Joint Crediting Mechanism Approved Methodology PH_AM005
“Enhancing carbon removals through afforestation/reforestation”

A. Title of the methodology

Enhancing carbon removals through afforestation/reforestation, Version 1.0

B. Terms and definitions

Terms	Definitions
Forest	Land spanning more than 0.5 hectares with trees higher than 5 meters and with a canopy cover of more than 10 percent, or trees that are able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use.
Non-forest	An area which does not meet the definition of forest.
Afforestation/Reforestation	Activities to convert from non-forest to forest through planting, sowing and human-assisted natural regeneration of woody vegetation.
Soil disturbance	Human activities (e.g. tilling, cultivating) that release organic carbon from the soil into the atmosphere.
Wetland	Wetlands include land that is covered or saturated by water for all or part of the year.

C. Summary of the methodology

Items	Summary
Project activities (emission reduction or removal enhancement measures)	Activities to enhance carbon removal in tree biomass by converting non-forest to forest through direct planting and assisted natural regeneration.
Establishment of project reference level	The project reference level is determined by estimating the carbon stock in biomass that is present in the project area prior to the start of the project. It is adjusted to take uncertainties into consideration.

Calculation of project net emissions or removals	Project net removals are calculated by estimating net carbon stock change of tree biomass of planted or naturally regenerated trees over the monitoring period, from the project start or the last verification to the current verification. GHG emissions in the project area resulting from the implementation of project activity are monitored and accounted for. Displaced emissions and uncertainties are deducted to calculate net removals.
Monitoring parameters and methods	- Project area (Area converted from non-forest to forest) [ha]: monitored by remote sensing and/or ground survey. - Average tree biomass per hectare in the project scenario in year t [tdm/ha]: estimated using remote sensing and/or ground survey. - Average tree biomass per hectare in the project area before the start of the project [tdm/ha]: estimated using remote sensing and/or ground survey. - Average nontree biomass per hectare in the project area before the project start [tdm/ha]: estimated using remote sensing and/or ground survey. - Amount of synthetic fertilizer applied [kg]: monitored using project records. - Amount of organic fertilizer applied [kg]: monitored using project records. - Project area burnt [ha]: monitored using remote sensing and/or ground survey. - Amount of fossil fuel used: monitored using project records. Area of forest-to-non-forest conversion attributable to project-induced activity shifting and converted to land-cover class c during the k_{th} monitoring period [ha]: estimated using remote sensing. - Average carbon stock of tree biomass before the conversion [tC/ha]: determined using project-specific data, national data, peer-reviewed literature, or other scientific evidence. - Average carbon stock of the converted land-cover class c [tC/ha]: determined using project-specific data, national data, peer-reviewed literature, or other scientific evidence. - Ratio of the livestock activity expected to be displaced during

	the crediting period, potentially impacting tree biomass outside the project area [0 to 1]: This is determined by credible estimations or a representative survey. - Number of livestock expected to be displaced during the crediting period, potentially affecting tree biomass outside the project area [head]: This is determined by credible estimations or a representative survey. - Grazing capacity of the area where the livestock will be displaced to [ha/head]: This is determined by credible estimations or a representative survey.
Calculation of project emission reductions or removals to be credited	Project emission reductions or removals are calculated in a conservative manner. A buffer rate of at least 15%, as defined in the *JCM Guidelines for Developing Proposed Methodology for REDD-plus and afforestation/reforestation*, is applied to account for the reversal risk.

D. Eligibility criteria

This methodology is applicable to projects that satisfy all of the following criteria.

Criterion 1	Project area is neither forest nor wetland.
Criterion 2	The most likely scenario without the project does not show an increase in biomass in the project area. This criterion is demonstrated through observations showing that biomass in the project area has not increased during the past 10 years prior to the start of the project.
Criterion 3	Project area has not been cleared of forest within the 10-years period prior to the start date of the project.
Criterion 4	Project activity is not mandated by law nor legal requirements.
Criterion 5	Project activity does not involve site preparation techniques (e.g. digging, stump removal) that cause soil disturbance.
Criterion 6	The project activity is to enhance carbon removals through plantation whose species are approved by the government of the Philippines to plant.
Criterion 7	Project applies silvicultural systems of conservation forests. Legal or illegal logging to supply commercial timber to regional, national or international timber markets is not carried out in the project area during the project period.

