Gold Standard for the Global Goals

METHODOLOGY

METHODOLOGY FOR AFFORESTATION/REFORESTATION (A/R) GHGs EMISSION REDUCTION & SEQUESTRATION

SDG 13

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SUMMARY

This Methodology document, hereafter "A/R Methodology", is to enable A/R activities to quantify and certify emissions sequestration impacts. In turn this allows the Project to access Gold Standard VERs as per the Gold Standard Emissions Reduction and Sequestration Product Requirements.

TABLE OF CONTENTS

1| Definition

1.1.1 | The following definitions apply

a. **Tree l** A tree is a perennial woody plant with one or several dominant sprouts that increase its circumference due to secondary growth.

For a practical use of this document the definition of a tree in these 'A/R Requirements' goes beyond the scientific definition of a tree and also includes shrubs, palms and bamboo plants. Differences in the context of specific requirements are noted on the individual pages.

In any project, trees shall reach a minimum height of 2 meters.

1.1.2 | For forest inventories of these different types of trees, additional guidance is provided by the forest inventory guidelines/ Sourcebook of the *BioCarbon Fund.*

b. **Forest l** A forest is defined by the *Designated National Authority (DNA)* or equivalent entity of the project's host country. In case no forest definition is yet given by the DNA, the Project Developer can refer to the forest definition of the FAO or the national forest definition of the project's host country.

c. **Wetland[1] l** Wetlands are lands that are transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water, and that have one or more of the following attributes:

i. At least periodically, the land supports predominantly plants typically occurring in wetlands, AND

ii. The substrate is predominantly undrained and water saturated soil, AND

iii. The substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of each year.

d. **Organic Soil l** Organic soils fulfil one of the following requirements:

i. If the soil is never saturated with water for more than a few days, and contains >20% (by weight) of organic carbon (35% organic matter)

ii. If the soil is subject to water saturation episodes and has either:

[1] Source: *Cowardin et al. 1979* - Classification of Wetlands and Deepwater Habitats of the United States

a. >12% (by weight) organic carbon (20% organic matter) if it has no clay

b. >18% (by weight) organic carbon (30% organic matter) if it has >60% clay

c. a proportional lower limit of organic carbon content between 12 and 18% if the clay content of the mineral fraction is between 0 and 60%

e. **Selective harvesting l** Selective harvesting is done through the continuous harvest of single trees or groups of trees by maintaining forest on the area.

f. **Planting l** Planting refers to the activity of putting trees in the ground for growth; it also includes sowing or assisted natural regeneration.

g. **Modelling Unit (MU) l** Modelling Units are distinct parts of the planting area where carbon stocks can be quantified based on applying a forest growth-model. To meet the precision level for the carbon stocks estimation (see section *CO2 removal, below*), MU areas normally have homogeneous characteristics in their growth patterns, silvicultural treatment and planting date.

2| Scope, Applicability, and entry into force

2.1 | Scope

2.1.1 | Projects that include the planting of trees on land that does not meet the definition of a forest are eligible to apply this methodology. Please refer to Annex C of Land-use & Forests Activity Requirements – Gold Standard for the Global Goals for carrying out spatial assessment of land to assess eligibility of areas.

2.1.2 | The project area shall meet all of the requirements below for this methodology to be applicable for the calculation of CO_2 removal units from the project.

a. Projects can apply all silvicultural systems:

i. Conservation forests (no use of timber)

ii. Forests with selective harvesting

iii. Rotation forestry

b. All projects can include agriculture (agroforestry) or pasture (silvopasture) activities.

c. Project Areas shall not be on wetlands.

d. Project Areas with organic soils shall not be drained or irrigated (except for irrigation for planting).

e. Soil disturbance (through ploughing, digging of pits, stump removals, infrastructure, etc.) on organic soils shall be in less than 10% of the

area that is submitted to certification (not 10% of the entire project area).

f. The most likely scenario without the project (baseline scenario) shall be defined for the project area. This scenario shall not show any significant[2] increase of the Baseline biomass ('tree' and 'non-tree').

