Using the Carbon Benefits Measurement and Modelling Tools

Part 1: Linking Measurement and Monitoring with Greenhouse Gas Inventories

Table of Contents

The Importance of Measurement and Monitoring

The decision to adopt a carbon/greenhouse gas (GHG) measurement and monitoring protocol for a GEF project should be made based on the project's goals and objectives and the facilities and expertise available. Projects that are good candidates for a measurement and monitoring program are those that either;

a) have GHG emissions reductions from land use in their primary goals and objectives; or
b) are tied to or would like to be tied to financial contracts for carbon sequestration or GHG reduction; or

c) have other project objectives that are closely linked to reducing GHG emissions or increasing C stocks, such as improving soil fertility, reforestation, or livestock improvement and an interest in tracking carbon stocks and GHG emissions.

Users of the CBP system whose projects meet the above criteria should consider using the Detailed Assessment or the Dynamic Modelling portions of the CBP toolkit. Users without these incentives should consider using the Simple Assessment portion of the CBP toolkit. Further guidance on which tools to use is given in Guidance Part 3.

Why implement a Measurement and Monitoring Program?

The CBP System uses the methods of the Intergovernmental Panel on Climate Change (IPCC) to estimate C stock changes and GHG flux from agriculture, forestry and other land uses (AFOLU). The methods are based on straightforward models of GHG flux from various land management activities, however, as with all models, the results are only as good as the information used to drive them. Most information used to drive the equations in these models has an inherent uncertainty, meaning there is a measurement or estimation error associated with it. The larger the error terms in the equations, the larger the uncertainty will be in the equation results.

Land management projects whose performance is tied to carbon sequestration or GHG reduction have an incentive to reduce the uncertainty in the GHG flux estimates associated with their land management activities. Implementing a measurement and monitoring program will allow them to improve the accuracy of their GHG flux estimates and monitor the success of their activities over time. Additionally, financial contracts for carbon sequestration and/or GHG reductions are frequently based on the uncertainty of their estimates. For example, a project that yields an estimated carbon sequestration of 2 tonnes/ha +/- 30% will often only be paid for 1.4 tonnes/ha, which is 30% less than the mean estimate. This is referred to as the *discount rate*.

GHG Flux Estimates in the CBP Simple and Detailed Assessments.

The total GHG flux for a project is calculated by adding up whether land management activities store or release carbon, combined with the degree to which these activities generate other greenhouse gases known as trace gases. These are all calculated from a series of Greenhouse Gas Flux equations. Table 2 contains a complete list of the equations. Below we consider three examples in detail in order to explain how the equations are used to calculate GHG flux.

Components of a GHG Flux Equation

The Simple and Detailed Assessments utilize eighty-five equations derived from the IPCC AFOLU methods. Equations include activity data, factors and constants defined below:

- ***Activity Data*** contain information on the extent and details of land management activities and practices in the project area. Examples include populations of livestock, acres of land in annual crops, number of trees planted in an Agroforestry project, or the amount and nitrogen content of fertilizer applied to crops. Providing accurate estimates of activity data will improve the accuracy of estimates of GHG flux from a project.

- ***Factors*** are generally multipliers that extend the activity data to greenhouse gas emissions. Examples include the biomass accumulation rate of trees in an Agroforestry system, or the rate of soil carbon change in annual cropland. Many equation factors are very project-specific and provide users with the

best opportunity to reduce the uncertainty of their GHG flux estimates. Within the CBP Simple and Details Assessments, factors are divided into four categories:

- ***Laboratory Measurements*** consist of relatively straightforward, inexpensive measurements that can be accomplished in natural resource laboratories in most developing and developed countries around the world. Examples include the nitrogen content of wood and the dry weight of crop residues.
- ***Field Measurements*** consist of relatively straightforward, inexpensive measurements that can be made in the field using protocols in the source documents by Ravindranath and Ostwald, Person *et al.*, and MacDicken.
- ***Complex Measurements*** are those factors that might improve project-specific GHG flux estimates but which require extensive field work or laboratory analysis utilizing specialized equipment. The relative improvement in GHG flux estimates is generally not worth the extra expense and labor required. Examples include the combustion efficiency of biomass or the root:shoot ratio of trees.
- ***Recommend Default Only*** are factors that might be improved upon with extensive laboratory or field measurements, but which would require specialized equipment, or the factor already has a high degree of certainty. Examples include methane emission ratios from livestock, oxidation rates of organic soils and the methane emission ratio from burning forests.

- ***Constants*** are essentially equation factors that are physical constants which never change. Examples include the molecular weight and the global warming potential of nitrous oxide.

Examples of GHG Flux Equations

The following three examples show three different GHG flux equations with their associated activity data, factors and constants.

1) Basic Enteric Methane Emissions from Livestock, in tonnes CO_2e per tonne CH4.

Equation: Lent = (Pop * (months/12) * EFb) / kg-tonne * GWP(CH4)

WHERE:-

Lent - is an abbreviation of Livestock Enteric

Activity Data: **Pop** = the population of a livestock species; **months** = the average number of months the species is present in the project area.

Factors: **EFb** = Enteric Fermentation emissions ratio in kg CH4 per animal per year.

Constants: **kg-tonne** = conversion rate between kilograms and tonnes; **GWP(CH4)** = global warming potential of methane.

2) Soil Carbon Stocks in tonnes C

Equation: SOC = A * SOCref * Flu * Fi * Fmg

WHERE:-

SOC is an abbreviation for Soil Organic Carbon

Activity Data: **A** = the area in a land management system such as annual crops or Agroforestry.

Factors: **SOCref** = the carbon stock (tonnes/ha) of the soil under native equilibrium conditions; **Flu** = land use factor; **Fi** = land management input factor; **Fmg** = land management factor.

Constants: none.

3) Biomass Carbon Losses from Deforestation in tonnes CO_2e[1].

Equation: Ldf = A * (Bwp - Bwr) * (1 + R) * CF * CO2-C

WHERE:-

Ldf is an abbreviation for loss from deforestation

Activity Data: **A** = area deforested in hectares

Factors: **Bwp** = biomass in tonnes/ha present prior to deforestation, **Bwr** = biomass present in tonnes/ha after deforestation, **R** = root:shoot ratio of trees in the forest; **CF** = carbon fraction of wood

Constants: **CO2-C** = carbon to carbon dioxide conversion ratio.

[1] CO_2e refers to carbon-dioxide equivalents. Different greenhouse gases have different *global warming potentials*, meaning on a ton-per-ton basis they have different levels of effect in affecting climate change. For example, methane (CH_4) has approximately 25 times the global warming potential of carbon dioxide, and nitrous oxide (N_2O) has approximately 310 times that of carbon dioxide. Multiplying the mass of the emissions of these gases by their global warming potential allows us to compare the total effect of all emissions against the common, accepted standard of CO_2e.

How Uncertainty is Calculated

The relative uncertainty in the equations above is calculated using the combined relative uncertainty of the equation factors. Consider the equation in example 3 above:

*Ldf = A * (Bwp - Bwr) * (1 + R) * CF * CO2-C*

The default relative uncertainty of each of the four factors follows: Bwp = 50%, Bwr = 50%, R = 25%, CF = 7%. The relative uncertainty of the equation is calculated as the square root of the sum of squares of the factor uncertainties, or

$$U = \sqrt{u(Bwp)^2 + u(Bwr)^2 + u(R)^2 + u(CF)^2}$$

Where u(SOCref), etc. is the relative uncertainty of each of the equation factors. The relative uncertainty for the equation becomes

$$U = \sqrt{0.50^2 + 0.50^2 + 0.25^2 + 0.07^2}$$

which is 0.75, or 75%.

The two factors Bwp and Bwr are good examples of factors that may be measured using a combination of straightforward field and laboratory techniques utilized by foresters and/or other natural resource specialists. By implementing a measurement and monitoring protocol, it is possible to reduce the uncertainty of those two factors to 20% or less, which would reduce the overall uncertainty of the equation to 38%, or almost half of the default value. The factor R is very difficult to measure and hence project managers should avoid trying to measure it. The relative uncertainty of the factor CF is already very small and hence projects can devote their resources to other efforts.

The reader should see from this example that it is in their best interest to reduce the uncertainty of their GHG flux estimates by calculating project-specific equation factors wherever possible through a measurement and monitoring program.

Table 3 lists all of the factors present in the CBP system and also lists, by activity data category, which factors are good candidates for improvment via a Measurement and Monitoring program.

Where to access protocols for field and laboratory measurements

Activity Data, Equations and Factors

Table 1 lists the activity data needed by the CBP Simple and Detailed Assessments with information on where to access measurement protocols. In most cases the activity data listed involves a field measurement with the exception of % Nitrogen in Fertilizer which can often be found on fertilizer packaging.