E. Geographical Boundaries

Geographical boundary	Required (Y/N/TBD)	Additional requirements / Remarks
Project area	Y	None
Reference area	N	This methodology does not require to set the reference area.
Activity area	N	None
Displacement belt	TBD	None

TBD: to be decided by the project proponent

F. Carbon pools and GHG sources

The net emission sources to be considered include all the following Carbon pools and GHG sources.

Project reference level			
Carbon pools and GHG sources		Included (Y/N)	Explanation
Carbon pools	Aboveground tree biomass	N	This pool would not have increased in the absence of the project. Conservatively excluded.
	Belowground tree biomass	N	This pool would not have increased in the absence of the project. Conservatively excluded.
	Aboveground non-tree biomass	N	This pool would not have increased in the absence of the project. Conservatively excluded.
	Belowground non-tree biomass	N	This pool would not have increased in the absence of the project. Conservatively excluded.
	Dead wood	N	This pool would have decreased in the absence of the project. Conservatively excluded.
	Litter	N	This pool would have decreased in the absence of the project. Conservatively excluded.

	Soil organic carbon	N	Soil disturbance is avoided in this methodology.
GHG sources	N/A.		N/A.
Project net emissions or removals			
Carbon pools and GHG sources		Included (Y/N)	Explanation
Carbon pools	Aboveground tree biomass	Y	Major carbon pool
	Belowground tree biomass	Y	Major carbon pool
	Aboveground non-tree biomass	N	Carbon stock may not increase due to the project activity. Conservatively excluded.
	Belowground non-tree biomass	N	Carbon stock may not increase due to the project activity. Conservatively excluded.
	Dead wood	N	Carbon stock may increase due to the project activity. Conservatively excluded.
	Litter	N	Carbon stock may increase due to the project activity. Conservatively excluded.
	Soil organic carbon	N	Carbon stock may increase due to the project activity. Conservatively excluded.
GHG sources	N_2O emissions from fertilizer application		Where nitrogen fertilizer is applied, N_2O emissions should be included.
	CH_4 and N_2O emissions from burning of biomass (natural cause)		Where natural biomass burning occurs, CH_4 and N_2O emissions may constitute significant sources of emissions. Decreases in carbon stock due to burning are accounted for as changes in tree biomass.
	CO_2 emissions from fossil fuel burning		Where fossil fuels are consumed by machines used for forest

		management and reforestation, such as site preparation, CO_2 emissions are included.

G. Establishment and calculation of project reference level

G.1. Establishment of project reference level

Approach for estimation of project reference level

Project reference level is established based on the historical data of carbon stock in the project area where trees are planted during the project period. Since the 'Eligibility Criterion 2' of this methodology requires that there is no increase of biomass in the project area without project activity, the project reference level is assumed to be zero. Carbon removals in the carbon pools of dead wood, litter and soil organic carbon may increase with the project activity and may be constant without the project activity. To ensure the conservativeness of the net carbon removal, these carbon removals are not accounted in either reference level or project net carbon removal. Project reference level is established based on the historical data of carbon stock in the project area where trees are planted during the project period. Since the 'Eligibility Criterion 2' of this methodology requires that there is no increase of biomass in the project area without project activity, the project reference level is assumed to be zero. Carbon removals in the carbon pools of dead wood, litter and soil organic carbon may increase with the project activity and may be constant without the project activity. To ensure the conservativeness of the net carbon removal, these carbon removals are not accounted in either reference level or project net carbon removal.

G.2. Calculation of project reference level

Since the 'Eligibility Criterion 2' of this methodology assumes no increase of biomass without project activity, the project reference level is zero.

