

REDD Methodological Module

“Estimation of baseline carbon stock changes and greenhouse gas emissions from planned deforestation”

Version 1.0 - April 2009

I. SCOPE, APPLICABILITY AND PARAMETERS

Scope

This module allows for estimating GHG emissions related to planned deforestation¹ in the baseline case.

Applicability

The module is applicable for estimating the baseline emissions on forest lands (usually privately or government owned) that are legally authorized and documented to be converted to non-forest land.

Required conditions

- Conversion of forest lands to a deforested condition must be legally authorized
- The boundaries of the planned deforestation must be clearly defined and documented
- The module requires documentation to be available to clearly demonstrate that indeed the land would have been converted to non-forest use if not for the REDD project. The project developer must be able to provide credible evidence and documentation.

Exclusionary conditions

- If land is not being converted to an alternative use but will be allowed to naturally regrow, this module does not apply
- If deforestation is illegal / unsanctioned, this module does not apply

¹ **Avoiding planned deforestation (APD):** reduces GHG emissions by stopping deforestation on forest lands that are legally authorized and documented to be converted to non-forest land, and enhances carbon stock of degraded and secondary forests (if present in the project area) that would be deforested in the absence of the REDD project activity. This REDD practice can occur in degraded to mature forests at the forest frontier or in the forest mosaic configuration.

Parameters

This module provides procedures to determine the following parameter:

Parameter	SI Unit	Description
$\Delta C_{BSL,planned}$	t-CO ₂ -e	Net CO ₂ equivalent emissions in the baseline from planned deforestation

II. PROCEDURE

The baseline net GHG emissions for planned deforestation will be determined as:

$$\Delta C_{BSL,planned} = \sum_{t=1}^{t^*} \sum_{i=1}^{M_B} \left((D\%_{planned,i,t} * A_{planned,i}) * \Delta C_{BSL,i} \right) + GHG_{BSL-E,i,t} \quad (1)$$

Where:

- $\Delta C_{BSL,planned}$ Baseline net greenhouse gas emissions through planned deforestation; t CO₂-e
- $D\%_{planned,i,t}$ Projected annual proportion of land that will be deforested in stratum *i* at year *t*. If actual annual proportion is known and documented (e.g. 25% per year for 4 years), set to proportion; if not known, use Eq. 2 to calculate; % year⁻¹
- $A_{planned,i}$ Total area of planned deforestation over the entire project lifetime for stratum *i*; ha
- $\Delta C_{BSL,i}$ Net carbon stock changes in all pools in the baseline stratum *i*; t CO₂-e ha⁻¹
- $GHG_{BSL-E,i,t}$ Greenhouse gas emissions as a result of deforestation activities within the project boundary in the baseline stratum *i* at project year *t*; t CO₂-e year⁻¹
- 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

1. Calculating annual area of land deforested

1.1 Area of deforestation $A_{planned,i}$

For all instances of planned deforestation REDD projects there must be an **immediate site-specific threat of deforestation**.

This threat must be demonstrated by documentary proof of the following:

- Legal permissibility for deforestation;
- Suitability of project area for conversion to alternative non-forest land use²;
- Intent to deforest—intention to deforest must be demonstrated by one of the following forms of evidence:
 - Recent approval, if needed, from relevant government department (local to national) for conversion of forest to an alternative land use;
 - Documentation that a request for approval has been filed with the relevant government department for permission to deforest and convert to alternative land use;
 - Bona fide bidding process for the project area that reflects value of the area and with the expressed intent to deforest;
 - Documentation that provides evidence of recent landowner investment to establish suitability of project lands to proposed post-deforestation land use
 - Purchase offer of the project area by an entity that is clearly dedicated to agricultural, grazing or urban development activities.

The amount planned to be deforested cannot exceed the legal mandate unless common practice in a proxy area shows that the mandates are not enforced.

1.2 Rate of deforestation $D\%_{planned,i,t}$

The methodology requires knowledge of the rate (area deforested per year) at which the planned areas will be deforested to give an area per stratum (i) per year (t) through the project period.

Where a valid verifiable plan exists for rate at which deforestation is projected to occur this rate may be used.

The rate can also be established by examining proxy areas that encompass parcels of land that have used land conversion practices that the baseline land manager would implement. Proxy areas are defined as areas under the same ownership type as the proposed project area. The proxy area may be located in the immediate area of the project, or elsewhere in the country or even the region as long as it can be shown to the verifier to be representative. Owners of proxy areas must have deforested their land under the same criteria that the project lands must follow (legally permissible, suitable for conversion—see section 1.1 above). The proxy area will be used to estimate an average proportion of land that is cleared each year, thus a sufficient number of parcels are needed to be representative of the common practice in the proxy area, and hence also in the project area.

² Suitability should include accessibility to relevant markets, suitability of soils, topography and climate.

Examination of proxy areas may be through original data collection (field measurements and/or remote sensing analysis) or where appropriate use of directly applicable existing data generated from credible sources.