Table 1. Activity Data Measurements needed by the CBP Simple and Detailed Assessment Tools

Activity Data Type	abbreviation	name	units	Protocol for measurement available from Ravindranath and Ostwald:
Agroforestry	A	Area in Agroforestry System	ha	Sections 5.1 and 6.5, Chapter 8, Section 15.7.4.
Agroforestry	FertAmt	Fertilizer Amount	kg	Section 8.2.3.
Agroforestry	Fire%	% of trees burned	%	Section 9.1.
Agroforestry	N%	% Nitrogen in Fertilizer	%	Section 8.2.3.
Agroforestry	NT	number of trees	number	Section 17.1.4
Agroforestry	Other%	% trees lost to other causes	%	Section 9.1.
Agroforestry	Pest%	% trees lost to pests	%	Section 9.1.
Agroforestry	Wind%	% trees lost to wind	%	Section 9.1.
Annual cropland	A	Area in Annual Cropland System		Sections 5.1 and 6.5, Chapter 8, Section 16.7.4.
Annual cropland	A	Area in Annual Cropland System	ha	Sections 5.1 and 6.5, Chapter 8, Section 16.7.4.
Annual cropland	A	Area in Wetland Rice	ha	Sections 5.1 and 6.5, Chapter 8, Section 16.7.4.
Annual cropland	Burn%	% of residues burned	%	
Annual cropland	FertAmt	Fertilizer Amount	kg	Section 8.2.3.
Annual cropland	N%	% Nitrogen in Fertilizer	%	Section 8.2.3.
Annual cropland	Res:Yield	Residue to Yield Ratio	unitless	
Annual cropland	Retained%	% of residues retained	%	
Annual cropland	Yield	Crop Yield	Tonnes/ha	
Forestland	A	Area in Forest	ha	Sections 5.1 and 6.5, Chapter 8, Section 16.7.4.
Forestland	CA	Area cleared without burning	ha	Sections 5.1 and 6.5, Chapter 8, Section 16.7.4.
Forestland	FA	Area cleared by burning	ha	Sections 5.1 and 6.5, Chapter 8, Section 16.7.4.
Forestland	Fire%	% of forest burned	%	Section 9.1.
Forestland	fVol	Volume of wood gathered for fuel	m3	Section 9.3.
Forestland	tVol	Volume of wood harvested for timber	m3	Section 9.3.
Grassland	A	Area in Grassland	ha	Sections 5.1 and 6.5, Chapter 8, Section 16.7.4.

Grassland	A	Area in Silvipasture	ha	Sections 5.1 and 6.5, Chapter 8, Section 16.7.4.
Grassland	FertAmt	Fertilizer Amount	kg	Section 8.2.3.
Grassland	Fire%	% of forest burned	%	Section 9.1.
Grassland	Fire%	% of trees burned	%	Section 9.1.
Grassland	N%	% Nitrogen in Fertilizer	%	Section 8.2.3.
Grassland	Other%	% trees lost to other causes	%	Section 9.1.
Grassland	Pest%	% trees lost to pests	%	Section 9.1.
Grassland	Wind%	% trees lost to wind	%	Section 9.1.
Livestock	months	number of months resident per year	number	Section 10.8.
Livestock	Pop	number of livestock	number	Section 10.8.
Perennial Cropland	A	Area in perennial cropping system	ha	Sections 5.1 and 6.5, Chapter 8, Section 16.7.4.
Perennial Cropland	FertAmt	Fertilizer Amount	kg	Section 8.2.3.
Perennial Cropland	Fire%	% of trees burned	%	Section 9.1.
Perennial Cropland	N%	% Nitrogen in Fertilizer	%	Section 8.2.3.
Perennial Cropland	Other%	% trees lost to other causes	%	Section 9.1.
Perennial Cropland	Pest%	% trees lost to pests	%	Section 9.1.
Perennial Cropland	Wind%	% trees lost to wind	%	Section 9.1.
Settlements	A	Area in Settlements	ha	Sections 5.1 and 6.5, Chapter 8, Section 16.7.4.
Settlements	Fire%	% of trees burned	%	Section 9.1.
Settlements	NT	number of trees	number	Section 17.1.4
Settlements	Other%	% trees lost to other causes	%	Section 9.1.
Settlements	Pest%	% trees lost to pests	%	Section 9.1.
Settlements	TC%	Tree Crown %	%	Section 16.8.3.
Settlements	Wind%	% trees lost to wind	%	Section 9.1.
Wetlands	A	Area in Wetlands	ha	Sections 5.1 and 6.5, Chapter 8, Section 16.7.4.

Table 2. Greenhouse Gas Flux Equations used in the CBP Simple and Detailed Assessments.

Landuse	equation	equation text
Agroforestry	Biomass C Disturbance Losses	dCl = NT * BCt * (Fire% + Wind% + Pest% + Other%)/100 * CO2-C
Agroforestry	Biomass C Growth	dCg = NT * Crate * CO2-C
Agroforestry	CH4 Emissions	L(CH4) = NT * BCt * CE * (Fire%/100) * ER(CH4) * (CH4-C) * GWP(CH4)
Agroforestry	CO Emissions	L(CO) = NT * BCt * CE * (Fire%/100) * ER(CO) * (CO-C) * GWP(CO)
Agroforestry	Direct N2O Emissions from Synthetic N Fertilizers	L(N2O)dir = [(A * FertAmt * (N%/100)) * EF * N2O-N] / kg-tonne * GWP(N2O)
Agroforestry	Indirect N2O Emissions from Atmospheric N Deposition	L(N2O)Ndep = [(A * FertAmt * (N%/100)) * FNv * EFv * N2O-N] / kg-tonne * GWP(N2O)
Agroforestry	Indirect N2O Emissions from Leaching/Runoff	L(N2O)lr = [(A * FertAmt * (N%/100)) * FNlr * EFlr * N2O-N] / kg-tonne * GWP(N2O)
Agroforestry	Mineral Soils C Stocks	SOC = A * SOCref * Flu * Fi * Fmg
Agroforestry	N2O Emissions	L(N2O) = NT * BCt * CE * (Fire%/100) * ER(N2O) * NC * (N2O-N) * GWP(N2O)
Agroforestry	NOx Emissions	L(NOx) = NT * BCt * CE * (Fire%/100) * ER(NOx) * NC * (NOx-N) * GWP(NOx)
Agroforestry	Organic Soils Emissions	Lorg = A * EF * CO2-C
Annual cropland	CH4 Emissions	L(CH4) = A * Yield * Res:Yield * (Burn%/100)) * OR * DMF * CF * ER(CH4) * (CH4-C) * GWP(CH4)
Annual cropland	CO Emissions	L(CO) = A * Yield * Res:Yield * (Burn%/100)) * OR * DMF * CF * ER(CO) * (CO-C) * GWP(CO)
Annual cropland	Direct N2O Emissions from Crop Residues	L(N2O)dir = A * Yield * Res:Yield * (Retained%/100)) * DMF * CF * NC * EF * (N2O-N) * GWP(N2O)
Annual cropland	Direct N2O Emissions from Cultivated Organic Soils	L(N2O)dir = [A * EF * (N2O-N)] / kg-tonne * GWP(N2O)
Annual cropland	Direct N2O Emissions from Synthetic N Fertilizers	L(N2O)dir = [(A * FertAmt * (N%/100)) * EF * N2O-N] / kg-tonne * GWP(N2O)
Annual cropland	Indirect N2O Emissions from Atmospheric N Deposition	L(N2O)Ndep = [(A * FertAmt * (N%/100)) * FNv * EFv * N2O-N] / kg-tonne * GWP(N2O)
Annual cropland	Indirect N2O Emissions from	L(N2O)lr = [(A * FertAmt * (N%/100)) * FNlr * EFlr * N2O-N] / kg-tonne * GWP(N2O)

	Leaching/Runoff	
Annual cropland	Mineral Soils C Stocks	SOC = A * SOCref * Flu * Fi * Fmg
Annual cropland	N2O Emissions	L(N2O) = A * Yield * Res:Yield * (Burn%/100)) * OR * DMF * CF * ER(N2O) * NC * (N2O-N) * GWP(N2O)
Annual cropland	NOx Emissions	L(NOx) = A * Yield * Res:Yield * (Burn%/100)) * OR * DMF * CF * ER(NOx) * NC * (NOx-N) * GWP(NOx)
Annual cropland	Organic Soils Emissions	Lorg = A * EF * CO2-C
Annual cropland	Rice Methane Emissions	Lrice = [(A * sqMeters-ha) * EFc * Mf * SFo * SFs * SFw] / gm-tonne * GWP(CH4)
Forestland	Biomass C Growth	dCg = A * Gw * (1 + R) * CF * CO2-C
Forestland	Biomass C Losses	Ldf = (CA + FA) * (Bwp - Bwr) * (1 + R) * CF * CO2-C
Forestland	CH4 Emissions	L(CH4) = A * MF * CE * CF * (Fire%/100) * ER(CH4) * (CH4-C)* GWP(CH4)
Forestland	CH4 Emissions	L(CH4) = FA * MF * CE * CF * ER(CH4) * (CH4-C) * GWP(CH4)
Forestland	CO Emissions	L(CO) = A * MF * CE * CF * (Fire%/100) * ER(CO) * (CO-C) * GWP(CO)
Forestland	CO Emissions	L(CO) = FA * MF * CE * CF * ER(CO) * (CO-C) * GWP(CO)
Forestland	Fuelwood Gathering C Losses	dC(F)l = fVol * D * BEFf * CF * CO2-C
Forestland	Mineral Soils C Stocks	SOC = A * SOCref * Flu * Fi * Fmg
Forestland	N2O Emissions	L(N2O) = A * MF * CE * CF * (Fire%/100) * ER(N2O) * NC * (N2O-N) * GWP(N2O)
Forestland	N2O Emissions	L(N2O) = FA * MF * CE * CF * ER(N2O) * NC * (N2O-N) * GWP(N2O)
Forestland	NOx Emissions	L(NOx) = A * MF * CE * CF * (Fire%/100) * ER(NOx) * NC * (NOx-N) * GWP(NOx)
Forestland	NOx Emissions	L(NOx) = FA * MF * CE * CF * ER(NOx) * NC * (NOx-N) * GWP(NOx)
Forestland	Organic Soils Emissions	Lorg = A * EF * CO2-C
Forestland	Timber Harvest C Losses	dC(T)l = tVol * D * BEFt * CF * (1 - Fbl) * CO2-C
Forestland	Total Biomass C Disturbance Losses	dCl = A * Bw * CF * (Fire% + Wind% + Pest% + Other%)/100 * CO2-C
Grassland	Biomass C Growth	dCg = A * G * CO2-C
Grassland	CH4 Emissions	L(CH4) = [(A * BD * FB * Fl * FOl * CFl * ERl(CH4)) + (A * BD * FB * (1 - Fl) * FOd * CFd * ERd(CH4))] * (CH4-C) * GWP(CH4)
Grassland	CH4 Emissions	L(CH4) = A * BC * CE * (Fire%/100) * ER(CH4) * (CH4-C) * GWP(CH4)
Grassland	CO Emissions	L(CO) = [(A * BD * FB * Fl * FOl * CFl * ERl(CO)) + (A * BD * FB * (1 - Fl) * FOd * CFd * ERd(CO))] * (CO-C) * GWP(CO)
Grassland	CO Emissions	L(CO) = A * BC * CE * (Fire%/100) * ER(CO) * (CO-C) * GWP(CO)
Grassland	Direct N2O Emissions from Synthetic N Fertilizers	L(N2O)dir = [(A * FertAmt * (N%/100)) * EF * N2O-N] / kg-tonne * GWP(N2O)
Grassland	Herbaceous Biomass C Change (Land Use Change)	dCherb = A * (Ca - Cb + dCg) * CO2-C

