**Approved VCS Module VMD0008**
**Version 1.0**
**REDD Methodological Module:**
**Estimation of baseline emission from forest degradation caused by extraction of wood for fuel (BL-DFW)**
**Sectoral Scope 14**

**I.      SCOPE, APPLICABILITY AND PARAMETERS**

**Scope**

This module allows for estimating GHG emissions related to degradation from fuelwood 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*

- Fuelwood collection and charcoal production must be "non-renewable"[1] in the baseline period.

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[1]    **Non-Renewable biomass (NRB)  -** Forest biomass is "*non-renewable*" if *either* of the following two conditions apply:
1.   If 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.   If the biomass is **biomass residue** from timber harvesting 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

**Parameters**

This module provides procedures to determine the following parameters:

| Parameter | SI Unit | Description |
|---|---|---|
| $\Delta C_{BSL,degrad\text{-}FW/C}$ | t $CO_2$-e | Net greenhouse gas emissions in the baseline from degradation caused by fuelwood collection and charcoal making |
| $FG_{BSL,i,t}$ | m$^3$ | Average projected volume of fuelwood to be gathered in the project area in the baseline scenario in stratum $i$ in year $t$ |
| $GHG_{BSL,E}$ | t $CO_2$-e | Greenhouse gas emissions as a result of degradation activities within the project boundary in the baseline |
| $C_{BSL,i}$ | t $CO_2$-e ha$^{-1}$ | Carbon stock in all pools in the baseline in stratum $i$ |

## II.    PROCEDURE

Annual emissions from degradation are calculated from the likely annual volume removed from the forest for fuelwood 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:

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

Where:

$\Delta C_{BSL,degrad\text{-}FW/C}$      Net greenhouse gas emissions in the baseline from degradation caused by fuelwood collection and charcoal making; t $CO_2$-e

$FG_{BSL,i,t}$      Average projected volume of fuelwood to be gathered in the project area in the baseline scenario in stratum $i$ at time $t$; m$^3$

$D_{mn}$      Mean wood density of species harvested for fuelwood or charcoal production; t d.m.m$^{-3}$

$CF$      Carbon fraction of dry matter; t C t d.m.$^{-1}$

$GHG_{BSL,E}$      Greenhouse gas emissions as a result of degradation activities within the project boundary in the baseline; t $CO_2$-e

| *i* | 1, 2, 3, …*M* strata |
|---|---|
| *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 fuelwood collection and/or charcoal production**

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

1. Quantify baseline consumption of fuelwood ($V_{BSL,FW,i,t}$): Baseline consumption of fuelwood 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.  Other 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 fuelwood 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 fuelwood 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 separately from fuelwood collection for household use.  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 fuelwood 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 cannot 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: Define project area**

The project area shall be spatially defined. The project area shall be used for calculation of baseline fuelwood collection/charcoal production and shall be the area subject to monitoring ex-post for deforestation and degradation.

Definition of the project area shall be with reference to accessibility for fuelwood collection / charcoal production (e.g. with consideration of local communities, roads and markets).

**STEP 3: Determine the available forest area for fuelwood collection / charcoal production by focal populations**

During interviews with local populations identify the maximum distance that would be traveled to collect fuelwood or fuel for charcoal production. Using this distance identify the total area of forest around each community available for fuelwood 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 fuelwood collection or charcoal production (PAF).

**STEP 4: Calculate the likely baseline rate of fuelwood collection / charcoal production**

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

Where:

$FG_{BSL,i,t}$         Average projected volume of fuelwood to be gathered in the project area in the baseline scenario in stratum *i* in year *t*; m$^3$

$PAF_i$           The area of forest available for fuelwood collection and/or charcoal production that is located in stratum *i* within the project area; ha

$TAF_i$           The total area of forest in stratum *i* inside and outside the project boundaries available for fuelwood collection and/or charcoal production; ha

$V_{BSL,FW,i,t}$ The mean annual per capita consumption of fuelwood and/or mean annual production of charcoal per mobile/commercial charcoal producer in the baseline period in stratum $i$; $m^3$ $yr^{-1}$

