REDD Methodological Module

"Estimation of greenhouse gas emissions from biomass burning" – E-BB

Version – April 2010

I. SCOPE, APPLICABILITY AND PARAMETERS

Scope

This module provides a step-wise approach for estimating greenhouse emissions from biomass burning.

Applicability

If fire is used to clear the land or constitutes a cause of forest degradation, emissions of CO2, N_2O and CH_4 result. Inclusion in the baseline is always optional. Where used in the baseline, accounting must occur under both the baseline and with project scenarios, and both ex-ante and ex-post. Tool T-SIG must be used to determine whether or not the emission source has to be included ex-post. Analysis using T-SIG shall be conducted for both the project area and the leakage belt.
As described in the Framework REDD-MF the use of this module is mandatory.

- Baseline:
  - In all cases, inclusion of greenhouse gas emissions from biomass burning is optional. If included in the baseline, emissions must be monitored ex-post
- Where not included in the baseline, an ex-ante assessment of the significance of greenhouse gas emissions from biomass burning shall be made using Tool T-SIG:
  - If biomass burning emissions are projected to be higher within the project boundaries in the with-project scenario than in the baseline and significant then the module shall be used ex-post for all emissions within the project boundaries
  - If biomass burning emissions are projected to be higher within the leakage belt in the with-project scenario than in the baseline and significant then the module shall be used ex-post for all emissions within the leakage belt
- Where emissions from biomass burning are shown ex-ante to not be significant, an ex-post analysis is required to justify continued omission of the emission source:
  - Tool T-SIG must be applied ex-post to any area of deforestation in the project area or the leakage belt. Where emissions are

significant the module shall be used to account greenhouse gas emmisions.

- Where areas of fire are identified ex-post in the project area and these areas coincide with areas deforested in the baseline case the module shall be used to account greenhouse gas emissions

Parameters

Parameter	SI Unit	Description
$E_{BiomassBurn}$	tCO_2-e	Non-CO_2 emissions due to biomass burning as part of deforestation activities

II. PROCEDURE

Greenhouse emissions from biomass burning can result from:

1. Conversion of forest land to non-forest land using fire
2. Periodical burning of grassland or agricultural land after deforestation.
3. Burning in forest land remaining forest land

This module describes how greenhouse emissions from biomass burning shall be estimated. Carbon dioxide may be omitted from calculations under this module if it can be shown that accounting of carbon dioxide emissions is accounted through stock change (e.g. where fire is used during deforestation).

Some GHG emissions can be measured, but because of the high spatial and temporal variability the following method shall be used. Based on the IPCC 2006 Inventory Guidelines, estimating greenhouse gas emissions from biomass burning shall be determined as:

$$E_{BiomassBurn} = \sum_{t=1}^{t} \sum_{i=1}^{M} \sum_{g=1}^{g} A_{burn,i,t} * B_{i,t} * COMF_i * G_{g,i} * 10^3 \quad (1)$$

Where:

$E_{BiomassBurn}$ Greenhouse emissions due to biomass burning as part of deforestation activities, tCO_2-e of each GHG (CO_2, CH_4, N_2O)

$A_{burn,i,t}$ area burnt for stratum *i* at time *t*, ha

$B_{i,t}$ average above-ground biomass stock before burning stratum *i*, time *t*; tonnes d. m. ha^{-1}

$COMF_i$ combustion factor for stratum *i*, dimensionless (see annex 1 for default values as derived from Table 2.6 of IPCC, 2006)

$G_{g,i}$ emission factor for stratum *i* for gas *g*, kg t^{-1} dry matter burnt (see section III and annex 2 for default values as derived from Table 2.5 of IPCC, 2006)

g 1, 2, 3 ... *G* greenhouse gases (to include carbon dioxide[1], methane and nitrous oxide)

i 1, 2, 3 …*M* strata

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

$B_{i,t}$ The average above-ground biomass stock before burning for a particular stratum is estimated as follows:

$$B_{i,t} = (C_{AB\_tree,i,t} + C_{DWi,t} + C_{LI,i,,t})*12/44 *(1/CF) \quad (2)$$

Where:

$B_{i,t}$ average above-ground biomass stock before burning for stratum *i*, time *t*; tonnes d. m. ha^{-1}

$C_{AB\_tree,i,t}$ Mean aboveground biomass carbon stock in stratum *i* at time *t*; t CO2-e ha-1 (estimated using the CP-AB)

$C_{DWi,t}$ carbon stock in dead wood for stratum *i,* at time *t*; t CO_2-e ha^{-1} (estimated using CP-D)