Grassland	Indirect N2O Emissions from Atmospheric N Deposition	L(N2O)Ndep = [(A * FertAmt * (N%/100)) * FNv * EFv * N2O-N] / kg-tonne * GWP(N2O)
Grassland	Indirect N2O Emissions from Leaching/Runoff	L(N2O)lr = [(A * FertAmt * (N%/100)) * FNlr * EFlr * N2O-N] / kg-tonne * GWP(N2O)
Grassland	Mineral Soils C Stocks	SOC = A * SOCref * Flu * Fi * Fmg
Grassland	N2O Emissions	L(N2O) = [(A * BD * FB * Fl * FOl * CFl * ERl(N2O) * NCl) + (A * BD * FB * (1 - Fl) * FOd * CFd * ERd(N2O) * NCd)] * (N2O-N) * GWP(N2O)
Grassland	N2O Emissions	L(N2O) = A * BC * CE * (Fire%/100) * ER(N2O) * NC * (N2O-N) * GWP(N2O)
Grassland	NOx Emissions	L(NOx) = [(A * BD * FB * Fl * FOl * CFl * ERl(NOx) * NCl) + (CRd * ERd(NOx) * NCd)] * (NOx-N) * GWP(NOx)
Grassland	NOx Emissions	L(NOx) = A * BC * CE * (Fire%/100) * ER(NOx) * NC * (NOx-N) * GWP(NOx)
Grassland	Organic Soils Emissions	Lorg = A * EF * CO2-C
Grassland	Total Biomass C Disturbance Losses	dCl = A * L * (Fire% + Wind% + Pest% + Other%)/100 * CO2-C
Livestock	Basic Enteric Methane Emissions	Lent = (Pop * (months/12) * EFb) / kg-tonne * GWP(CH4)
Livestock	Basic Manure Methane Emissions	Lmm = (Pop * (months/12) * EFb) / kg-tonne * GWP(CH4)
Livestock	Direct N2O Emissions from Manure Amendment	L(N2O)dir = [[Pop * (months/12) * (Nex * Nadj)] * (MMS% / 100) * EF * (N2O-N)] / kg-tonne * GWP(N2O)
Livestock	Direct N2O Emissions from Manure in PRP	L(N2O)dir = [[Pop * (months/12) * (Nex * Nadj)] * (MMS% / 100) * EF * (N2O-N)] / kg-tonne * GWP(N2O)
Livestock	Direct N2O Emissions from Manure Management	L(N2O)dir = [[Pop * (months/12) * (Nex * Nadj)] * (MMS% / 100) * EF * (N2O-N)] / kg-tonne * GWP(N2O)
Livestock	Indirect N2O Emissions from Atmospheric N Deposition	L(N2O)Ndep = [[Pop * (months/12) * (Nex * Nadj)] * (MMS% / 100) * FNv * EFv * (N2O-N)] / kg-tonne * GWP(N2O)
Livestock	Indirect N2O Emissions from Atmospheric N Deposition	L(N2O)Ndep = [[Pop * (months/12) * (Nex * Nadj)] * (MMS% / 100) * FNv * EFv * (N2O-N)] / kg-tonne * GWP(N2O)
Livestock	Indirect N2O Emissions from	L(N2O)lr = [[Pop * (months/12) * (Nex * Nadj)] * (MMS% / 100) * FNlr * EFlr * (N2O-N)] / kg-tonne * GWP(N2O)

	Leaching/Runoff	
Livestock	Indirect N2O Emissions from Leaching/Runoff	L(N2O)lr = [[Pop * (months/12) * (Nex * Nadj)] * (MMS% / 100) * FNlr * EFlr * (N2O-N)] / kg-tonne * GWP(N2O)
Perennial Cropland	Biomass C Growth	dCg = A * G * CO2-C
Perennial Cropland	CH4 Emissions	L(CH4) = A * BC * CE * (Fire%/100) * ER(CH4) * (CH4-C) * GWP(CH4)
Perennial Cropland	CO Emissions	L(CO) = A * BC * CE * (Fire%/100) * ER(CO) * (CO-C) * GWP(CO)
Perennial Cropland	Direct N2O Emissions from Cultivated Organic Soils	L(N2O)dir = [A * EF * (N2O-N)] / kg-tonne * GWP(N2O)
Perennial Cropland	Direct N2O Emissions from Synthetic N Fertilizers	L(N2O)dir = [(A * FertAmt * (N%/100)) * EF * N2O-N] / kg-tonne * GWP(N2O)
Perennial Cropland	Indirect N2O Emissions from Atmospheric N Deposition	L(N2O)Ndep = [(A * FertAmt * (N%/100)) * FNv * EFv * N2O-N] / kg-tonne * GWP(N2O)
Perennial Cropland	Indirect N2O Emissions from Leaching/Runoff	L(N2O)lr = [(A * FertAmt * (N%/100)) * FNlr * EFlr * N2O-N] / kg-tonne * GWP(N2O)
Perennial Cropland	Mineral Soils C Stocks	SOC = A * SOCref * Flu * Fi * Fmg
Perennial Cropland	N2O Emissions	L(N2O) = A * BC * CE * (Fire%/100) * ER(N2O) * NC * (N2O-N) * GWP(N2O)
Perennial Cropland	NOx Emissions	L(NOx) = A * BC * CE * (Fire%/100) * ER(NOx) * NC * (NOx-N) * GWP(NOx)
Perennial Cropland	Organic Soils Emissions	Lorg = A * EF * CO2-C
Perennial Cropland	Total Biomass C Disturbance Losses	dCl = A * L * (Fire% + Wind% + Pest% + Other%)/100 * CO2-C
Settlements	CH4 Emissions	L(CH4) = ((A * (TC%/100) * BC * CE) + (NT * BCt * CE)) * (Fire%/100) * ER(CH4) * (CH4-C) * GWP(CH4)
Settlements	CO Emissions	L(CO) = ((A * (TC%/100) * BC * CE) + (NT * BCt * CE)) * (Fire%/100) * ER(CO) * (CO-C) * GWP(CO)
Settlements	Mineral Soils C Stocks	SOC = A * SOCref * Flu * Fi * Fmg
Settlements	N2O Emissions	L(N2O) = ((A * (TC%/100) * BC * CE) + (NT * BCt * CE)) * (Fire%/100) * ER(N2O) * (N2O-N) * GWP(N2O)
Settlements	NOx Emissions	L(NOx) = ((A * (TC%/100) * BC * CE) + (NT * BCt * CE)) * (Fire%/100) * ER(NOx) * (NOx-N) * GWP(NOx)
Settlements	Organic Soils	Lorg = A * EF * CO2-C

	Emissions	
Settlements	Settlements Biomass C Growth	dCg =((A * (TC%/100) * CRW) + (NT * Crate)) * CO2-C
Settlements	Settlements Biomass C Losses	dCl = ((A * (TC%/100) * L) + (NT * BCt)) * (Fire% + Wind% + Pest% + Other%)/100 * CO2-C
Wetlands	Mineral Soils C Stocks	SOC = A * SOCref * Flu * Fi * Fmg
Wetlands	Organic Soils Emissions	Lorg = A * EF * CO2-C

Table 3. Equation factors used in the CBP Simple and Detailed Assessments.

Factor Name	Abbreviation	Source Category	Subsource Category	Units	Citations
Aboveground Biomass C Stock	BC	Biomass Burning	Agroforestry	tonnes C/ha	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry. Table 3.3.2, p. 3.71 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 5. p. 5.9 Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 7.2, p. 18 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p. 237
Aboveground Biomass C Stock	BC	Biomass Burning	Perennial Cropland	tonnes C/ha	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry. Table 3.3.2, p. 3.71 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 5. p. 5.9 Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 7.2, p. 18 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p. 237
Aboveground Biomass C Stock	BC	Biomass Burning	Settlements	tonnes C/ha	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry. Table 3.3.2, p. 3.71 Forest Carbon Measurement Guidelines, Module 1 of 5: Guidelines for Ex Ante Forest Carbon Calculations. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State

					University. Http://www.goes.msu.edu Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Carbon in Trees Outside Forests. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 7.2, p. 18 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p. 237
Aboveground Biomass C Stock	BC	Biomass C Stocks	Agroforestry	tonnes C/ha	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry. Table 3.3.2, p. 3.71 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 5. p. 5.9 Forest Carbon Measurement Guidelines, Module 1 of 5: Guidelines for Ex Ante Forest Carbon Calculations. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Carbon in Trees Outside Forests. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 7.2, p. 18 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p. 237

Aboveground Biomass C Stock	BC	Biomass C Stocks	Perennial Cropland	tonnes C/ha	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry. Table 3.3.2, p. 3.71 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 5. p. 5.9 Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 7.2, p. 18 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p. 237
Aboveground Biomass C Stock per Tree	BCt	Biomass Burning	Agroforestry	tonnes C per tree	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 4.5,p. 4.50 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 8.2, p. 8.10 Forest Carbon Measurement Guidelines, Module 1 of 5: Guidelines for Ex Ante Forest Carbon Calculations. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Carbon in Trees Outside Forests. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 8.3, p. 26 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 16, p. 217

					Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p. 237
Aboveground Biomass C Stock per Tree	BCt	Biomass Burning	Settlements	tonnes C per tree	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 4.5,p. 4.50 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 8.2, p. 8.10 Forest Carbon Measurement Guidelines, Module 1 of 5: Guidelines for Ex Ante Forest Carbon Calculations. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Carbon in Trees Outside Forests. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 8.3, p. 26 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 16, p. 217 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p. 237
Aboveground Biomass C Stock per Tree	BCt	Biomass C Stocks	Agroforestry	tonnes C per tree	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 4.5,p. 4.50 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 8.2, p. 8.10 Forest Carbon Measurement Guidelines, Module 1 of 5: Guidelines for Ex Ante Forest Carbon Calculations. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State

					University. Http://www.goes.msu.edu Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Carbon in Trees Outside Forests. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 8.3, p. 26 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 16, p. 217 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p. 237
Aboveground Biomass C Stock per Tree	BCt	Biomass C Stocks	Settlements	tonnes C per tree	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 4.5,p. 4.50 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 8.2, p. 8.10 Forest Carbon Measurement Guidelines, Module 1 of 5: Guidelines for Ex Ante Forest Carbon Calculations. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Carbon in Trees Outside Forests. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 8.3, p. 26 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p.