2.1.3 | Special Considerations for A/R Mangrove projects:

a. 90% of the planting area shall be planted with mangrove species

b. Due to the accumulation of soil organic carbon, an additional 1.8 tCO_2/ha/year can be accounted for in the first 20 years after a Modelling Unit (MU) is planted, unless transparent and verifiable information can be provided to justify a different value. This value is based on the recommendation of 0.5 tC/ha/year by the A/R CDM methodology AR-AM0014 v3.0. It has been converted to the unit tCO_2/ha/year.

c. In case there are targeted management / inputs leading to SOC improvement involved, applicable SOC Framework Methodology approaches may be allowed.

d. SOC sequestration component shall be excluded from the issuance of Planned Emission Reductions.

e. Paragraph 2.1.2 (c) of this methodology does not apply to mangrove projects.

f. Paragraph 2.1.3 will stand not applicable if an approved earmarked mangrove methodology under Gs4GG is available to be applied.

2.2 | Entry into force

2.2.1 | This methodology comes into force on its publication date. The previous version of the methodology is valid for 30 days from the date of publication of this version. The projects already submitted for listing or achieved listed status may continue with the previous version of methodology as long as the project is in compliance with applicable requirements of Emissions Reduction and Sequestration Product Requirements.

3| Baseline Methodology

3.1 | Emission Pools & Sources

3.1.1 | For the calculation of the parameters CO_2-removal, Baseline and Leakage, the carbon pools shall be assessed as summarised in table 1.

3.1.2 | Standing dead wood is part of the carbon pool 'tree biomass'.

[2] Significant: Significant is defined to be more than 5% of the 'long-term CO2 removal' - see section 'CO2 removal'.

3.1.3 |

Positive leakage as well as market leakage shall not be accounted for under this methodology.

3.1.4 | Table 1. Emissions sources included in or excluded from the project boundary

Carbon Pools		Includes	CO_2-removal	Baseline	Leakage
Tree biomass	Aboveground	Stem, branches, bark	Yes	Yes	Yes
	Belowground	Tree roots	Yes	Yes	Yes
Non-tree biomass	Aboveground	Grass, herbs, etc.	No	Yes	No
	Belowground	Roots of grass, herbs, etc.	No	Yes	No
Soil		Organic material	Optional	Optional	No
Harvested wood (timber & energy wood)		Furniture, construction material, etc.	No	No	No
Litter & Lying dead wood		Leaves, small fallen branches, lying dead wood	No	No	No

3.1.5 | Projects complying with A/R Requirements may use the A/R Soil Carbon Tool in order to account for soil carbon change. The A/R Soil Carbon Tool estimates the change in soil organic carbon stocks due to the planting of forests and applies to soils on planting areas only. Once a project has undergone a successful design certification, GS-VERs calculated using this tool may be issued following a successful performance certification. Projects shall not issue PERs resulting from this calculation tool.

3.2 | Demonstration of additionality

3.2.1 | The project developer shall demonstrate additionality as per the requirements defined in ~~*Land Use & Forests Activity Requirements*~~.

3.2.2 | The regulatory surplus shall be demonstrated by all the projects, irrespective of scale. The project shall demonstrate that proposed activity is neither directly mandated by law nor otherwise triggered by legal requirements (e.g., legally binding agreements, covenants, consent decrees, or contracts (with government agencies or private parties). If such legal requirements are identified, then crediting for the activity shall only be allowed until the date the legal requirements would take effect.

3.2.3 | The project developer shall demonstrate that the project could not or would not take place without carbon finance. The project developer shall demonstrate additionality by conforming to additionality requirements of one of the options below,

a. Applicable GS4GG Activity Requirements;

b. CDM Tool 01 - Tool for the Demonstration and Assessment of Additionality;

c. CDM Tool 19 - Demonstration of additionality of microscale project activities; (not applicable to Gold Standard microscale projects)

d. CDM Tool 21 – Demonstration of additionality of small-scale project activities; (applicable to small-scale projects only)

e. An approved Gold Standard VER additionality tool

3.3 | Calculation of CO_2 removal

3.3.1 | The CO_2 removal unit is determined for every year (t) of the crediting period using the following formula.