H. Calculation of project net emissions or removals

Project net removals are calculated as follows. $CR_{PJ,t} = \sum_{k=1}^{K} \Delta C_{TREE_{PJ},t,k} - C_{LOST,t} - GHG_{BURN,t} - GHG_{FERT,t} - GHG_{FUEL,t} -$

$DE_{agri+wood,t,k} - DE_{livestock,t=1}$ (Equation 1)

Where:
$CR_{PJ,t}$= Project net removals in year t [tCO2eq]
$\Delta C_{TREE_{PJ},t,k}$= Carbon stock change in year t during k_{th} monitoring interval [tCO2eq]
$C_{LOST,t}$= Loss of carbon stock due to site preparation for tree planting in shrubland and grassland in year t [tCO2eq]
$GHG_{BURN,t}$= GHG emissions from biomass burning in year t [tCO2eq]
$GHG_{FERT,t}$= GHG emissions from fertilizer consumption in year t [tCO2eq]
$GHG_{FUEL,t}$= GHG emission from fossil fuel use in year t [tCO2eq]
$DE_{agri+wood,t,k}$= Displaced emissions from agriculture and wood collection [tCO2eq]
$DE_{livestock}$= Displaced emissions from livestock [tCO2eq]

t= Years during the crediting period 1,2,3…T
k= Monitoring period number for tree biomass during the project 1,2,3..K

< Carbon stock change in tree biomass >
Carbon stock change in tree biomass is estimated using the stock difference method which estimates the difference in carbon stocks at two points in time. Carbon stock at a given point in time is estimated using the stratified random sampling method. The number of sample plots required for estimation of biomass stocks is calculated using the A/R Methodology Tool "Calculation of the number of sample plots for measurements within A/R CDM project activities". For the ex-ante estimation of carbon stock change in tree biomass, annual change is estimated based on growth models conservatively representing the project activity.
Carbon stock change in tree biomass in year t is calculated as follows. Where monitoring intervals are longer than one-year, yearly amount of project net removals are calculated through annualization, dividing project net removals in the monitoring interval by the number of years of the monitoring interval.

$$\Delta C_{TREE_{PJ},t,k} = [\sum_{i=1}^{M} C_{TREE_{PJ},t,k,i} \times \left(1 - Unc_{PJ,t}\right) - \sum_{i=1}^{M} C_{TREE_{PJ},t-xk,i} \times \left(1 - Unc_{PJ,t-xk}\right)] \div x_k$$

(Equation 2)

Where:
$C_{TREE_{PJ},t,i}$= Carbon stock in tree biomass in stratum i in year t [tCO2eq]
x_k= Number of years of the monitoring interval in the k_{th} monitoring
$Unc_{PJ,t}$ =Uncertainty in cumulative removals through year t [0 to 1]

Carbon stock in tree biomass in year t is a sum of carbon stock in aboveground biomass and belowground biomass.

$$C_{TREE_{PJ},t,i} = C_{ABG_{PJ},t,i} + C_{BLG_{PJ},t,i} \quad \text{(Equation 3)}$$

Where:

$C_{ABG_{PJ},t,i} =$ Carbon stock in aboveground biomass in year t in stratum i [tCO2eq]

$C_{BLG_{PJ},t,i} =$ Carbon stock in belowground biomass in year t in stratum i [tCO2eq]

Carbon stock in aboveground biomass is converted from tree biomass.

$$C_{ABG_{PJ},t,i} = \frac{44}{12} \times CF_{TREE} \times B_{ABG,t,i} \times A_i \quad \text{(Equation 4)}$$

Where:

$\frac{44}{12} =$ Ratio of molecular weight of carbon dioxide to carbon

$CF_{TREE} =$ Carbon fraction of tree biomass on dry weight basis [tC/tdm]

$B_{ABG,t,i} =$ Aboveground tree biomass per hectare in year t in stratum i [tdm/ha]

$A_i =$ Project area of stratum i [ha]

Aboveground tree biomass per hectare is assessed using the allometric equation appropriate for the tree species.