					113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 16, p. 217 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p. 237
Aboveground Biomass Density	BD	Biomass Burning	Grassland/Savanna	tonnes dm/ha	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3.4.2, p. 3.109 Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 8.3, p. 26 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p. 237 Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, Table 4-14 p. 4.76
Biomass Expansion Factor for Fuelwood	BEFf	Biomass C Stocks	Timber Harvest and Fuelwood Gathering	unitless	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3.A.1.10,p. 3.171 Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 8, p. 23 2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3.A.1.10,p. 3.171 Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 8, p. 23 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p. 237
Aboveground Biomass	Bw	Biomass	Forestland	tonnes	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3.3.2,p. 3.71

Stock		C Stocks		dm/ha	Forest Carbon Measurement Guidelines, Module 1 of 5: Guidelines for Ex Ante Forest Carbon Calculations. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Forest Carbon for Afforestation and Reforestation Projects. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 7.2, p. 18 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p. 237
Previous Aboveground Biomass Stock	Bwp	Biomass C Stocks	Deforestation	tonnes dm/ha	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3.3.2,p. 3.71 Forest Carbon Measurement Guidelines, Module 1 of 5: Guidelines for Ex Ante Forest Carbon Calculations. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Forest Carbon for Afforestation and Reforestation Projects. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 8.2, p. 26
Previous Aboveground Biomass Stock	Bwp	Biomass C Stocks	Shifting Cultivation	tonnes dm/ha	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3.3.2,p. 3.71 Forest Carbon Measurement Guidelines, Module 1 of 5: Guidelines for Ex Ante Forest Carbon Calculations. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Forest Carbon for Afforestation and Reforestation Projects. Global Observatory for Ecosystem Services, Department of

					Forestry, Michigan State University. Http://www.goes.msu.edu Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 8.2, p. 26
Remaining Aboveground Biomass Stock	Bwr	Biomass C Stocks	Deforestation	tonnes dm/ha	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3.3.2,p. 3.71 Forest Carbon Measurement Guidelines, Module 1 of 5: Guidelines for Ex Ante Forest Carbon Calculations. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Forest Carbon for Afforestation and Reforestation Projects. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 8.2, p. 26 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p. 237
Remaining Aboveground Biomass Stock	Bwr	Biomass C Stocks	Shifting Cultivation	tonnes dm/ha	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3.3.2,p. 3.71 Forest Carbon Measurement Guidelines, Module 1 of 5: Guidelines for Ex Ante Forest Carbon Calculations. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Forest Carbon for Afforestation and Reforestation Projects. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 8.2, p. 26 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p.

					113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p. 237
Remaining Herbaceous Biomass C Stock	Ca	Biomass C Stocks	Herbaceous Biomass (Land Use Change)	tonnes C/ha	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Section 3.3.2.1, p. 3.85 2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry,Section 3.3.2.1,p. 3.85
Combustion Efficiency of Biomass	CE	Biomass Burning	Agroforestry	unitless	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.6,p. 2.48
Combustion Efficiency of Biomass	CE	Biomass Burning	Deforestation	unitless	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.6,p. 2.48
Combustion Efficiency of Biomass	CE	Biomass Burning	Forestland	unitless	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.6,p. 2.48
Combustion Efficiency of Biomass	CE	Biomass Burning	Perennial Cropland	unitless	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.6,p. 2.48
Combustion Efficiency of Biomass	CE	Biomass Burning	Settlements	unitless	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.6,p. 2.48
Combustion Efficiency of Biomass	CE	Biomass Burning	Shifting Cultivation	unitless	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.6,p. 2.48
Combustion Efficiency of Biomass	CE	Biomass Burning	Silvipasture	unitless	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.6,p. 2.48
Combustion	Cf	Biomass	Agroforestry	g burned	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and

Factor		Burning		g-1 dry matter	Other Land Use, Table 2.6, p. 2.48.
Combustion Factor	Cf	Biomass Burning	Cropland Residue	g burned g-1 dry matter	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.6, p. 2.48.
Combustion Factor	Cf	Biomass Burning	Deforestation	g burned g-1 dry matter	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.6, p. 2.48.
Combustion Factor	Cf	Biomass Burning	Forestland	g burned g-1 dry matter	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.6, p. 2.48.
Combustion Factor	Cf	Biomass Burning	Grassland/Savanna	g burned g-1 dry matter	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.6, p. 2.48.
Combustion Factor	Cf	Biomass Burning	Perennial Cropland	g burned g-1 dry matter	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.6, p. 2.48.
Combustion Factor	Cf	Biomass Burning	Settlements	g burned g-1 dry matter	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.6, p. 2.48.
Combustion Factor	Cf	Biomass Burning	Shifting Cultivation	g burned g-1 dry matter	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.6, p. 2.48.
Combustion Factor	Cf	Biomass Burning	Silvipasture	g burned g-1 dry matter	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.6, p. 2.48.
Carbon Fraction	CF	Biomass Burning	Cropland Residue	tonnes C/tonnes dm	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, page 4.82
Carbon	CF	Biomass	Deforestatio	tonnes	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change

Fraction		Burning	n	C/tonnes dm	and Forestry, page 4.82
Carbon Fraction	CF	Biomass Burning	Forestland	tonnes C/tonnes dm	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, page 4.82
Carbon Fraction	CF	Biomass Burning	Shifting Cultivation	tonnes C/tonnes dm	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, page 4.82
Carbon Fraction	CF	Biomass C Stocks	Deforestation	tonnes C/tonnes dm	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, page 4.82
Carbon Fraction	CF	Biomass C Stocks	Forestland	tonnes C/tonnes dm	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, page 4.82
Carbon Fraction	CF	Biomass C Stocks	Shifting Cultivation	tonnes C/tonnes dm	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, page 4.82
Carbon Fraction	CF	Biomass C Stocks	Timber Harvest and Fuelwood Gathering	tonnes C/tonnes dm	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, page 4.82
Carbon Fraction	CF	Soil Nitrous Oxide	Cropland Residue	tonnes C/tonnes dm	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, page 4.82
Dead Biomass C Fraction	CFd	Biomass Burning	Grassland/Savanna	tonnes C/tonnes dm	Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Carbon in Trees Outside Forests. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 8, p. 23 Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change

					and Forestry, p. 4.79 Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, p. 4.79 Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Carbon in Trees Outside Forests. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 8, p. 23 Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, p. 4.79 Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, p. 4.79.
Aboveground Biomass Carbon Accumulation Rate	Crate	Developed	Agroforestry	tonnes C/ha/yr	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 4.5,p. 4.50 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 5.1 p. 5.9 Forest Carbon Measurement Guidelines, Module 1 of 5: Guidelines for Ex Ante Forest Carbon Calculations. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Carbon in Trees Outside Forests. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 8.3, p. 26 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 16, p.

					217 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p. 237
Average C Accumulation per Tree	Crate	Biomass C Stocks	Agroforestry	tonnes C/tree/yr	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 4.5,p. 4.50 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 8.2,p. 8.10 Forest Carbon Measurement Guidelines, Module 1 of 5: Guidelines for Ex Ante Forest Carbon Calculations. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Carbon in Trees Outside Forests. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 8.3, p. 26 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 16, p. 217 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p. 237
Average C Accumulation per Tree	Crate	Biomass C Stocks	Settlements	tonnes C/tree/yr	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 4.5,p. 4.50 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 8.2,p. 8.10

					Forest Carbon Measurement Guidelines, Module 1 of 5: Guidelines for Ex Ante Forest Carbon Calculations. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Carbon in Trees Outside Forests. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 8.3, p. 26 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 16, p. 217 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p. 237
crop yield	CropYield	Biomass Burning	Cropland Residue	Mg/ha	FAOSTAT database -> http://faostat.fao.org/site/567/default.aspx#ancor
crop yield	CropYield	Soil Nitrous Oxide	Cropland Residue	Mg/ha	FAOSTAT database -> http://faostat.fao.org/site/567/default.aspx#ancor
Crown Cover C Growth Rate	CRW	Biomass C Stocks	Settlements	tonnes C/ha crown cover/yr	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 8.1, p.8.9 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 4.5,p. 4.50 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 8.1,p.8.9 Forest Carbon Measurement Guidelines, Module 1 of 5: Guidelines for Ex Ante Forest Carbon Calculations. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State