CO_2 removal units MU,t

= (CO_2-removal MU,t – Baseline MU,t – Leakage MU,t – Other Emissions MU,t) × Eligible planting area MU *Eq. 1*

$$\mathrm{CO2_{removal}Project\ area,t} = \sum_{\mathrm{MU=1}}^{\mathrm{MUs}} \sum_{\mathrm{t=1}}^{\mathrm{CP}} \mathrm{CO2\_removal\ MU,t} \qquad \textit{Eq. 2}$$

3.3.2 | Where,

$\mathrm{CO2_{removal}Project\ area,t}$	=	CO_2-removal units of a project area in year t (tCO_2)
CO_2 removal MU,t	=	CO_2-removal of a MU in year t (tCO_2)
MUs	=	MUs of a project area (1, 2, 3, …)
t	=	Years of the crediting period (1, 2, 3, …)
CP	=	Year the crediting period ends (1, 2, 3, …)

3.3.3 | The CO_2-removal units are determined in a cumulative way, alongside the growth of a forest. This implies that at the beginning of a project, emissions from the parameters Other Emissions, Baseline, and Leakage can outweigh the parameter CO_2-removal units and the net amount of CO_2 sequestered is negative. In this case, no GS VERs are generated. Only when the accumulation becomes positive can GS VERs be issued.

3.3.4 | The different parameters of this formula are described on the following pages. A Summary of the calculation approach is provided below -

a. The number of CO_2 removal units is determined for each Modelling Unit (MU). Therefore, the CO_2 removal of every MU is determined, and its portion of the total Baseline and total Leakage is deducted.

b. The sum of all MUs CO_2 removal units make up the CO_2 removal units of the entire project.

c. With the applicability conditions this methodology assumes no significant[3] increase in the Baseline, so the Baseline is only deducted in year 1 (t=1).

d. All Leakage is deducted in year 1 (t=1).

e. Other Emissions are either linked to the Baseline and therefore deducted in year 1 (t=1) or linked to the use of fertiliser and deducted over time.

3.3.5 | All carbon emission and sequestration figures shall be submitted using the templates available on the A/R methodology page.

3.4 | Selection and justification of the baseline scenario

3.4.1 | The Baseline is the estimated carbon stock that would occur in the baseline scenario. The baseline scenario describes the activities that would occur in the absence of the proposed project.

3.5 | Baseline

3.5.1 | The Baseline shall be determined by estimating the 'tree' and 'non-tree' biomass that is present in the eligible planting area just prior to the planting start.

3.5.2 | To determine the Baseline of the eligible planting area the land shall be

a. stratified according to its vegetation types (grassland, bushland, etc.), AND

b. for each of these strata scientifically based project-specific[4], regional or national default values shall be found which state 'tree' and 'non-tree' biomass of these vegetation types.

c. default values[5] from the IPCC shall only be used if no other values are available.

3.5.3 | The Baseline shall be determined on a Modelling Unit (MU) level using the following formula:

Baseline MU,t [tCO_2/ha]

= Baseline Eligible planting area [tCO2] ÷ Eligible planting area [ha] *Eq. 3*

[3] Significant is defined to be more than 5% of the 'long-term CO2-Fixtation' - see section CO_2 removal.

[4]Project-specific default values are generated through a 'tree' and 'non-tree' inventory on the project area.

[5] Default values are found e.g. in the IPCC Guidelines for National GHG Inventories https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4_Volume4/19R_V4_Ch04_Forest%20Land.pdf

3.5.4 | The baseline modelling unit will include all trees identified as 'baseline trees' within the project area. Any losses in baseline trees will specifically be mentioned and accounted. Where possible, the stock change in baseline trees should be based on census, after identifying and numbering each tree in the baseline. If sampling of baseline trees was conducted, the need for the same shall be assessed at the time of design review.

3.5.5 | Baseline stock change will be reported for the entire crediting period.

3.5.6 | If it is established at the time of project design certification that baseline will not increase, monitoring will be limited to confirming any loss of 'baseline trees'.

3.5.7 | The Baseline is not subject to reassessment at the time of renewal of the crediting period.

3.6 | CO_2 removal

3.6.1 | The yearly CO_2-removal is determined at the level of Modelling Unit (MU) during the crediting period.