Carbon stock in belowground biomass is estimated from aboveground biomass.

$$C_{BLG_{PJ},t} = C_{ABG_{PJ},t} \times R_{TREE} \quad \text{(Equation 5)}$$

Where:

$R_{TREE} =$ Root to shoot ratio of tree [0 to 1]

< Loss of carbon stock>

Loss of carbon stock due to site preparation for tree planting in shrubland and grassland is calculated as follows:

$$C_{LOST,t} = \sum_{i=1}^{M} (C_{TREE_{LOST},t,i} + C_{NONTREE_{LOST},t,i}) \times \left(1 + Unc_{LOST,t}\right) \quad \text{(Equation 6)}$$

Where:

$C_{LOST,t} =$ Loss of carbon stock from cuttings of herbaceous plants in grassland in year t [tCO2eq]

$C_{TREE\_LOST,t,i} =$ Carbon stock loss in tree biomass in stratum i in year t [tCO2eq]

$C_{NONTREE\_LOST,t,i} =$ Carbon stock loss in nontree biomass in stratum i in year t [tCO2eq]

$i =$ Stratum 1,2,3,…M

$Unc_{LOST,t}$= Carbon stock loss uncertainty in year t [0 to 1]

< Loss of carbon stock in tree biomass >

Carbon stock in tree biomass is estimated using a stratified random sampling method. The number of sample plots required for estimation of biomass stocks is calculated using the A/R Methodology Tool "Calculation of the number of sample plots for measurements within A/R CDM project activities".

$$C_{TREE\_LOST,t,i} = C_{ABG\_LOST,t,i} + C_{BLG\_LOST,t,i} \quad \text{(Equation 7)}$$

Where:

$C_{TREE\_LOST,t,i} =$ Total carbon stock loss in tree biomass in stratum i in year t [tCO2eq]
$C_{ABG\_LOST,t,i} =$ Carbon stock loss in aboveground biomass in stratum i in year t [tCO2eq]
$C_{BLG\_LOST,t,i} =$ Carbon stock loss in belowground biomass in stratum i in year t [tCO2eq]

$$C_{ABG\_LOST,t,i} = \frac{44}{12} \times CF_{TREE} \times B_{ABG_{LOST},t,i} \times A_{LOST,t,i} \quad \text{(Equation 8)}$$

Where:

$\frac{44}{12} =$ Ratio of molecular weight of carbon dioxide to carbon

$CF_{TREE} =$ Carbon fraction of tree biomass [tC/tdm]
$B_{ABG\_LOST,t,i} =$ Loss of aboveground tree biomass per hectare in stratum i in year t [tdm/ha]
$A_{LOST,t,i} =$ Area of stratum i where carbon stocks are lost in year t [ha]

Aboveground tree biomass per hectare is assessed using the allometric equation appropriate for the tree species. Allometric equations are sourced from peer-reviewed literature or other scientific evidence and should be specific to the species, genus or family within the ecoregion or Holdridge life zone in the region where the project is located. For project activities involving facilitated natural regeneration or with more than two species in a single stand, equation(s) are selected from the following as available, listed in descending order of preference: i) Equations specific to the forest type within the same ecoregion (defined at the biome level) or Holdridge life-zone as the region in which the project is located, or ii) Global equations specific to the forest type.

$$C_{BLG\_LOST,t,i} = C_{ABG\_LOST,t,i} \times R_{TREE} \quad \text{(Equation 9)}$$

Where:

$R_{TREE} =$ Root to shoot ratio of tree [0 to 1]

< Loss of carbon stock in nontree biomass>

Carbon stock in nontree biomass is estimated using a stratified random sampling method or estimated by using project-specific, regional, national or IPCC default values for each vegetation type.

$$C_{NONTREE\_LOST,t,i} = \frac{44}{12} \times CF_{NONTREE} \times B_{NONTREE\_LOST,t,i} \times A_{LOST,t,i} \quad \text{(Equation 10)}$$

Where:

$CF_{NONTREE} =$ Carbon fraction of nontree biomass [tC/tdm]

$B_{NONTREE\_LOST,t,i} =$ Nontree biomass loss per hectare in stratum i in year t [tdm/ha]