					University. Http://www.goes.msu.edu Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Carbon in Trees Outside Forests. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 8.3, p. 26 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 16, p. 217 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p. 237
Wood Density	D	Biomass C Stocks	Timber Harvest and Fuelwood Gathering	tonnes dm/m3	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3.A.1.9-1,p. 3.171 2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry: Annex 3, Table 3A.1.9, p. 3.171 Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 8.4.1, Appendix C, p. 26,44
Change in Herbaceous Biomass C from Growth	dCg	Biomass C Stocks	Herbaceous Biomass (Land Use Change)	tonnes CO2/ha	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3.4.2 p. 3.109 and Table 3.4.3 p. 3.110 (aboveground biomass + root-to-shoot * aboveground biomass) 2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3.4.9 p. 3.125 (grassland) (assumes carbon fraction = 0.45)
Dry Matter Fraction of Residue	DMF	Biomass Burning	Cropland Residue	tonnes dm/tonnes residue	Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Carbon in Trees Outside Forests. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu

					Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 8.3, p. 26 Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, Table 4-17,page 4.85
Dry Matter Fraction of Residue	DMF	Soil Nitrous Oxide	Cropland Residue	tonnes dm/tonnes residue	Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Carbon in Trees Outside Forests. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 8.3, p. 26 Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, Table 4-17,page 4.85
Direct Emission Factor for Crop Residues	EF	Soil Nitrous Oxide	Cropland Residue	Kg N2O-N/Kg N	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use,vol.4,p.11.11 Verchote, L, M. Thiongo, E. Anyango, P. Mutuo and S. Abwanda. 2010. Field and Laboratory Protocols, Non-CO2 GHG measurements: Inorganic-N measurements, Soil water content measurement. Center for International Forestry Research. http://www.cifor.org
Direct Emission Factor for Cultivated Organic Soil	EF	Soil Nitrous Oxide	Mineralization of Cultivated Organic Soils	Kg N2O-N/ha/yr	2000 IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, Chapter 4: Agriculture, Table 4.17,p. 4.60
Direct Emission Factor for Manure Amendment	EF	Soil Nitrous Oxide	Manure N Amendments	Kg N2O-N/Kg N	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 11.1,page 11.12
Direct Emission Factor for Manure in PRP	EF	Soil Nitrous Oxide	Manure N in Pasture/Range/Paddock	Kg N2O-N/Kg N	2000 IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, Chapter 4: Agriculture, Table 4.13,p. 4.44

Direct Emission Factor for N Fertilizers	EF	Soil Nitrous Oxide	Synthetic N Fertilizer	Kg N2O-N/Kg N	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 11.1,page 11.11
Direct Emission Factor for N Fertilizers	EF	Soil Nitrous Oxide	Synthetic N Fertilizer	Kg N2O-N/Kg N	Verchote, L, M. Thiongo, E. Anyango, P. Mutuo and S. Abwanda. 2010. Field and Laboratory Protocols, Non-CO2 GHG measurements: Inorganic-N measurements, Soil water content measurement. Center for International Forestry Research. http://www.cifor.org
Direct Emission Factor for Sewage Sludge	EF	Soil Nitrous Oxide	Sewage Sludge	Kg N2O-N/Kg N	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 11.1,page 11.11
Organic Soil Emission Factor	EF	Soil C Stocks	Organic Soils	tonnes C/ha/yr	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use vol.4: tbl 4.6,p. 4.53 (Forestlands)
Indirect Emission Factor for N Leached/Run off	EFlr	Soil Nitrous Oxide	Manure N Amendments	Kg N2O-N/Kg N leached and runoff	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 11.3,page 11.26 Verchote, L, M. Thiongo, E. Anyango, P. Mutuo and S. Abwanda. 2010. Field and Laboratory Protocols, Non-CO2 GHG measurements: Inorganic-N measurements, Soil water content measurement. Center for International Forestry Research. http://www.cifor.org
Indirect Emission Factor for N Leached/Run off	EFlr	Soil Nitrous Oxide	Manure N in Pasture/Range/Paddock	Kg N2O-N/Kg N leached and runoff	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 11.3,page 11.26 Verchote, L, M. Thiongo, E. Anyango, P. Mutuo and S. Abwanda. 2010. Field and Laboratory Protocols, Non-CO2 GHG measurements: Inorganic-N measurements, Soil water content measurement. Center for International Forestry Research. http://www.cifor.org
Indirect Emission Factor for N Leached/Run off	EFlr	Soil Nitrous Oxide	Sewage Sludge	Kg N2O-N/Kg N leached and runoff	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 11.3,page 11.26 Verchote, L, M. Thiongo, E. Anyango, P. Mutuo and S. Abwanda. 2010. Field and Laboratory Protocols, Non-CO2 GHG measurements: Inorganic-N measurements, Soil water content measurement. Center for International Forestry Research. http://www.cifor.org

Indirect Emission Factor for N Leached/Run off	EFlr	Soil Nitrous Oxide	Synthetic N Fertilizer	Kg N2O-N/Kg N leached and runoff	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 11.3,page 11.26 Verchote, L, M. Thiongo, E. Anyango, P. Mutuo and S. Abwanda. 2010. Field and Laboratory Protocols, Non-CO2 GHG measurements: Inorganic-N measurements, Soil water content measurement. Center for International Forestry Research. http://www.cifor.org
Indirect Emission Factor for Volatilized N	EFv	Soil Nitrous Oxide	Manure N Amendments	Kg N2O-N/Kg N volatilized	2000 IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, Chapter 4: Agriculture, Table 4.18,p. 4.73
Indirect Emission Factor for Volatilized N	EFv	Soil Nitrous Oxide	Manure N in Pasture/Range/Paddock	Kg N2O-N/Kg N volatilized	2000 IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, Chapter 4: Agriculture, Table 4.18,p. 4.73
Indirect Emission Factor for Volatilized N	EFv	Soil Nitrous Oxide	Sewage Sludge	Kg N2O-N/Kg N volatilized	2000 IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, Chapter 4: Agriculture, Table 4.18,p. 4.73
Indirect Emission Factor for Volatilized N	EFv	Soil Nitrous Oxide	Synthetic N Fertilizer	Kg N2O-N/Kg N volatilized	2000 IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, Chapter 4: Agriculture, Table 4.18,p. 4.73
CH4 Emission Ratio	ER(CH4)	Biomass Burning	Agroforestry	tonnes CH4-C/tonnes C	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, Table 4-16,page 4.84 and 2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3A.1.15,p. 3.185
CH4 Emission Ratio	ER(CH4)	Biomass Burning	Cropland Residue	tonnes CH4-C/tonnes C	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, Table 4-16,page 4.84 and 2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3A.1.15,p. 3.185
CH4 Emission Ratio	ER(CH4)	Biomass Burning	Deforestation	tonnes CH4-C/tonnes	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, Table 4-16,page 4.84 and 2003 IPCC Good Practice Guidance for Land Use, Land-Use

				C	Change and Forestry, Table 3A.1.15,p. 3.185
CH4 Emission Ratio	ER(CH4)	Biomass Burning	Forestland	tonnes CH4-C/tonnes C	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, Table 4-16,page 4.84 and 2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3A.1.15,p. 3.185
CH4 Emission Ratio	ER(CH4)	Biomass Burning	Perennial Cropland	tonnes CH4-C/tonnes C	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, Table 4-16,page 4.84 and 2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3A.1.15,p. 3.185
CH4 Emission Ratio	ER(CH4)	Biomass Burning	Settlements	tonnes CH4-C/tonnes C	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, Table 4-16,page 4.84 and 2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3A.1.15,p. 3.185
CH4 Emission Ratio	ER(CH4)	Biomass Burning	Shifting Cultivation	tonnes CH4-C/tonnes C	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, Table 4-16,page 4.84 and 2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3A.1.15,p. 3.185
CH4 Emission Ratio	ER(CH4)	Biomass Burning	Silvipasture	tonnes CH4-C/tonnes C	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, Table 4-16,page 4.84 and 2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3A.1.15,p. 3.185
CO Emission Ratio	ER(CO)	Biomass Burning	Agroforestry	tonnes CO-C/tonnes C	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3A.1.15,p. 3.185
CO Emission Ratio	ER(CO)	Biomass Burning	Cropland Residue	tonnes CO-C/tonnes C	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3A.1.15,p. 3.185
CO Emission Ratio	ER(CO)	Biomass Burning	Deforestation	tonnes CO-C/tonnes	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3A.1.15,p. 3.185

				C	
CO Emission Ratio	ER(CO)	Biomass Burning	Forestland	tonnes CO-C/tonnes C	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3A.1.15,p. 3.185
CO Emission Ratio	ER(CO)	Biomass Burning	Perennial Cropland	tonnes CO-C/tonnes C	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3A.1.15,p. 3.185
CO Emission Ratio	ER(CO)	Biomass Burning	Settlements	tonnes CO-C/tonnes C	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3A.1.15,p. 3.185
CO Emission Ratio	ER(CO)	Biomass Burning	Shifting Cultivation	tonnes CO-C/tonnes C	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3A.1.15,p. 3.185
CO Emission Ratio	ER(CO)	Biomass Burning	Silvipasture	tonnes CO-C/tonnes C	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3A.1.15,p. 3.185
N2O Emission Ratio	ER(N2O)	Biomass Burning	Agroforestry	tonnes N2O-N/tonnes N	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3A.1.15,p. 3.185 Verchote, L, M. Thiongo, E. Anyango, P. Mutuo and S. Abwanda. 2010. Field and Laboratory Protocols, Non-CO2 GHG measurements: Inorganic-N measurements, Soil water content measurement. Center for International Forestry Research. http://www.cifor.org
N2O Emission Ratio	ER(N2O)	Biomass Burning	Cropland Residue	tonnes N2O-N/tonnes N	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3A.1.15,p. 3.185 Verchote, L, M. Thiongo, E. Anyango, P. Mutuo and S. Abwanda. 2010. Field and Laboratory Protocols, Non-CO2 GHG measurements: Inorganic-N measurements, Soil water content measurement. Center for International Forestry Research. http://www.cifor.org
N2O Emission	ER(N2O)	Biomass	Deforestatio	tonnes	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3A.1.15,p. 3.185