$C_{LI,i,,t}$ Mean carbon stock in litter for stratum *i,* at time *t*; t CO_2-e ha^{-1} (estimated using CP-L)

12/44 *Inverse* ratio of molecular weight of CO_2 to carbon, t CO_2-e t C^{-1}

CF Carbon fraction of biomass; t C t^{-1} d.m. (default carbon fraction of biomass is 0.47 tC t^{-1} d.m. (see also section III))

[1] Carbon dioxide may be omitted where carbon dioxide emissions are calculated in an alternate module through stock change

i	1, 2, 3 …*M* strata
t	1, 2, 3, … *t* years elapsed since the start of the REDD project activity

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

Data / parameter:	*CF*
Data unit:	t C t^{-1} d.m.
Used in equations:	2
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:	

Data / parameter:	$COMF_i$
Data unit:	dimensionless
Used in equations:	1
Description:	combustion factor for stratum *i* (vegetation type)
Source of data:	default values in Table 2.6 of IPCC, 2006 (Annex 2)
Measurement procedures (if any):	
Any comment:	The combustion factor is a measure of the proportion of the fuel that is actually combusted, which varies as a function of the size and architecture of the fuel load (i.e., a smaller proportion of large, coarse fuel such as tree stems will be burnt compared to fine fuels, such as grass leaves), the moisture content of the fuel and the type of fire (i.e., intensity and rate of spread). Default values shall be updated whenever new guidelines are produced by the IPCC

Data / parameter:	G_{gi}
Data unit:	g kg^{-1} dry matter burnt

Used in equations:	1
Description:	Emission factor for stratum *i* for gas *g*,
Source of data:	Defaults can be found in Volume 4, Chapter 2, of the IPCC 2006 Inventory Guidelines in table 2.5 (see Annex 2: emission factors for various types of burning for CH_4 and N_2O).
Measurement procedures (if any):	
Any comment:	Default values shall be updated whenever new guidelines are produced by the IPCC

IV. DATA AND PARAMETERS MONITORED

V. PARAMETERS ORIGINATING IN OTHER MODULES

Data / parameter:	$A_{burn,i,t}$
Data unit:	ha
Used in equations:	1
Description:	Area burnt in stratum *i* at time *t*
Module parameter originates in:	M-EXP
Any comment:	Corresponding information shall be included in the PDD

Data / parameter:	$C_{AB,tree,i}$
Data unit:	t CO_2-e ha^{-1}
Used in equations:	2
Description:	Carbon stock in aboveground biomass in trees in stratum *i*
Module parameter originates in:	CP-AB
Any comment:	Corresponding information shall be included in the PDD

Data / parameter:	$C_{DW,i}$
Data unit:	t CO_2-e ha^{-1}

Used in equations:	2
Description:	Carbon stock in dead wood in the baseline in stratum *i*
Module parameter originates in:	CP-W
Any comment:	Corresponding information shall be included in the PDD

Data / parameter:	$C_{LI,i}$
Data unit:	t CO_2-e ha^{-1}
Used in equations:	2
Description:	Carbon stock in litter in the baseline in stratum *i*
Module parameter originates in:	CP-L
Any comment:	Corresponding information shall be included in the PDD

Annex 1:

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Annex 2:

TABLE 2.6

EMISSION FACTORS (g kg^{-1} DRY MATTER BURNT) FOR VARIOUS TYPES OF BURNING. VALUES ARE MEANS ± SD AND ARE BASED ON THE COMPREHENSIVE REVIEW BY ANDREAE AND MERLET (2001)

(To be used in equation 2.27)

Category	CO_2	CO	CH_4	N_2O	NO_x
Savanna and grassland	1613 ± 95	65 ± 20	2.3 ± 0.9	0.21 ± 0.10	3.9 ± 2.4
Agricultural residues	1515 ± 177	92 ± 54	2.7	0.07	2.5 ± 1.0
Tropical forest	1580 ± 90	104 ± 30	6.8 ± 2.9	0.20	1.9 ± 0.7
Extra-tropical forest	1569 ± 131	107 ± 37	4.7 ± 1.9	0.26 ±0.07	3.0 ± 1.4
Biofuel burning	1550 ± 95	78 ± 31	6.1 ± 2.2	0.06	1.1 ± 0.8

Note: The 'extra-tropical forest' category includes all other forest types.

Note: For combustion of non-woody biomass in Greenland and Cropland, CO_2 emissions do not need to be estimated and reported, because it is assumed that annual CO_2 removals (through growth) and emissions (whether by decay or fire) by biomass are in balance (see earlier discussion on croplands) in Section 2.4.