3.6.2 | For every MU a growth-model and conversion factors (see section *3.9 | below* for Conversion Procedure) shall be determined.

3.6.3 | The conversion factors allow the conversion of the 'Stem volume', which is normally measured in cubic meters [m3] during the forest inventories, to 'tree biomass' with the unit tCO_2. For the conversion, section *3.9 | below* shall be followed. The conversion factors are not subject to monitoring.

3.6.4 | Existing 'tree biomass' from the carbon stock of the Baseline that is not removed shall be reflected in the growth-model.

3.6.5 | A realistic survival rate shall be reflected in the growth model.

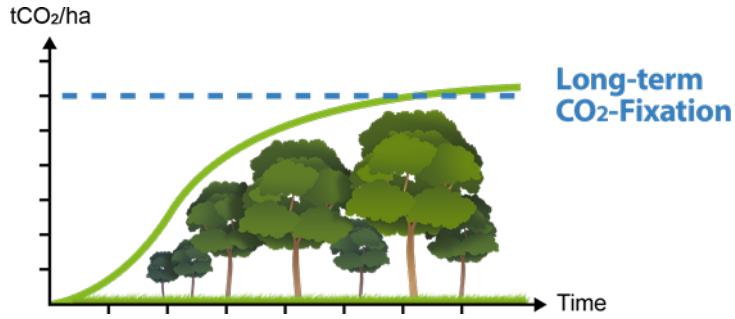
3.6.6 | The long-term CO_2 removal shall be determined depending on the silvicultural method applied / envisioned.

Option 1 - Selective harvesting or Conservation Forest

3.6.7 | If the silvicultural method applied/envisioned is selective harvesting or conservation forest[6], the long-term CO_2 removal is determined by the 'tree biomass' when a MU reaches its equilibrium.

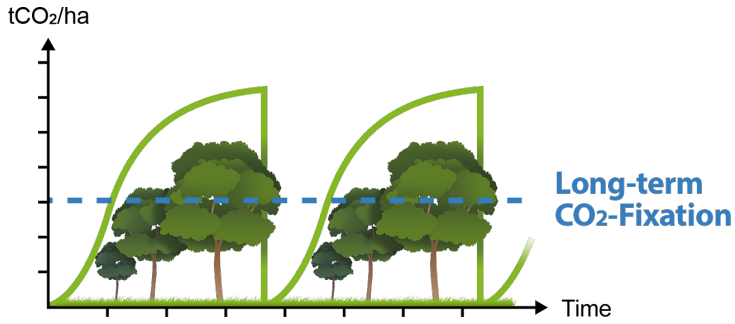
3.6.8 | If the 'tree biomass' is still increasing at the end of the crediting period, the long-term CO_2 removal is determined by the 'tree biomass' of a MU in the year the crediting period ends.

[6] Conservation forest is forest managed without any intention of tree cutting.



Option 2 - Rotation forestry

3.6.9 | If the silvicultural method applied/envisioned is 'rotation forestry', the long-term CO_2 removal is the average 'tree biomass' of a MU during the planting start and the end of the crediting period.



3.6.10 |The following formula is used to determine the long-term CO_2 removal units.

$$CR_{MU,long\_term} = = \frac{\sum_{t=1}^{T} CR_{MU,t}}{T} \qquad \textit{Eq. 4}$$

3.6.11 |

3.6.12 |Where,

$CR_{MU,long\_term}$	=	Long-term CO_2-removal of a MU [tCO_2/ha]
$CR_{MU,t}$	=	CO_2 removal of a MU in year t [tCO_2/ha]
T	=	Number of years between the planting start and the end of the crediting period [ ]
t	=	Years [1, 2, 3, …]

3.7 | Leakage emissions

3.7.1 | Leakage are emissions that occur due to a *shift of activities* from the inside of a project area to the outside of a project area. These shifts of activities can cause four different categories of Leakage by:

a. collection of wood (for firewood, charcoal, etc.)

b. timber harvesting

c. agriculture (crop cultivation, shrimp cultivation, etc.)

d. livestock.

3.7.2 | These four categories are used in the formulas below. Note that only the 'tree biomass' affected by these activity shifts shall be considered.