$TotPopn_{BSL,i}$ 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, …$M$ strata

$t$ 1, 2, 3, … $t^*$ years elapsed since the projected start of the REDD project activity

## STEP 5: Greenhouse gas emissions

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

$$GHG_{BSL,E} = \sum_{t=1}^{t^*} \left( E_{FC,i,t} + E_{BiomassBurn,i,t} \right) \tag{3}$$

Where:

$GHG_{BSL,E}$ Greenhouse gas emissions as a result of degradation activities within the project boundary in the baseline; t $CO_2$-e

$E_{FC,t}$ Emission from fossil fuel combustion in stratum $i$ in year $t$; t $CO_2$-e

$E_{BiomassBurn,t}$ Non-$CO_2$ emissions due to biomass burning as part of degradation activities in stratum $i$ in year $t$; t $CO_2$-e

$i$ 1, 2, 3, …$M$ strata

$t$ 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 6: Baseline carbon stocks

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

$$C_{BSL,i} = C_{AB\_tree,i} + C_{BB\_tree,i} + C_{AB\_non-tree,i} + C_{BB\_non-tree,i} + C_{DW,i} + C_{LI,i} + C_{SOC,i} \tag{4}$$

Where:

$C_{BSL,i}$ Carbon stock in all pools in the baseline in stratum $i$; t $CO_2$-e $ha^{-1}$

$C_{AB\_tree,i}$ Carbon stock in aboveground biomass in the baseline in stratum $i$; t $CO_2$-e $ha^{-1}$

$C_{BB\_tree,i}$ Carbon stock in belowground biomass in the baseline in stratum $i$; t $CO_2$-e $ha^{-1}$

$C_{AB\_non-tree,i}$    Carbon stock in aboveground non-tree vegetation in stratum *i*; t $CO_2$-e ha$^{-1}$

$C_{BB\_non-tree,i}$    Carbon stock in belowground non-tree vegetation in stratum *i*; t $CO_2$-e ha$^{-1}$

$C_{DW,i}$    Carbon stock in dead wood in the baseline in stratum *i*; t $CO_2$-e ha$^{-1}$

$C_{LI,i}$    Carbon stock in litter in the baseline in stratum *i*; t $CO_2$-e ha$^{-1}$

$C_{SOC,i}$    Carbon stock in soil organic carbon in the baseline in stratum *i*; t $CO_2$-e ha$^{-1}$

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, use Module T-SIG and the framework module - REDD-MF.

**STEP 6: Baseline revision**

The baseline must be revised every ten years for ongoing fuelwood collection/charcoal production projects.

### III. DATA AND PARAMETERS <u>NOT</u> MONITORED (DEFAULT OR MEASURED ONLY FOR BASELINE REVISION)

| Data / parameter: | *CF* |
|---|---|
| Data unit: | t C t d.m.$^{-1}$ |
| Used in equations: | 1 |
| Description: | Carbon fraction of dry matter |
| Source of data: | Default value 0.47 t C t$^{-1}$ 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: | Must be updated each time the baseline is revisited (every 10 years) |

| Data / parameter: | $D_{mn}$ |
|---|---|
| Data unit: | t d.m.m$^{-3}$ |
| Used in equations: | 1 |
| 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:<br>(a) Averaged national and commercial species-specific (e.g. from National GHG inventory or site specific measurements);<br>(b) Averaged commercial species-specific from neighboring countries with similar conditions. Sometimes (b) may be preferable to (a).<br>(c) Averaged regional commercial species-specific (e.g. Table 4.13 IPCC National Guidance for Greenhouse Gas Inventories AFOLU Section).<br>(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: | Must be updated each time the baseline is revisited (every 10 years) |

| **Data / parameter**: | $PAF_i$ |
|---|---|
| Data unit: | ha |
| Used in equations: | 2 |
| Description: | The area of forest available for fuelwood 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 fuelwood 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 (every 10 years) |