< Carbon stock loss uncertainty >

The carbon stock loss uncertainty is calculated by propagating the errors associated with the estimates of included pools as follows

$$Unc_{LOST,t} = MIN(1, MAX\left(0, \frac{\sqrt{\sum_{p=1}^{n} (U_p \times C_p)^2}}{\sum_{p=1}^{n} C_p} - 0.1\right)) \quad \text{(Equation 11)}$$

Where:

$Unc_{LOST,t}$= Carbon stock loss uncertainty at year t [0 to 1]

U_p= Uncertainty (expressed as 90 percent confidence interval as a fraction of the mean) in carbon stock estimate of pool p [0 to 1]

C_p = Carbon stock estimate of pool p [tCO2eq]

$p =$ Type of carbon pools (tree biomass or nontree biomass)

< GHG emissions from biomass burning >

$$GHG_{BURN,t} = \sum_{i=1}^{M} (B_{ABG\_BURN,t,i} \times A_{BURN,t,i} \times COMF) \times (GWP_{CH4} \times EF_{CH4} + GWP_{N2O} \times EF_{N2O}) \quad \text{(Equation 12)}$$

Where:

$GHG_{BURN,t}$ = Project emissions due to biomass burning in year t [tCO2eq]

$A_{BURN,t,i}$ = Area burned year t in stratum i [ha]

GWP_{CH4} = Global warming potential for CH4 [tCO2/tCH4]

EF_{CH4}= Emission factor for CH4 [t/tdm. burned]

GWP_{N2O} = Global warming potential for N2O [tCO2/tN2O]

EF_{N2O}= Emission factor for N2O [t/tdm. burned]

$B_{ABG\_BURN,t,i}$ = Average aboveground biomass stock per hectare subject to burning in year t in stratum i [tdm/ha]

$COMF$ = Combustion factor [0 to 1]

< N2O emissions from fertilizer applications >

N2O emissions from fertilizer applications are calculated as follows.

$$GHG_{FERT,t} = GHG_{Direct-N,t} + GHG_{Indirect-N,t} \quad \text{(Equation 13)}$$

Where:

$GHG_{Direct-N,t} =$ Direct N2O emissions from fertilizer use in year t [tCO2eq]

$GHG_{Indirect-N,t} =$ Indirect N2O emissions from fertilizer use in year t [tCO2eq]

$$GHG_{Direct-N,t} = \left(F_{Synth,t} + F_{Org,t}\right) \times EF_{Direct-N} \times \frac{44}{28} \times GWP_{N2O} \quad \text{(Equation 14)}$$

Where:

$F_{Synth,t}$ = Synthetic N fertilizer used in year t [tN]

$F_{Org,t}$ = Organic N fertilizer used in year t [tN]

$EF_{Direct-N} =$ Emission factor for N2O emission from N inputs by fertilizers [tN2O-N (tN-input)$^{-1}$]

$\frac{44}{28} =$ Ratio of molecular weight of N2O to N

$GWP_{N2O} =$ Global warming potential for N2O [tCO2/tN2O]

$$F_{Synth,t} = M_{Synth,t} \times NC_{Synth,t} \quad \text{(Equation 15)}$$

Where:

$F_{Synth,t}$ = Synthetic N fertilizer used in year t [tN]

$M_{Synth,t} =$ Mass of synthetic fertilizer used in year t [t]

$NC_{Synth,t}$ = N content of synthetic fertilizer used in year t [tN/t]

$$F_{Org,t} = M_{Org,t} \times NC_{Org,t} \quad \text{(Equation 16)}$$

Where:

$F_{Org,t}$ = Organic N fertilizer used in year t [tN]

$M_{Org,t} =$ Mass of organic fertilizer used in year t [t]

$NC_{Org,t}$ = N content of organic fertilizer used in year t [tN/t]

$$GHG_{Indirect-N,t} = Nfert_{volat,t} + Nfert_{leach,t} \quad \text{(Equation 17)}$$

