Gold Standard

Gold Standard Afforestation/Reforestation (A/R) GHG Emissions Reduction & Sequestration Methodology

Gold Standard
for the Global Goals

Version 1 – Published July 2017

Gold Standard®

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PREFACE

In 2015 Gold Standard began development of a single, holistic climate and sustainable development standard for projects and programmes (Gold Standard for the Global Goals). This comprehensive standard improves consistency and efficiency, updates to the latest best practice and allows quantification and monetisation of SDG outcomes. The long-standing key Gold Standard principles of inclusivity, holistic design, robust safeguards and MRV are all retained and further enhanced in Gold Standard for the Global Goals.

This Methodology document, hereafter "the Methodology", is intended to function as part of a pathway to certification within the Gold Standard for the Global Goals Framework with the specific intention of enabling 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.

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1.0 SCOPE AND APPLICABILITY

1. Projects shall apply Gold Standard for the Global Goals Principles & Requirements and all other associated and referenced documents.

2. Projects that include the planting of trees on land that does not meet the definition of a forest[1] at planting start are eligible to apply this methodology. The project area shall meet all of the requirements below for this methodology to be applicable for the calculation of CO2-certificates from the project.

Projects can apply all silvicultural systems:

- Conservation forests (no use of timber)
- Forests with selective harvesting
- Rotation forestry

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

3. Project Areas shall not be on wetlands[2].

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

5. Soil disturbance (through ploughing, digging of pits, stump removals, infrastructure, etc.) on organic soils[3] shall be in less than 10% of the area that is submitted to certification (not 10% of the entire project area).

6. The most likely scenario without the project (baseline scenario) shall be defined for the project area. This scenario shall not show any significant[4] increase of the Baseline biomass ('tree' and 'non-tree').
7. Projects shall apply the Gold Standard Land-use Activity Requirements as applicable to A/R Projects.

8. By applying 1.1 to 1.7 above the Project is also eligible to apply the Gold Standard Emissions Reduction and Sequestration Product Requirements.

9. Process: The project developer shall undertake the following process based on the type of certification that is being pursued:

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[1] A forest is defined by the Designated National Authority (DNA) of the project's host-country. In case no forest definition is yet given by the DNA, the project developer can take the forest definition of the FAO: http://www.fao.org/docrep/003/x6896e/x6896e0e.htm or the national forest definition of the project's host country.

[2] Wetland: Definition of wetland according to the IPCC: 'This category includes land that is covered or saturated by water for all or part of the year (e.g. peatland) and that does not fall into the forest land, cropland, grassland or settlements categories'. Source – IPCC – Good Practice Guidance - Wetlands

[3] Organic soils: Organic soils fulfil one of the following requirements:
   1. 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)

   2.If the soil is subject to water saturation episodes and has either:
   - 12% (by weight) organic carbon (20% organic matter) if it has no clay
   - 18% (by weight) organic carbon (30% organic matter) if it has >60% clay
   - 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

[4] Significant is defined to be more than 5% of the 'long-term CO2-Fixtation' - see 'CO2-Fixation'.

Process for Design Certification

For the Design Certification the project developer shall provide documentation using the template 'Applicability'.

Process - Performance Certification

For the Performance Certification the project developer is not required to update the template 'Applicability'.

Process for New Area Certification

For the New Area Certification the project developer shall update the existing filled-in template 'Applicability' with the information from the new areas added. The new information shall be clearly distinguishable by the use of a different colour. The existing version of the template shall be used.