| **Data / parameter**: | $TAF_i$ |
|---|---|
| Data unit: | ha |
| Used in equations: | 2 |
| Description: | The total area of forest in stratum $i$ available for fuelwood collection and/or charcoal production |
| Source of data: | Determination of maximum distance of travel from communities for |

| | |
|---|---|
| | fuelwood 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 (every 10 years). |

| | |
|---|---|
| **Data / parameter**: | $TotPopn_{BSL,i}$ |
| 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 (every 10 years). |

| | |
|---|---|
| **Data / parameter**: | $V_{BSL,FW,i,t}$ |
| Data unit: | $m^3 \ yr^{-1}$ |
| Used in equations: | 2 |
| Description: | The mean annual per capita consumption of fuelwood 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 anecdotal evidence in the community 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 (every 10 years). |

## IV.     TERMS ORIGINATING IN OTHER MODULES

| Data / parameter: | $C_{AB\_tree,i}$ |
|---|---|
| Data unit: | t $CO_2$-e ha$^{-1}$ |
| Used in equations: | 4 |
| Description: | Carbon stock in aboveground biomass in trees in the baseline in stratum *i* |
| Module parameter originates in: | CP-AB |
| Any comment: | |

| Data / parameter: | $C_{BB\_tree,i}$ |
|---|---|
| Data unit: | t $CO_2$-e ha$^{-1}$ |
| Used in equations: | 4 |
| Description: | Carbon stock in belowground biomass in trees in the baseline in stratum *i* |
| Module parameter originates in: | CP-AB |
| Any comment: | |

| Data / parameter: | $C_{AB\_nontree,i,}$ |
|---|---|
| Data unit: | t $CO_2$-e ha$^{-1}$ |
| Used in equations: | 4 |
| Description: | Carbon stock in aboveground non-tree vegetation in the baseline in stratum *i* |
| Module parameter originates in: | CP-AB |
| Any comment: | Herbaceous vegetation considered *de minimis* in all instances |

| Data / parameter: | $C_{BB\_nontree,i,}$ |
|---|---|
| Data unit: | t $CO_2$-e ha$^{-1}$ |
| Used in equations: | 4 |
| Description: | Carbon stock in belowground non-tree vegetation in the baseline in stratum *i* |

| Module parameter originates in: | CP-AB |
|---|---|
| Any comment: | Herbaceous vegetation considered *de minimis* in all instances |

| **Data / parameter**: | $C_{DW,i}$ |
|---|---|
| Data unit: | t $CO_2$-e ha$^{-1}$ |
| Used in equations: | 4 |
| Description: | Carbon stock in dead wood in the baseline in stratum *i* |
| Module parameter originates in: | CP-W |
| Any comment: | |

| **Data / parameter**: | $C_{LI,i}$ |
|---|---|
| Data unit: | t $CO_2$-e ha$^{-1}$ |
| Used in equations: | 4 |
| Description: | Carbon stock in litter in the baseline in stratum *i* |
| Module parameter originates in: | CP-L |
| Any comment: | |

| **Data / parameter**: | $C_{SOC,i}$ |
|---|---|
| Data unit: | t $CO_2$-e ha$^{-1}$ |
| Used in equations: | 4 |
| Description: | Carbon stock in soil organic carbon in the baseline in stratum *i* |
| Module parameter originates in: | CP-S |
| Any comment: | |

| **Data / parameter**: | $E_{BiomassBurn,i,t}$ |
|---|---|
| Data unit: | t $CO_2$-e |
| Used in equations: | 3 |

| Description: | Non-$CO_2$ emissions due to biomass burning in stratum $i$ in year $t$ |
|---|---|
| Module parameter originates in: | E-BB |
| Any comment: | |

| Data / parameter: | $E_{FC,i,t}$ |
|---|---|
| Data unit: | t $CO_2$-e |
| Used in equations: | 3 |
| Description: | Emission from fossil fuel combustion in stratum $i$ in year $t$ |
| Module parameter originates in: | E-FFC |
| Any comment: | |