Where:
$Nfert_{volat,t}$= Indirect N2O emissions produced from atmospheric deposition of N volatilized due to fertilizer use in year t [tCO2eq]
$Nfert_{leach,t}$= Indirect N2O emissions from leaching and runoff of N due to fertilizer use in year t [tCO2eq]

$$Nfert_{volat,t} = [(F_{Synth,t} \times Frac_{GASF}) + (F_{Org,t} \times Frac_{GASM})] \times EF_{NVolat} \times \frac{44}{28} \times GWP_{N20}$$

(Equation 18)

Where:
$Frac_{GASF}$= Fraction of all synthetic N added to soils that volatilizes as NH3 and NOx [0-1]
$Frac_{GASM}$= Fraction of all organic N added to soils that volatilizes as NH3 and NOx [0-1]
EF_{NVolat}= Emission factor for N2O emissions from atmospheric deposition of N on soils and water surfaces [tN2O-N (t NH3-N and NOX-N volatilized)$^{-1}$]

$$Nfert_{leach,t} = [(F_{Synth,t} + F_{Org,t}) \times Frac_{Leach})] \times EF_{NLeach} \times \frac{44}{28} \times GWP_{N20}$$ (Equation 19)

Where:
$Frac_{Leach}$= Fraction of synthetic or organic N added to soils that is lost through leaching and runoff, in regions where leaching and runoff occurs [0-1]
EF_{NLeach}= Emission factor for N2O emissions from leaching and runoff [tN2O-N (t leaching and runoff)$^{-1}$]

< GHG emission from fossil fuel use >

$$GHG_{FUEL,t} = \sum_j FC_{j,t} \times NCV_j \times EF_j$$ (Equation 20)

Where:
$FC_{j,t} =$ Quantity of fossil fuel use type i in year t [t]
$NCV_j =$ Net Calorific Value of fossil fuel use type j [TJ/t]
$EF_j =$ GHG emission from fossil fuel burning type j [tCO2eq/TJ]

< Displaced emissions >

Displaced emissions occur due to an activity shifting from inside of the project area to outside of the project area. Displaced emissions from activity shifting of collection of wood, agriculture, and livestock are considered. Displaced emissions are assessed by activity type as follows:

1. Collection of wood and agricultural activities: assessed using ex-post monitoring in displacement belt at each verification;
2. Livestock grazing: assessed using ex-ante estimation before the initial verification; ex-post monitoring is not required.

Activities demonstrated through pre-project assessment to be absent within the project area may be excluded from further displaced emissions assessment and monitoring. Displaced emissions through change in market is not considered where credible estimations or representative surveys demonstrate that the project area is not used for commercial production of fuelwood, agricultural commodities or livestock products prior to the project start.

[1. Displaced emissions from collection of wood and agriculture]

Displaced emissions from collection of wood and agriculture are assessed using a two-step approach.

Step 1: Screening of forest-to-non-forest conversion

For monitoring displaced emissions, a displacement belt is established. The displacement belt is defined as the area extending 3 km outward from and surrounding the project area boundary. The assessment of displaced emissions is based on observed forest-to-non-forest conversion resulting in a reduction of tree biomass. Forest-to-non-forest conversion is defined as a change from land classified as forest to any land classified as non-forest (e.g. brushland, grassland, cropland, bare land). Changes in herbaceous biomass are excluded because they are highly seasonal, reversible, and difficult to attribute to project-induced activity shifting. At each verification, forest-to-non-forest conversion within the displacement belt is assessed using remote sensing data by comparing forest cover at the beginning and the end of the monitoring period.

Where the forest-to-non-forest conversion area is not observed in the displacement belt, no additional investigation is required and displaced emissions from activity shifting is set to zero. If the additional investigation indicates that the forest-to-non-forest conversion is caused by activity shifting, displaced emissions is quantified in accordance with Step 2.