The annual rate would be calculated with Equation 2:

$$D\%_{planned,i,t} = \sum_{pn=1}^{pn^*} \left(\left(\frac{D\%_{pn,i}}{Yrs_{pn}} \right) / n \right) \quad (2)$$

Where:

$D\%_{planned,i,t}$	Projected annual proportion of land that will be deforested in stratum i at year t . If actual annual proportion is known and documented (e.g. 25% per year for 4 years), set to proportion; % year ⁻¹
$D\%_{pn,i}$	Percent of deforestation in land parcel ³ pn etc in stratum i of a proxy area; %
Yrs_{pn}	Number of years over which deforestation occurred in land parcel pn in stratum i in proxy area; years
n	Total number of land parcels examined
pn	1, 2, 3 ... n^* land parcels examined in proxy area
i	1, 2, 3 ... M_B strata in the baseline scenario

If no proxy area exists under the same ownership type then representative areas under different ownerships should be examined and documentation must be provided to the satisfaction of the verifier establishing that the lands are representative.

Where forest areas are under government ownership and/or the areas have been zoned for deforestation, a suitable representative sample of similar zoned areas must be examined to define the likelihood of deforestation occurring and the likely rate at which it would occur.

2) Baseline carbon stocks

The net carbon stock changes in the baseline is equal to the baseline pre-deforestation stock minus the long-term carbon stock after deforestation and minus the baseline stock which is harvested and stored long-term in wood products.

³ Parcels are a unit of land area. A stratum may contain many parcels.

$$\Delta C_{BSL,i} = C_{BSL,i} - C_{BSL,post,i} - C_{BSL,wp,i} \quad (3)$$

Where:

$\Delta C_{BSL,i}$ Net carbon stock changes in all pools in the baseline in stratum i ; t CO₂-e ha⁻¹

$C_{BSL,i}$ Carbon stock in all pools in the baseline in stratum i ; t CO₂-e ha⁻¹

$C_{BSL,post,i}$ Carbon stock in all pools in the baseline post-deforestation in stratum i ; t CO₂-e ha⁻¹

$C_{BSL,wp,i}$ Carbon stock sequestered in wood products in the baseline in stratum i ; t CO₂-e ha⁻¹

i 1, 2, 3 ... M_B strata in the baseline scenario

For calculation of carbon stock sequestered in wood products, see the VCS-approved Module “Estimation of carbon stocks and changes in carbon stocks in the harvested wood products carbon pool in REDD project activities” (CP-W).

Instead of tracking annual emissions through burning and/or decomposition, this methodology employs the simplifying assumption that all carbon stocks are emitted in the year deforested and that no stocks are permanently sequestered (beyond 100 years after deforestation). This assumption applies regardless of whether burning is employed as part of the forest conversion process or as part of post conversion land use activities.

2.1 Forest carbon stocks

$$C_{BSL,i} = C_{BSL,AB_tree,i} + C_{BSL,BB_tree,i} + C_{BSL,DW,i} + C_{BSL,LI,i} + C_{BSL,SOC,i} \quad (4)$$

Where:

$C_{BSL,i}$ Carbon stock in all pools in the baseline in stratum i ; t CO₂-e ha⁻¹

$C_{BSL,AB_tree,i}$ Carbon stock in aboveground biomass in the baseline in stratum i ; t CO₂-e ha⁻¹

$C_{BSL,BB_tree,i}$ Carbon stock in belowground biomass in the baseline in stratum i ; t CO₂-e ha⁻¹

$C_{BSL,DW,i}$ Carbon stock in dead wood in the baseline in stratum i ; t CO₂-e ha⁻¹

$C_{BSL,LI,i}$ Carbon stock in litter in the baseline in stratum i ; t CO₂-e ha⁻¹

$C_{BSL,SOC,i}$ Carbon stock in soil organic carbon in the baseline in stratum i ; t CO₂-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, see Module **X-SIG**.

2.2 Post-deforestation carbon stocks

Post-deforestation carbon stocks should be the long-term average stocks on the land following deforestation. Post-deforestation carbon stocks can be measured in proxy areas or values may be taken from credible and representative literature sources. Where stocks accumulate through time the ultimate stock should be used and where stocks are in a cycle such as in shifting cultivation the mean stock across the cycle should be used.

$$C_{BSL,post,i} = C_{BSL,AB_tree,i} + C_{BSL,BB_tree,i} + C_{BSL,DW,i} + C_{BSL,LI,i} + C_{BSL,SOC,i} \quad (5)$$

Where:

$C_{BSL,post,i}$	Carbon stock in all pools in the baseline post-deforestation in stratum i ; t CO ₂ -e ha ⁻¹
$C_{BSL,AB_tree,i}$	Carbon stock in aboveground biomass in the baseline in stratum i ; t CO ₂ -e ha ⁻¹
$C_{BSL,BB_tree,i}$	Carbon stock in belowground biomass in the baseline in stratum i ; t CO ₂ -e ha ⁻¹
$C_{BSL,DW,i}$	Carbon stock in dead wood in the baseline in stratum i ; t CO ₂ -e ha ⁻¹
$C_{BSL,LI,i}$	Carbon stock in litter in the baseline in stratum i ; t CO ₂ -e ha ⁻¹
$C_{BSL,SOC,i}$	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. Non-tree vegetation is considered to be *de minimis* in all instances. For the determination which carbon pools must be included in the calculations as a minimum, see Module **X-SIG**.