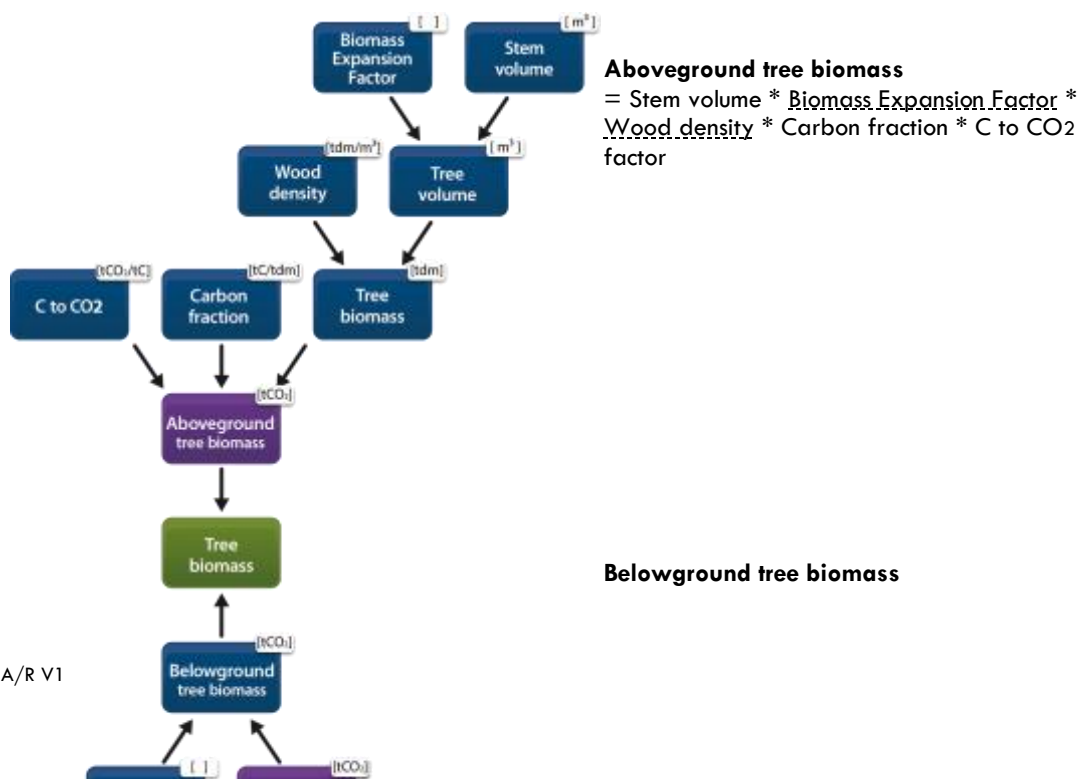## 2.0 METHODOLOGY

2.1 Conversion Procedure

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 [tCO2].

2. Conversion factors shall be determined at the level of a <u>Modelling Unit</u>:

   (a) <u>Wood Density</u>
   (b) <u>Biomass Expansion Factor</u>
   (c) <u>Root-to-Shoot ratio</u>

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

3. For the conversion the following factors are the influencing parameters:

Aboveground tree biomass
= Stem volume * <u>Biomass Expansion Factor</u> * <u>Wood density</u> * Carbon fraction * C to CO2 factor
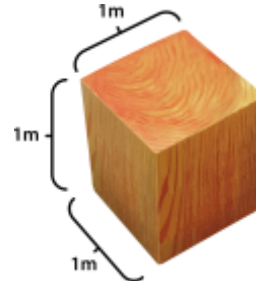
Belowground tree biomass

$$= \text{Aboveground tree biomass} * \text{Root-to-Shoot ratio}$$

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

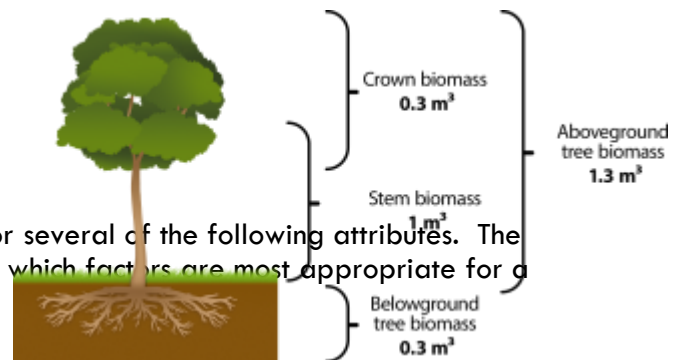Often the unit t (tonnes) is expressed as tdm (tonnes of dry matter).

Biomass Expansion Factor (BEF) and Root-to-Shoot ratio: The following graph 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

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

- Some BEFs already include the Root-to-Shoot ratio.
- The 'Stem volume' is based on a specific diameter of stump (x cm). The BEF should relate to this.
- Most Root-to-Shoot ratios are calculated from the 'Tree volume' (including branches and leaves/needles), but some are based on the 'Stem volume'.
- In cases where a Biomass Conversion and Expansion Factor (BCEF) is used the factors BEF and Wood density are both integrated.
- The BEF can be age-dependent and thus change over time.
- Dead-wood differs in its Wood density, BEF and Root-to-Shoot ratio from the living tree.
- Scientific sources can relate to a relative figure (0.4) or calculative figure (1.4)

5. 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 CO2-Fixation shall not be overestimated, AND
(b) the Baseline and Leakage shall not be underestimated.

6. Default Factors: The following default factors shall be used for all conversions:

- 0.5   [tC/tdm] as the 'Carbon fraction' for 'tree biomass'
- 0.4   [tC/tdm] as the 'Carbon fraction' for 'non-tree biomass'
- $^{44}/_{12}$ [tCO2/tC] is used to convert 'C to CO2'

7. The following default factors shall be used when no rigorous scientific information is available:

For the parameters of <u>CO2-Fixation</u>:
      (a) 0.3 [tdm/m^3]   <u>Wood density</u>
      (b) 1.1 [ ]   <u>BEF</u>
      (c) 0.2 [ ]   <u>Root-to-Shoot ratio</u> for '<u>tree</u> biomass'
For the parameters of <u>Baseline</u> or <u>Leakage</u>:
      (d) 0.7 [tdm/m^3]   <u>Wood density</u>
      (e) 3.5 [ ]   <u>BEF</u>
      (f) 0.8 [ ]   <u>Root-to-Shoot ratio</u> for '<u>tree</u> biomass'
      (g) 4.0 [ ]   <u>Root-to-Shoot ratio</u> for 'non-<u>tree</u> biomass'

8. More default values for '<u>tree</u> biomass' are in the IPCC Guidelines for National GHG Inventories:
www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_04_Ch4_Forest_Land.pdf

More default values for 'non-<u>tree</u> biomass' are in the IPCC Guidelines for National GHG Inventories:
www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_06_Ch6_Grassland.pdf

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.