Step 2: Quantification of displaced emissions

For the forest-to-non-forest conversion area attributable to activity shifting, the post-conversion land-cover class is identified through additional investigation. Displaced emissions is calculated separately for each post-conversion land-cover class.

$$DE_{agri+wood,t,k} = \sum_c (A_{DE,c,k} \times \Delta C_{lost_{belt,c}} \times \frac{44}{12}) \quad \text{(Equation 21)}$$

Where:

$DE_{agri+wood,t,k}$= Displaced emissions from agriculture and wood collection accounted in year t, corresponding to the end year of the k_{th} monitoring period [tCO2eq]
$A_{DE,c,k}$ = Area of forest-to-non-forest conversion attributable to project-induced activity shifting and converted to land-cover class c during the k_{th} monitoring period [ha]
$\Delta C_{lost_{belt},c}$= Average tree biomass carbon stock loss caused by land-cover change of type c per hectare [tC/ha]
$c =$ Type of land-cover change (e.g. forest to brushland, forest to grassland)
The carbon stock loss is determined as the difference between the carbon stock of tree biomass before the conversion and that of the post-conversion land-cover class.

$$\Delta C_{lost_{belt,c}} = C_{pre} - C_{post,c} \quad \text{(Equation 22)}$$

Where:
$C_{pre,c}$= Average carbon stock of tree biomass before the conversion [tC/ha]
$C_{post,c}$= Average carbon stock of the converted land-cover class c [tC/ha]

Average carbon stock is determined using remote sensing, project-specific data, national data, peer-reviewed literature, or other scientific evidence. In the absence of reliable data, average carbon stock of the converted land-cover class c may be conservatively set to zero.

[2. Displaced emissions from livestock]
Displaced emissions resulting from activity shifting associated with livestock grazing are considered where such activity causes forest-to-non-forest conversion and reduction in tree biomass carbon stock. Displaced emissions from livestock are estimated ex-ante before the first verification and deducted in the first year (t=1) of the project period. Grazing capacity is determined by credible estimations or a representative survey.

$$DE_{livestock} = Displaced\ heads\ \times Grazing\ capacity\ \times C_{pre} \times \frac{44}{12} \quad \text{(Equation 23)}$$

Where:
$DE_{livestock}$ =Displaced emissions from livestock [tCO2eq]
$Displaced\ heads =$ Number of heads that will be displaced during the crediting period and will have impact on the tree biomass outside the project area [head].
$Grazing\ capacity =$ Grazing capacity of the area where the livestock will be displaced to [ha/head]
$C_{pre} =$ Average carbon stock of tree biomass before the conversion [tC/ha].

< Uncertainty in cumulative removals in year t>

$Unc_{PJ,t}$ is calculated by propagating the errors associated with the estimates of included pools as follows:

$$Unc_{PJ,t} = MIN\left(1, MAX\left(0, \frac{\sqrt{\sum_{p=1}^{n}(U_{p,t=0} \times C_{p,t=0})^2 + \sum_{p=1}^{n}(U_{p,t} \times C_{p,t})^2 - 2\rho \sum_{p=1}^{n}(U_{p,t=0} \times C_{p,t=0} \times U_{p,t} \times C_{p,t})}}{\Delta C_{biomass,t}} - 0.1\right)\right)$$

(Equation 24)

Where:

$Unc_{PJ,t}$ = Uncertainty in cumulative removals through year t [0 to 1]

$U_{p,t}$ = Uncertainty (expressed as the 90% confidence interval as a fraction of the mean) in carbon stock of pool p in year t [0 to 1]

$C_{p,t}$ = Carbon stock of pool p (tree biomass and non-tree biomass) in year t [tCO2eq]

p= Type of carbon pools, tree biomass and non-tree biomass

ρ=Correlation coefficient between carbon stocks at t=0 and t (used only for permanent plots; ρ=0 for independent plots)

$\Delta C_{biomass,t}$ = Change in carbon stock in biomass carbon pools in year t [tCO2eq]

I. Calculation of project emissions reductions or removals to be credited

$$C_{credit,t} = CR_{PJ,t} - C_{REF} \quad \text{(Equation 25)}$$

Where:

$C_{credit,t}$ = Amount of carbon credits to be issued in year t [tCO2eq]

$CR_{PJ,t}$ = Project net removals in year t [tCO2eq]

C_{REF} = Reference net GHG removals (=0) in year t [tCO2eq]

Project net removals to be credited are subject to a buffer rate of at least 15 %, as defined in the *JCM Guidelines for Developing Proposed Methodology for REDD-plus and afforestation/reforestation*, to account for reversal risk.