3) Greenhouse gas emissions

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

$$GHG_{BSL,E,i,t} = ET_{BSL,FC,t} + E_{BSL,BiomassBurn,t} + N_2O_{BSL,direct-N,t} \quad (6)$$

Where:

$GHG_{BSL,E}$	Greenhouse gas emissions as a result deforestation activities within the project boundary in the baseline stratum i at project year t ; t CO ₂ -e
$ET_{BSL,FC,t}$	CO ₂ emission from fossil fuel combustion during year t in the baseline; t CO ₂ -e year ⁻¹

$E_{BSL, BiomassBurn,t}$	Non-CO ₂ emissions due to biomass burning as part of deforestation activities during the year t in the baseline; t CO ₂ -e year ⁻¹
$N_2O_{BSL,direct-N,t}$	Direct N ₂ O emission as a result of nitrogen application on the alternative land use within the project boundary in year t in the baseline; t CO ₂ -e year ⁻¹
t	1, 2, 3 ... t^* years elapsed since the start of the REDD VCS project activity

For detailed information regarding the calculation of $ET_{BSL,FC,t}$, $E_{BSL, BiomassBurn,t}$ and $N_2O_{BSL,direct-N,t}$ see the VCS-approved Modules “Estimating emissions from fossil fuel combustion in REDD project activities (E-FFC)”, “Estimating non-CO₂ emissions from biomass burning in REDD project activities (E-BB)” and the latest A/R CDM tool “Estimation of direct nitrous oxide emission from nitrogen fertilization”⁴.

GHG emission sources excluded from the project boundary can be neglected, i.e. accounted as zero. For the determination which sources of emissions must be included in the calculations as a minimum, see Module X-SIG.

⁴ http://cdm.unfccc.int/EB/033/eb33_repan16.pdf

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

Data / parameter:	$A_{planned,i}$
Data unit:	aa
Used in equations:	1
Description:	Total area of planned deforestation over the entire project lifetime for stratum i
Source of data:	GPS coordinates and/or Remote Sensing data and/or legal parcel records
Measurement procedures (if any):	N/A
Any comment:	

Data / parameter:	$D\%_{planned,i,t}$
Data unit:	% year ⁻¹
Used in equations:	1,2
Description:	Projected annual proportion of land that will be deforested in stratum i at year t
Source of data:	Analysis of Remote Sensing data and/or legal records for a number of parcels in the proxy area
Measurement procedures (if any):	N/A
Any comment:	

IV. TERMS ORIGINATING IN OTHER MODULES

Data / parameter:	$C_{BSL,AB,tree,i}$
Data unit:	t CO ₂ -e ha ⁻¹
Used in equations:	4,5
Description:	Carbon stock in aboveground biomass in trees in the baseline in stratum i
Module parameter originates in:	CP-A
Any comment:	

Data / parameter:	$C_{BSL, BB, tree, i}$
Data unit:	t CO ₂ -e ha ⁻¹
Used in equations:	4,5
Description:	Carbon stock in belowground biomass in trees in the baseline in stratum <i>i</i>
Module parameter originates in:	CP-B
Any comment:	

Data / parameter:	$C_{BSL, DW, i}$
Data unit:	t CO ₂ -e ha ⁻¹
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:	

Data / parameter:	$C_{BSL, LI, i}$
Data unit:	t CO ₂ -e ha ⁻¹
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:	

Data / parameter:	$C_{BSL, SOC, i}$
Data unit:	t CO ₂ -e ha ⁻¹
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:	

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

Data / parameter:	$E_{BSL,BiomassBurn,t}$
Data unit:	t CO ₂ -e year ⁻¹
Used in equations:	6
Description:	Non-CO ₂ emissions due to biomass burning as part of degradation activities during the year <i>t</i> in the baseline; t CO ₂ -e
Module parameter originates in:	E-BB
Any comment:	

Data / parameter:	$ET_{BSL,FC,t}$
Data unit:	t CO ₂ -e year ⁻¹
Used in equations:	6
Description:	CO ₂ emission from fossil fuel combustion during year <i>t</i> in the baseline; t CO ₂ -e
Module parameter originates in:	E-FFC
Any comment:	

Data / parameter:	$N_2O_{BSL,direct-N,t}$
Data unit:	t CO ₂ -e year ⁻¹
Used in equations:	6
Description:	Direct N ₂ O emission as a result of nitrogen application on the alternative land use within the project boundary in year <i>t</i> in the baseline; t CO ₂ -e year ⁻¹

Module parameter originates in:	E-NA
Any comment:	