<b>Any comment:</b>	

<b>Data / parameter:</b>	$C_{BSL,BB,tree,i}$
<b>Data unit:</b>	$t CO_2-e ha^{-1}$
<b>Used in equations:</b>	4,5
<b>Description:</b>	Carbon stock in belowground biomass in trees in the baseline in stratum $i$
<b>Module parameter originates in:</b>	CP-AB

Any comment:	
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<b>Data / parameter:</b>	$C_{BSL,DW,i}$
Data unit:	t CO <sub>2</sub> -e ha <sup>-1</sup>
Used in equations:	4,5
Description:	Carbon stock in dead wood in the baseline in stratum <i>i</i>
Module parameter originates in:	CP-W
Any comment:	

<b>Data / parameter:</b>	$C_{BSL,LI,i}$
Data unit:	t CO <sub>2</sub> -e ha <sup>-1</sup>
Used in equations:	4,5
Description:	Carbon stock in litter in the baseline in stratum <i>i</i>
Module parameter originates in:	CP-L
Any comment:	

<b>Data / parameter:</b>	$C_{BSL,SOC,i}$
Data unit:	t CO <sub>2</sub> -e ha <sup>-1</sup>
Used in equations:	4,5
Description:	Carbon stock in soil organic carbon in the baseline in stratum <i>i</i>
Module parameter originates in:	CP-S
Any comment:	

<b>Data / parameter:</b>	$E_{BSL,BiomassBurn,t}$
Data unit:	t CO <sub>2</sub> -e
Used in equations:	3
Description:	Non-CO <sub>2</sub> emissions due to biomass burning as part of degradation activities during the year <i>t</i> in the baseline; t CO <sub>2</sub> -e

Module parameter originates in:	E-BB
Any comment:	

Data / parameter:	$ET_{BSL,FC,t}$
Data unit:	t CO <sub>2</sub> -e
Used in equations:	3
Description:	CO <sub>2</sub> emission from fossil fuel combustion during year $t$ in the baseline; t CO <sub>2</sub> -e
Module parameter originates in:	E-FFC
Any comment:	