J. Data and parameters fixed *ex ante*

The source of each data and parameter fixed *ex ante* is listed as below.

Parameter	Description of data	Source
CF_{TREE}	Carbon fraction of tree biomass [tC/tdm]	Peer-reviewed literature, other scientific evidence or *the 2006 IPCC Guidelines*
R_{TREE}	Root to shoot ratio of tree [0 to 1]	Peer-reviewed literature or other scientific evidence including *2006 IPCC Guidelines*
$CF_{NONTREE}$	Carbon fraction of nontree biomass [tC/tdm]	Peer-reviewed literature, other scientific evidence or *the 2006 IPCC Guidelines*
NCV_j	Net Calorific Value of fossil fuel use type j [TJ/t]	Peer-reviewed literature, other scientific evidence or *the 2006 IPCC Guidelines* *Table 1.2 of Ch. 1 Vol. 2*
EF_j	GHG emission from fossil fuel burning type j [tCO2eq/TJ]	Peer-reviewed literature, other scientific evidence or *the 2006 IPCC Guidelines* *Table 3.2.1 of Ch. 3 and Table 2.5 of Ch.2, Vol. 2*
$EF_{Direct-N}$	Emission factor for N2O emission from N inputs by fertilizers [tN2O-N $(tN\text{-}input)^{-1}$]	Peer-reviewed literature, other scientific evidence or *the 2006 IPCC Guidelines* *Table 11.1 of Ch. 11*

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EF_{NVolat}	Emission factor for N2O emissions from atmospheric deposition of N on soils and water surfaces [tN2O-N (t NH3-N and NOX-N volatilized)$^{-1}$]	Peer-reviewed literature, other scientific evidence or *the 2006 IPCC Guidelines Table 11.3 of Ch. 11 Vol. 4*
EF_{NLeach}	Emission factor for N2O emissions from leaching and runoff [tN2O-N (t leaching and runoff)$^{-1}$]	Peer-reviewed literature, other scientific evidence or *the 2006 IPCC Guidelines Table 11.3 of Ch. 11 Vol. 4*
$Frac_{GASF}$	Fraction of all synthetic N added to soils that volatilizes as NH3 and Nox [0 to 1]	Peer-reviewed literature, other scientific evidence or *the 2006 IPCC Guidelines Table 11.3 of Ch. 11 Vol. 4*
$Frac_{GASM}$	Fraction of all organic N added to soils that volatilizes as NH3 and Nox [0 to 1]	Peer-reviewed literature, other scientific evidence or *the 2006 IPCC Guidelines Table 11.3 of Ch. 11 Vol. 4*
$Frac_{Leach}$	Fraction of synthetic or organic N added to soils that is lost through leaching and runoff, in regions where leaching and runoff occurs [0 to 1]	Peer-reviewed literature, other scientific evidence or *the 2006 IPCC Guidelines Table 11.3 of Ch. 11 Vol. 4*
GWP_{N2O}	Global warming potential for N2O	*IPCC Fifth Assessment*

	[tCO2/tN2O]	*Report (AR5)*
EF_{N2O}	Emission factor for N2O [t/tdm]	Peer-reviewed literature, other scientific evidence or *the 2006 IPCC Guidelines* *Table 2.5, Ch. 2, Vol. 4*
GWP_{CH4}	Global warming potential for CH4 [tCO2/tCH4]	*IPCC Fifth Assessment Report (AR5)*
EF_{CH4}	Emission factor for CH4 [t/tdm]	Peer-reviewed literature, other scientific evidence or *the 2006 IPCC Guidelines* *Table 2.5, Ch. 2, Vol. 4*
$COMF$	Combustion factor [0 to 1]	Peer-reviewed literature, other scientific evidence or *the 2006 IPCC Guidelines* *Table 2.6, Ch. 2, Vol. 4*

History of the document

Version	Date	Contents revised
01.0	31 July 2026	Electronic decision by the Joint Committee Initial approval.