3.7.3 | Leakage shall be determined on a Modelling Unit (MU) level using the following formula:

Leakage MU,t [tCO_2/ha] = Leakage Project area [tCO_2] ÷ Eligible planting area [ha] *Eq. 5*

Where Leakage is deducted in the first year (t=1).

3.7.4 | With the application of formulas below all potential Leakage caused by a project within its crediting period is accounted for in year 1. Thus, the parameter is not subject to monitoring.

3.7.5 | Category a, b & c leakage emissions shall be determined as per the formula below.

Leakage Project area [tCO_2] *Eq. 6*

= Area [ha] × % of activity-shift [%] × CO_2-stock [tCO_2/ha]

3.7.6 | Where,

Area	=	Land within the project area where the activity is taking place
% of activity-shift	=	Percentage of the activity that – will be displaced during the crediting period, AND – will have impact on the 'tree biomass' outside the project area The factor is determined by: – credible estimations, OR – a representative survey
CO_2-stock	=	Average stock of 'tree biomass' on the area where the activity will be displaced to If it is not known where the activity will be displaced to, the CO_2-stock = the average stock of 'tree biomass' of a natural forest in the projects host-country

3.7.7 | Category d leakage emission shall be determined as per the formula below.

Leakage Project area [tCO_2] *Eq. 7*

= Displaced heads [head] × Grazing capacity [ha/head] × CO_2-stock [tCO_2/ha]

3.7.8 | Where,

Displaced heads	=	Amount of heads that – will be displaced during the crediting period, AND

		– will have impact on the 'tree biomass' outside the project area The factor is determined by: – credible estimations, OR – a representative survey
Grazing capacity	=	Grazing capacity of the area where the livestock will be displaced to
CO_2-stock	=	Average stock of 'tree biomass' on the area where the activity will be displaced to If it is not known where the activity will be displaced to, the CO_2-stock = the average stock of 'tree biomass' of a natural forest in the projects host-country

3.8 | Other emissions

3.8.1 | The emissions that result from certain land preparation techniques, from the use of fertilisers and energy during project activities, and from nitrogen-fixing trees are included in other emissions as summarised in the section below.

3.8.2 | Site preparation - Where existing 'tree' and 'non-tree' biomass of the Baseline is burned for the purpose of land preparation, an additional 10% of the Baseline shall be deducted. This is to account for N_2O and CH_4 emissions that are released during the burning process. Based on project specific data, a lower percentage may be applied when justified based on relevant literature and other sources.

3.8.3 | Fertiliser - 0.005 tCO_2 per kg of nitrogen (N) fertiliser shall be deducted. No differentiation is made between synthetic and organic fertiliser. Based on project specific data, a lower value may be applied when justified based on relevant literature and other sources.

3.8.4 | Combustion of fossil fuel - CO_2 and Non-CO_2 green-house-gas emissions caused by the use of fossil fuel from project activities (flights, management operations, etc.) are insignificant and may therefore be neglected.

3.8.5 | N-fixing trees - CO_2 and Non-CO_2 green-house-gas emissions caused by the use of N-fixing species may be conservatively assumed to be zero.

3.9 | General requirements for methodology application

3.9.1 | The Conversion Procedure describes how to convert from the unit of cubic meters [m^3] or tonnes of dry matter [tdm] to tonnes of carbon [tC] and then to tonnes of carbon dioxide equivalent [tCO_2].

3.9.2 | Conversion factors shall be determined at the level of a Modelling Unit:

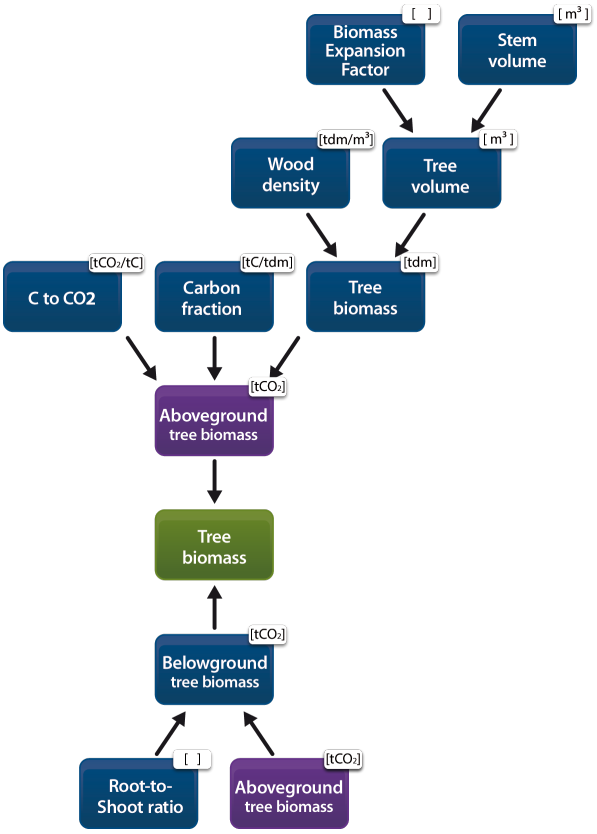
a. Wood Density

b. Biomass Expansion Factor

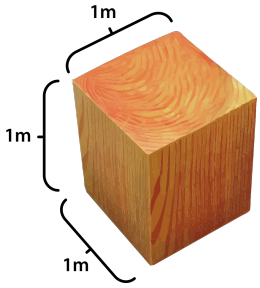
c. Root-to-Shoot ratio

3.9.3 | All factors shall be based on the best available scientific sources.

3.9.4 | For the conversion the following factors are the influencing parameters:



Aboveground tree biomass
= Stem volume * Biomass Expansion Factor * Wood density * Carbon fraction * C to CO2 factor



Belowground tree biomass
= Aboveground tree biomass * Root-to-Shoot ratio

3.9.5 | **Wood density -** The woody density is the ratio between the mass of dry wood divided by its volume.

Example:

Wood density
= Mass / Volume
= 0.6 t / 1 m^3
= 0.6 t / m^3

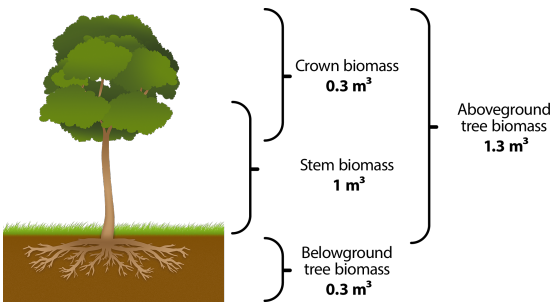
3.9.6 | Often the unit t (tonnes) is expressed as tdm (tonnes of dry matter).

3.9.7 | **Biomass Expansion Factor (BEF) and Root-to-Shoot ratio** - The following picture shows how the BEF and Root-to-Shoot ratio are determined based on the ratio of different parts of the tree.

Examples:

BEF
= Aboveground tree biomass / Stem biomass
= 1.3 m^3/ 1 m^3
= 1.3

Root-to-Shoot ratio



= Belowground tree biomass / Aboveground tree biomass
= 0.3 m^3/ 1.3 m^3
= 0.23

3.9.8 | The different factors can be influenced by one or several of the following attributes. The project owner should consider these in deciding which factors are most appropriate for a particular Modelling Unit:

a. Some BEFs already include the Root-to-Shoot ratio.

b. The 'Stem volume' is based on a specific diameter of stump (x cm). The BEF should relate to this.

c. Most Root-to-Shoot ratios are calculated from the 'Tree volume' (including branches and leaves/needles), but some are based on the 'Stem volume'.

d. In cases where a Biomass Conversion and Expansion Factor (BCEF) is used the factors BEF and Wood density are both integrated.

e. The BEF can be age-dependent and thus change over time.

f. Dead-wood differs in its Wood density, BEF and Root-to-Shoot ratio from the living tree.

g. Scientific sources can relate to a relative figure (0.4) or calculative figure (1.4).

3.9.9 | Conservative Approach - When aggregated together, the factors shall lead to a conservative calculation approach. This means that in the consideration and calculation of uncertainties:

a. the CO_2 removal shall not be overestimated, AND

b. the Baseline and Leakage shall not be underestimated.