Ratio		Burning	n	N2O-N/tonnes N	Verchote, L, M. Thiongo, E. Anyango, P. Mutuo and S. Abwanda. 2010. Field and Laboratory Protocols, Non-CO2 GHG measurements: Inorganic-N measurements, Soil water content measurement. Center for International Forestry Research. http://www.cifor.org
N2O Emission Ratio	ER(N2O)	Biomass Burning	Forestland	tonnes N2O-N/tonnes N	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3A.1.15,p. 3.185 Verchote, L, M. Thiongo, E. Anyango, P. Mutuo and S. Abwanda. 2010. Field and Laboratory Protocols, Non-CO2 GHG measurements: Inorganic-N measurements, Soil water content measurement. Center for International Forestry Research. http://www.cifor.org
N2O Emission Ratio	ER(N2O)	Biomass Burning	Perennial Cropland	tonnes N2O-N/tonnes N	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3A.1.15,p. 3.185 Verchote, L, M. Thiongo, E. Anyango, P. Mutuo and S. Abwanda. 2010. Field and Laboratory Protocols, Non-CO2 GHG measurements: Inorganic-N measurements, Soil water content measurement. Center for International Forestry Research. http://www.cifor.org
N2O Emission Ratio	ER(N2O)	Biomass Burning	Settlements	tonnes N2O-N/tonnes N	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3A.1.15,p. 3.185 Verchote, L, M. Thiongo, E. Anyango, P. Mutuo and S. Abwanda. 2010. Field and Laboratory Protocols, Non-CO2 GHG measurements: Inorganic-N measurements, Soil water content measurement. Center for International Forestry Research. http://www.cifor.org
N2O Emission Ratio	ER(N2O)	Biomass Burning	Shifting Cultivation	tonnes N2O-N/tonnes N	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3A.1.15,p. 3.185 Verchote, L, M. Thiongo, E. Anyango, P. Mutuo and S. Abwanda. 2010. Field and Laboratory Protocols, Non-CO2 GHG measurements: Inorganic-N measurements, Soil water content measurement. Center for International Forestry Research. http://www.cifor.org
N2O Emission Ratio	ER(N2O)	Biomass Burning	Silvipasture	tonnes N2O-N/tonnes N	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3A.1.15,p. 3.185 Verchote, L, M. Thiongo, E. Anyango, P. Mutuo and S. Abwanda. 2010. Field and Laboratory Protocols, Non-CO2 GHG measurements: Inorganic-N measurements, Soil water content measurement. Center for International Forestry Research. http://www.cifor.org
NOx Emission Ratio	ER(NOx)	Biomass Burning	Agroforestry	tonnes NOx-N/tonnes N	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3A.1.15,p. 3.185
NOx Emission	ER(NOx)	Biomass	Cropland	tonnes NOx-	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3A.1.15,p. 3.185

Ratio		Burning	Residue	N/tonnes N	
NOx Emission Ratio	ER(NOx)	Biomass Burning	Deforestation	tonnes NOx-N/tonnes N	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3A.1.15,p. 3.185
NOx Emission Ratio	ER(NOx)	Biomass Burning	Forestland	tonnes NOx-N/tonnes N	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3A.1.15,p. 3.185
NOx Emission Ratio	ER(NOx)	Biomass Burning	Perennial Cropland	tonnes NOx-N/tonnes N	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3A.1.15,p. 3.185
NOx Emission Ratio	ER(NOx)	Biomass Burning	Settlements	tonnes NOx-N/tonnes N	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3A.1.15,p. 3.185
NOx Emission Ratio	ER(NOx)	Biomass Burning	Shifting Cultivation	tonnes NOx-N/tonnes N	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3A.1.15,p. 3.185
NOx Emission Ratio	ER(NOx)	Biomass Burning	Silvipasture	tonnes NOx-N/tonnes N	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3A.1.15,p. 3.185
CH4 Emission Ratio for Dead Biomass	ERd(CH4)	Biomass Burning	Grassland/Savanna	tonnes CH4-C/tonnes C	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, Table 4-15 p. 4.80
CO Emission Ratio for	ERd(CO)	Biomass	Grassland/S	tonnes CO-	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change

Dead Biomass		Burning	avanna	C/tonnes C	and Forestry, Table 4-15 p. 4.80
N2O Emission Ratio for Dead Biomass	ERd(N2O)	Biomass Burning	Grassland/Savanna	tonnes N2O-N/tonnes N	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, Table 4-15 p. 4.80 Verchote, L, M. Thiongo, E. Anyango, P. Mutuo and S. Abwanda. 2010. Field and Laboratory Protocols, Non-CO2 GHG measurements: Inorganic-N measurements, Soil water content measurement. Center for International Forestry Research. http://www.cifor.org
NOx Emission Ratio for Dead Biomass	ERd(NOx)	Biomass Burning	Grassland/Savanna	tonnes NOx-N/tonnes N	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, Table 4-15 p. 4.80
CH4 Emission Ratio for Live Biomass	ERl(CH4)	Biomass Burning	Grassland/Savanna	tonnes CH4-C/tonnes C	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, Table 4-15 p. 4.80
CO Emission Ratio for Live Biomass	ERl(CO)	Biomass Burning	Grassland/Savanna	tonnes CO-C/tonnes C	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, Table 4-15 p. 4.80
N2O Emission Ratio for Live Biomass	ERl(N2O)	Biomass Burning	Grassland/Savanna	tonnes N2O-N/tonnes N	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, Table 4-15 p. 4.80 Verchote, L, M. Thiongo, E. Anyango, P. Mutuo and S. Abwanda. 2010. Field and Laboratory Protocols, Non-CO2 GHG measurements: Inorganic-N measurements, Soil water content measurement. Center for International Forestry Research. http://www.cifor.org
NOx Emission Ratio for Live Biomass	ERl(NOx)	Biomass Burning	Grassland/Savanna	tonnes NOx-N/tonnes N	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, Table 4-15 p. 4.80
Fraction Actually Burned	FB	Biomass Burning	Grassland/Savanna	unitless	Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Carbon in Trees Outside Forests. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu

					Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 16, p. 217 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p. 237 Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, p. 4.79 Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, p. 4.79
Biomass Fraction Left After Harvest	Fbl	Biomass C Stocks	Timber Harvest and Fuelwood Gathering	fraction	Default Biomass Fraction Left after Disturbance
Input Factor	Fi	Soil C Stocks	Mineral Soils	unitless	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 5.5 p. 5.18 and Table 6.2 p. 6.16
Fraction Live Biomass	Fl	Biomass Burning	Grassland/Savanna	unitless	Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Carbon in Trees Outside Forests. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 7.2, p. 18 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p. 237

					Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, Table 4-14 p. 4.76. Midpoint in range given Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, Table 4-14 p. 4.76. Midpoint in range given.
Land Use Factor	Flu	Soil C Stocks	Mineral Soils	unitless	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 5.5 p. 5.17 (cropland)
Management Factor	Fmg	Soil C Stocks	Mineral Soils	unitless	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 5.5 p. 5.17
Fraction of Fertilizer N Leached/Run off	FNlr	Soil Nitrous Oxide	Synthetic N Fertilizer	Kg N leached and runoff/Kg N	2000 IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, Chapter 4: Agriculture, p. 4.74
Fraction of Manure N Leached/Run off	FNlr	Soil Nitrous Oxide	Manure N Amendments	Kg N leached and runoff/Kg N	2000 IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, Chapter 4: Agriculture, p. 4.74
Fraction of Manure N Leached/Run off	FNlr	Soil Nitrous Oxide	Manure N in Pasture/Range/Paddock	Kg N leached and runoff/Kg N	2000 IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, Chapter 4: Agriculture, p. 4.74
Fraction of Sewage N Leached/Run off	FNlr	Soil Nitrous Oxide	Sewage Sludge	Kg N leached and runoff/Kg N	2000 IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, Chapter 4: Agriculture, p. 4.74
Fraction of Fertilizer N Volatilized	FNv	Soil Nitrous Oxide	Synthetic N Fertilizer	Kg N volatilized /Kg N	2000 IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, Chapter 4: Agriculture, p. 4.74

Fraction of Manure N Volatilized	FNv	Soil Nitrous Oxide	Manure N Amendments	Kg N volatilized /Kg N	2000 IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, Chapter 4: Agriculture, p. 4.74
Fraction of Manure N Volatilized	FNv	Soil Nitrous Oxide	Manure N in Pasture/Range/Paddock	Kg N volatilized /Kg N	2000 IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, Chapter 4: Agriculture, p. 4.74
Fraction of Sewage N Volatilized	FNv	Soil Nitrous Oxide	Sewage Sludge	Kg N volatilized /Kg N	2000 IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, Chapter 4: Agriculture, p. 4.74
Fraction of Dead Biomass Oxidized	FOd	Biomass Burning	Grassland/Savanna	unitless	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, p. 4.79.
Fraction of Live Biomass Oxidized	FOl	Biomass Burning	Grassland/Savanna	unitless	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, p. 4.79.
Woody Biomass C Growth Rate	G	Biomass C Stocks	Agroforestry	tonnes C/ha/yr	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry. Table 3.3.2, p. 3.71 Forest Carbon Measurement Guidelines, Module 1 of 5: Guidelines for Ex Ante Forest Carbon Calculations. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Carbon in Trees Outside Forests. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 8.3, p. 26 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 16, p. 217

					Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p. 237
Woody Biomass C Growth Rate	G	Biomass C Stocks	Perennial Cropland	tonnes C/ha/yr	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry. Table 3.3.2, p. 3.71 Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 8.3, p. 26 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 16, p. 217 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p. 237
Woody Biomass C Growth Rate	G	Biomass C Stocks	Silvipasture	tonnes C/ha/yr	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry. Table 3.3.2, p. 3.71 Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 8.3, p. 26 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 16, p. 217 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p. 237
CH4 Emission Factor for	Gef(CH4)	Biomass Burning	Agroforestry	g kg-1 dry matter	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.

Burning				burnt	
CH4 Emission Factor for Burning	Gef(CH4)	Biomass Burning	Cropland Residue	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
CH4 Emission Factor for Burning	Gef(CH4)	Biomass Burning	Deforestation	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
CH4 Emission Factor for Burning	Gef(CH4)	Biomass Burning	Forestland	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
CH4 Emission Factor for Burning	Gef(CH4)	Biomass Burning	Grassland/Savanna	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
CH4 Emission Factor for Burning	Gef(CH4)	Biomass Burning	Perennial Cropland	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
CH4 Emission Factor for Burning	Gef(CH4)	Biomass Burning	Settlements	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
CH4 Emission Factor for Burning	Gef(CH4)	Biomass Burning	Shifting Cultivation	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
CH4 Emission Factor for Burning	Gef(CH4)	Biomass Burning	Silvipasture	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
CO Emission Factor for Burning	Gef(CO)	Biomass Burning	Agroforestry	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
CO Emission Factor for	Gef(CO)	Biomass Burning	Cropland Residue	g kg-1 dry matter	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.

Burning				burnt	
CO Emission Factor for Burning	Gef(CO)	Biomass Burning	Deforestation	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
CO Emission Factor for Burning	Gef(CO)	Biomass Burning	Forestland	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
CO Emission Factor for Burning	Gef(CO)	Biomass Burning	Grassland/Savanna	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
CO Emission Factor for Burning	Gef(CO)	Biomass Burning	Perennial Cropland	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
CO Emission Factor for Burning	Gef(CO)	Biomass Burning	Settlements	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
CO Emission Factor for Burning	Gef(CO)	Biomass Burning	Shifting Cultivation	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
CO Emission Factor for Burning	Gef(CO)	Biomass Burning	Silvipasture	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
CO2 Emission Factor for Burning	Gef(CO2)	Biomass Burning	Agroforestry	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
CO2 Emission Factor for Burning	Gef(CO2)	Biomass Burning	Cropland Residue	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
CO2 Emission Factor for	Gef(CO2)	Biomass Burning	Deforestation	g kg-1 dry matter	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.

Burning				burnt	
CO2 Emission Factor for Burning	Gef(CO2)	Biomass Burning	Forestland	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
CO2 Emission Factor for Burning	Gef(CO2)	Biomass Burning	Grassland/Savanna	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
CO2 Emission Factor for Burning	Gef(CO2)	Biomass Burning	Perennial Cropland	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
CO2 Emission Factor for Burning	Gef(CO2)	Biomass Burning	Settlements	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
CO2 Emission Factor for Burning	Gef(CO2)	Biomass Burning	Shifting Cultivation	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
CO2 Emission Factor for Burning	Gef(CO2)	Biomass Burning	Silvipasture	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
N2O Emission Factor for Burning	Gef(N2O)	Biomass Burning	Agroforestry	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
N2O Emission Factor for Burning	Gef(N2O)	Biomass Burning	Cropland Residue	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47 Verchote, L, M. Thiongo, E. Anyango, P. Mutuo and S. Abwanda. 2010. Field and Laboratory Protocols, Non-CO2 GHG measurements: Inorganic-N measurements, Soil water content measurement. Center for International Forestry Research. http://www.cifor.org
N2O Emission Factor for Burning	Gef(N2O)	Biomass Burning	Deforestation	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47 Verchote, L, M. Thiongo, E. Anyango, P. Mutuo and S. Abwanda. 2010. Field and Laboratory Protocols,

					Non-CO2 GHG measurements: Inorganic-N measurements, Soil water content measurement. Center for International Forestry Research. http://www.cifor.org
N2O Emission Factor for Burning	Gef(N2O)	Biomass Burning	Forestland	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47 Verchote, L, M. Thiongo, E. Anyango, P. Mutuo and S. Abwanda. 2010. Field and Laboratory Protocols, Non-CO2 GHG measurements: Inorganic-N measurements, Soil water content measurement. Center for International Forestry Research. http://www.cifor.org
N2O Emission Factor for Burning	Gef(N2O)	Biomass Burning	Grassland/Savanna	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47 Verchote, L, M. Thiongo, E. Anyango, P. Mutuo and S. Abwanda. 2010. Field and Laboratory Protocols, Non-CO2 GHG measurements: Inorganic-N measurements, Soil water content measurement. Center for International Forestry Research. http://www.cifor.org
N2O Emission Factor for Burning	Gef(N2O)	Biomass Burning	Perennial Cropland	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47 Verchote, L, M. Thiongo, E. Anyango, P. Mutuo and S. Abwanda. 2010. Field and Laboratory Protocols, Non-CO2 GHG measurements: Inorganic-N measurements, Soil water content measurement. Center for International Forestry Research. http://www.cifor.org
N2O Emission Factor for Burning	Gef(N2O)	Biomass Burning	Settlements	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47 Verchote, L, M. Thiongo, E. Anyango, P. Mutuo and S. Abwanda. 2010. Field and Laboratory Protocols, Non-CO2 GHG measurements: Inorganic-N measurements, Soil water content measurement. Center for International Forestry Research. http://www.cifor.org
N2O Emission Factor for Burning	Gef(N2O)	Biomass Burning	Shifting Cultivation	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47 Verchote, L, M. Thiongo, E. Anyango, P. Mutuo and S. Abwanda. 2010. Field and Laboratory Protocols, Non-CO2 GHG measurements: Inorganic-N measurements, Soil water content measurement. Center for International Forestry Research. http://www.cifor.org
N2O Emission Factor for	Gef(N2O)	Biomass Burning	Silvipasture	g kg-1 dry matter	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47

Burning				burnt	Verchote, L, M. Thiongo, E. Anyango, P. Mutuo and S. Abwanda. 2010. Field and Laboratory Protocols, Non-CO2 GHG measurements: Inorganic-N measurements, Soil water content measurement. Center for International Forestry Research. http://www.cifor.org
NOx Emission Factor for Burning	Gef(NOx)	Biomass Burning	Agroforestry	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
NOx Emission Factor for Burning	Gef(NOx)	Biomass Burning	Cropland Residue	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
NOx Emission Factor for Burning	Gef(NOx)	Biomass Burning	Deforestation	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
NOx Emission Factor for Burning	Gef(NOx)	Biomass Burning	Forestland	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
NOx Emission Factor for Burning	Gef(NOx)	Biomass Burning	Grassland/Savanna	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
NOx Emission Factor for Burning	Gef(NOx)	Biomass Burning	Perennial Cropland	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
NOx Emission Factor for Burning	Gef(NOx)	Biomass Burning	Settlements	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
NOx Emission Factor for Burning	Gef(NOx)	Biomass Burning	Shifting Cultivation	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.
NOx Emission Factor for Burning	Gef(NOx)	Biomass Burning	Silvipasture	g kg-1 dry matter burnt	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.5, p. 2.47.

Aboveground Biomass Growth Increment	Gw	Biomass C Stocks	Forestland	tonnes dm/ha/yr	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 4.5,p. 4.50 Forest Carbon Measurement Guidelines, Module 1 of 5: Guidelines for Ex Ante Forest Carbon Calculations. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Forest Carbon for Afforestation and Reforestation Projects. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 8.3, p. 26 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 16, p. 217 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p. 237
Aboveground Biomass C Stock	L	Biomass C Stocks	Silvipasture	tonnes C/ha	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry. Table 3.3.2, p. 3.71 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 5. p. 5.9 Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 7.2, p. 18 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p.

					237
Woody Biomass C Loss Rate	L	Biomass C Stocks	Agroforestry	tonnes C/ha	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry. Table 3.3.2, p. 3.71 Forest Carbon Measurement Guidelines, Module 1 of 5: Guidelines for Ex Ante Forest Carbon Calculations. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Carbon in Trees Outside Forests. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 8.3, p. 26 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 16, p. 217
Woody Biomass C Loss Rate	L	Biomass C Stocks	Perennial Cropland	tonnes C/ha	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry. Table 3.3.2, p. 3.71 Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 8.3, p. 26 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 16, p. 217
Woody Biomass C Loss Rate	L	Biomass C Stocks	Settlements	tonnes C/ha	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry. Table 3.3.2, p. 3.71 Forest Carbon Measurement Guidelines, Module 1 of 5: Guidelines for Ex Ante Forest Carbon Calculations. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu

					Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Carbon in Trees Outside Forests. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 8.3, p. 26 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 16, p. 217
Mass of Fuel	MF	Biomass Burning	Deforestation	tonnes dm/ha	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.4,p. 2.45 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p. 237
Mass of Fuel	MF	Biomass Burning	Forestland	tonnes dm/ha	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.4,p. 2.45 Forest Carbon Measurement Guidelines, Module 1 of 5: Guidelines for Ex Ante Forest Carbon Calculations. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Forest Carbon for Afforestation and Reforestation Projects. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113

					Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p. 237
Mass of Fuel	MF	Biomass Burning	Shifting Cultivation	tonnes dm/ha	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 2.4,p. 2.45 Forest Carbon Measurement Guidelines, Module 1 of 5: Guidelines for Ex Ante Forest Carbon Calculations. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Forest Carbon for Afforestation and Reforestation Projects. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p. 237
Nitrogen Excretion Rate Adjustment Factor	Nadj	Soil Nitrous Oxide	Manure N Amendments	unitless	2000 IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, Chapter 4: Agriculture, Table 4.14, p. 4.45
Nitrogen Excretion Rate Adjustment Factor	Nadj	Soil Nitrous Oxide	Manure N in Pasture/Range/Paddock	unitless	2000 IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, Chapter 4: Agriculture, Table 4.14, p. 4.45
N/C Ratio	NC	Biomass Burning	Cropland Residue	tonnes N/tonnes C	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, p. 3.50 2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, p. 3.50
N/C Ratio	NC	Soil	Cropland	tonnes	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, p. 3.50