3.10 | Default Values

3.10.1 | The following default values shall be used for all conversions:

a. 0.47~~5~~ [tC/tdm] as the 'Carbon fraction' for 'tree biomass'

b. 0.4 [tC/tdm] as the 'Carbon fraction' for 'non-tree biomass'

c. $^{44}/_{12}$ [tCO2/tC] is used to convert 'C to CO2'

3.10.2 | The following default factors shall be used when no rigorous scientific information is available:

a. For the parameters of CO2 removal:

i. 0.3 [tdm/m^3] Wood density

ii. 1.1 [ ] BEF

iii. 0.2 [ ] Root-to-Shoot ratio for 'tree biomass'

b. For the parameters of Baseline or Leakage:

iv. 0.7 [tdm/m^3] Wood density

v. 3.5 [ ] BEF

vi. 0.8 [ ] Root-to-Shoot ratio for 'tree biomass'

vii. 4.0[ ] Root-to-Shoot ratio for 'non-tree biomass'

3.10.3 | More default values for 'tree biomass' are in the IPCC Guidelines for National GHG Inventories: https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4_Volume4/19R_V4_Ch04_Forest%20Land.pdf

3.10.4 | More default values for 'non-tree biomass' are in the IPCC Guidelines for National GHG Inventories: https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4_Volume4/19R_V4_Ch06_Grassland.pdf

3.10.5 | If preferred, project developers may also select the more precise IPCC defaults when available in place of the GS defaults for factors relating to tree and non-tree biomass with no justification required.

3.11 | Forest Inventory

3.11.1 | The growth-models of the MUs shall be confirmed/adjusted by the results of MU specific forest inventories.

3.11.2 | For the forest inventories the guidelines of the BioCarbon Fund[7] shall be followed.

3.11.3 | The process of a forest inventory shall be documented clearly and easy replicated.

3.11.4 | Forest inventories shall be repeated at minimum before every Performance Certification.

3.11.5 | The number of sample plots of a forest inventory shall be sufficient to meet a MU precision with a maximum error of ±20% at a 90% confidence interval. Where the error is above 20%, the additional difference shall be deducted. For example –

A *forest inventory* determined the mean 'Stem volume' of a MU at 100 m^3/ha with an error of 23%.

The error is 3% higher than required: 3% * 100 m^3/ha = 3 m^3/ha

The mean 'Stem volume' which can be accounted for is: 100 - 3 = 97 m^3/ha

4| Documentation requirements

4.1.1 | The project developer shall undertake the following process based on the step of certification that is being pursued:

[7] https://winrock.org/wp-content/uploads/2016/03/Winrock-BioCarbon_Fund_Sourcebook-compressed.pdf

a. Project certification

   i. Design Certification: For the Design Certification the project developer shall provide documentation using the respective sections of Consolidated A/R template viz. 'Applicability', 'Baseline', 'Leakage', 'Other Emissions', 'Carbon Performance' and 'CO2 fixation'.

   ii. Performance Certification: For the Performance Certification the project developer is not required to update the information in 'Applicability', 'Baseline', 'Leakage' and 'Other Emission' sections of Consolidated A/R template.

   iii. New Area Certification: For the New Area Certification, the project developer shall update the existing filled-in Consolidated A/R template with the information from the new areas added, as applicable. The new information shall be clearly distinguishable.

b. PoA certification

   i. Design Certification: Information on aforementioned sections of the Consolidated template, would be filled out for each real-case and regular VPA separately.

   ii. CME can opt to provide information for group of regular VPAs covering all areas of lands under the regular VPAs corresponding to a real-case VPA in one single document of Consolidated Template.

   iii. Consolidated Template will be updated for each performance certification for 'CO2 fixation' and 'Carbon Performance' sections of the Consolidated Template.

DOCUMENT HISTORY

Version	Date	Description
2.1	16.05.2024	— Minor Updates — Further details on demonstration of additionality. — Further clarity on accounting of baseline removals — Editorial corrections
2.0	25.10.2022	— New Methodology template. — Clarity on mangroves, soil carbon pool. — References updated. — Rule update/ clarification included. — Other editorial changes.
1.0	03.07.2017	First version