		Nitrous Oxide	Residue	N/tonnes C	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, p. 3.50
N/C Ratio of Dead Biomass	NCd	Biomass Burning	Grassland/Savanna	tonnes N/tonnes C	Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Carbon in Trees Outside Forests. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, p. 4.80 Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, p. 4.80
N/C Ratio of Live Biomass	NCl	Biomass Burning	Grassland/Savanna	tonnes N/tonnes C	Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Carbon in Trees Outside Forests. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, p. 4.80 Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, p. 4.80
Nitrogen Excretion Rate	Nex	Soil Nitrous Oxide	Manure N Amendments	kg N per animal per year	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, Table 4-20,page 4.99
Nitrogen Excretion Rate	Nex	Soil Nitrous Oxide	Manure N in Pasture/Range/Paddock	kg N per animal per year	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, Table 4-20,page 4.99
Oxidation Rate for Residue	OR	Biomass Burning	Cropland Residue	unitless	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3): Land Use Change and Forestry, page 4.83
Root:Shoot Ratio	R	Biomass C Stocks	Deforestation	unitless	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry: Table 3.4.3, p. 3.109-3.110 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 4.4,p. 4.49

					Forest Carbon Measurement Guidelines, Module 1 of 5: Guidelines for Ex Ante Forest Carbon Calculations. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Forest Carbon for Afforestation and Reforestation Projects. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 8.2, p. 25 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 11, p. 149
Root:Shoot Ratio	R	Biomass C Stocks	Forestland	unitless	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry: Table 3.4.3, p. 3.109-3.110 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 4.4,p. 4.49 Forest Carbon Measurement Guidelines, Module 1 of 5: Guidelines for Ex Ante Forest Carbon Calculations. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Forest Carbon for Afforestation and Reforestation Projects. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 8.2, p. 25 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 11, p. 149
Root:Shoot Ratio	R	Biomass C Stocks	Shifting Cultivation	unitless	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry: Table 3.4.3, p. 3.109-3.110 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and

					Other Land Use, Table 4.4,p. 4.49 Forest Carbon Measurement Guidelines, Module 1 of 5: Guidelines for Ex Ante Forest Carbon Calculations. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Forest Carbon for Afforestation and Reforestation Projects. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 8.2, p. 25 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 11, p. 149
residue to yield ratio	RYR	Biomass Burning	Cropland Residue	unitless	2000 IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, Chapter 4: Agriculture, Chapter 4: Agriculture, p. 4.58.
residue to yield ratio	RYR	Soil Nitrous Oxide	Cropland Residue	unitless	2000 IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, Chapter 4: Agriculture, Chapter 4: Agriculture, p. 4.58.
Reference Soil Carbon Stock	SOCref	Soil C Stocks	Mineral Soils	tonnes C/ha	2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use,vol.4,Table 2.3 p. 2.31 A Protocol for Measurement and Monitoring Soil Carbon Stocks in Agricultural Landscapes. 2011. World Agroforestry Centre (ICRAF), The Earth Institute, Columbia University (EI). Http://www.worldagroforestry.org Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Carbon in Trees Outside Forests. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 7.6, p. 22
Time Dependency	T	Soil C Stocks	Mineral Soils	yr	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, p. 3.41,p. 3.74,p. 3.112,p. 3.146

Factor					A Protocol for Measurement and Monitoring Soil Carbon Stocks in Agricultural Landscapes. 2011. World Agroforestry Centre (ICRAF), The Earth Institute, Columbia University (EI). Http://www.worldagroforestry.org
Aboveground Biomass C Stock	BC	Biomass Burning	Agroforestry	tonnes C/ha	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry. Table 3.3.2, p. 3.71 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 5. p. 5.9 Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 7.2, p. 18 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p. 237
Aboveground Biomass C Stock	BC	Biomass Burning	Perennial Cropland	tonnes C/ha	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry. Table 3.3.2, p. 3.71 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 5. p. 5.9 Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 7.2, p. 18 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p. 237
Aboveground Biomass C Stock	BC	Biomass Burning	Settlements	tonnes C/ha	2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry. Table 3.3.2, p. 3.71 Forest Carbon Measurement Guidelines, Module 1 of 5: Guidelines for Ex Ante Forest Carbon Calculations. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu

					Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Carbon in Trees Outside Forests. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 7.2, p. 18 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p. 237 2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry. Table 3.3.2, p. 3.71 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4): Agriculture, Forestry and Other Land Use, Table 5. p. 5.9 Pearson, T.R.H., S. Brown and N.H. Ravindranath. 2005. Integrating Carbon Benefit Estimates into GEF Projects. Winrock International, Arlington, Virginia, USA. http://www.winrock.org. Chapter 7.2, p. 18 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 10, p. 113 Ravindranath, N.H. & Ostwald, M. 2008. Carbon inventory methods. Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects. Netherlands, Springer Chapter 17, p. 237

Part 2: Linking Measurement and Monitoring with the CBP Detailed Assessment

How Project-based or Regional Measurements are used

As explained in Part 1, the main purpose for collecting project-based measurements is to allow one to utilize factor data that are specific to one's project or region, and to reduce the uncertainty of the data used to drive the IPCC greenhouse gas flux models. Users may enter the data for their project into the CBP Detailed Assessment via the *Emission Factors* page associated with each land use category.

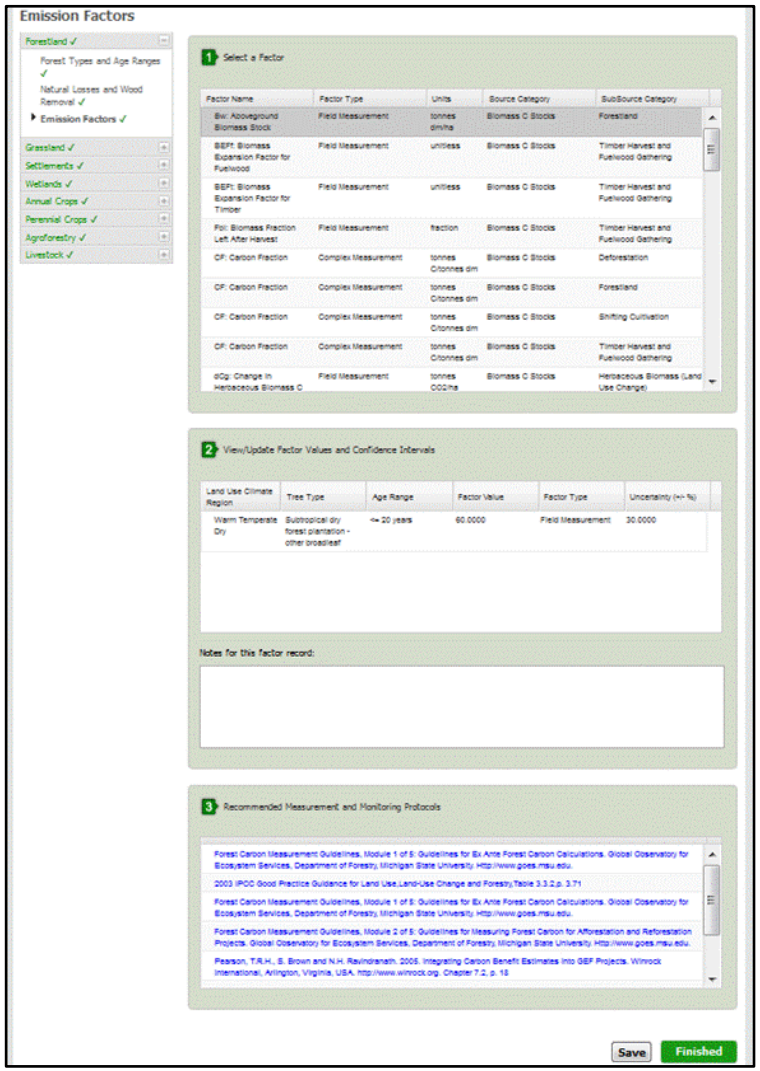

Figure 1. The Emission Factors page in the CBP Detailed Assessment.

Figure 1 shows a screen shot of the Emission Factors page, shown for forestland. There are three sections on the page the user should understand in order to use the tool effectively:

- Step Box 1 shows the list of all of the equation factors associated with Forestland in the IPCC calculations. By clicking on any factor (Bw: Aboveground Biomass Stock in this case) the tool will locate all of the equation factor information associated with activity data the user has entered for Forestland, which is shown in Step Box 2. It will also locate the applicable measurement and monitoring references associated with this factor, and prepare a list of them in Step Box 3.

- Step Box 2 shows a list of all records for the equation factor selected in Step Box 1. The list is filtered to only show the equation factors for activity data utilized in the project's activity data. For example, there are hundreds of records in the database for different forest type categories, however in this case the user has specified only one forest type (Subtropical dry forest plantation – other broadleaf). Therefore only the factor records associated with that forest type in the user's climate region will be shown. The user may modify the value and/or the uncertainty for this record based on the results of their measurement and monitoring program. Additionally, it is considered *Good Practice* for the user to document any changes made to the factor values or uncertainty. This can be done in the section labeled "Notes for this factor record" immediately below Step Box 2.

- Step Box 3 shows a list of factor references that may support the user's measurement and monitoring program. It includes a link to the primary IPCC factor reference, along with protocols the user may use to support his or her Measurement and Monitoring program. Clicking on any of these references will bring up that document in a new tab on the user's browser.

The Emission Factors page is identical across all 8 of the land use categories (Forestland, Grassland, Settlements, etc.) however the list of factors shown Step Box 1 in each land use category is different. The list of factors shown is specific to the land use category.

Changes made in the equation factor values and uncertainty will be used the next time the user runs the calculations for this project. After changing a factor value, the user should not generate a new report until he or she reruns the calculations for their project.