2.2 Calculation of co2-certificates

1. The number of <u>CO2-certificates</u> is determined for every year (t) of the <u>crediting period</u> using the following formula:

[tCO2]   of every <u>MU</u> [tCO2/ha]   [ha]

Summary of this Methodology:

- The number of CO2-certificates is determined for each Modelling Unit. Therefore, the CO2-Fixation of every MU is determined and its portion of the total Baseline and total Leakage is deducted.
- The sum of all MUs CO2-certificates make up the CO2-certificates of the entire project.
- With the applicability conditions this methodology assumes no significant[1] increase in the Baseline, so the Baseline is only deducted in year 1 (t=1).

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[1] Significant   Significant is defined to be more than 5% of the 'long-term CO2-Fixtation' - see chapter '5.7 CO2-Fixation'.

- All Leakage is deducted in year 1 (t=1).
- Other Emissions are either linked to the Baseline and therefore deducted in year 1 (t=1) or linked to the use of fertilizer and deducted over time.

2. Process: The Project Developer shall undertake the following process based on the type of certification that is being pursued:

Process for Design Certification
For the Design Certification the project developer shall meet the requirements by entering the numbers from chapters 'Other Emissions', 'Baseline', 'Leakage' and 'CO2-Fixation' in its ClimateProjects[1] account. The system will create a 'MU Report' that the project developer shall submit to The Gold Standard Registry.

Process for Performance Certification
For the Performance Certification the project developer shall meet the requirements by updating the numbers from the chapters 'Other Emissions' and 'CO2-Fixation' and in its ClimateProjects account. The system will create a 'MU Report' that the project developer shall submit to The Gold Standard Registry.

Process for New Area Certification
See Design Certification. To enter the numbers of the new areas into the ClimateProjects system the project developer has to create a new 'Modelling Units Cluster'.

For all types of certification the project developer can also submit its 'MU Report' by creating a spreadsheet with the calculations instead of using the Climate Projects software.

3. Scientific Formulae:

CO2-certificates MU,t
= (CO2-Fixation MU,t - Baseline MU,t - Leakage MU,t - Other Emissions MU,t) * Eligible planting area MU

$$\text{CO2\_certificates Project area}, t = \sum_{MU=1}^{MUs} \sum_{t=1}^{CP} \text{CO2\_certificates MU}, t$$

CO2-certificates Project area, t $= [tCO2]$ CO2-certificates of a project area in year t

CO2-certificates MU,t $= [tCO2]$ CO2-certificates of a MU in year t

MUs $= 1, 2, 3, …$ MUs of a project area

t= 1, 2, 3, … Years of the crediting period

CP= [ ]Year the crediting period ends

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[1] ClimateProjects   ClimateProjects is a web-based software that allows project developers to manage their carbon calculation: www.ClimateProjects.info

The CO2-certificates 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 CO2-Fixation and the net amount of CO2 sequestered is negative. In this case, no CO2-certificates are generated. Only when the accumulation becomes positive can CO2-certificates be issued.

The different parameters of this formula are described on the following pages.

4. Carbon pools

For the calculation of the parameters CO2-Fixation, Baseline and Leakage, the following carbon pools shall be assessed:

Carbon Pools		Includes	CO2-Fixation	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	No	No	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

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

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

2.3 Other Emissions

1. The requirements in this section relate to the emissions that result from certain land preparation techniques, from the use of fertilisers and energy during project activities, and from nitrogen-fixing trees.

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 the non-CO2 green-house-gas emissions (N2O and CH4) that are released during the burning process.

3. Fertilizer 0.005 tCO2 per kg of nitrogen (N) fertilizer shall be deducted. No differentiation is made between synthetic and organic fertilizer.

4. Combustion of fossil fuel: CO2 and Non-CO2 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.

5. N-fixing trees: Non-CO2 green-house-gas emissions caused by the use of N-fixing species may be conservatively assumed to be zero.

6. Process:

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

Process for Design Certification
For the Design Certification the project developer shall tick in its ClimateProjects account the Modelling Units (MUs) where the Baseline vegetation was burned (requirement 2). For the fertilizer (requirement 3) the project developer shall submit the amounts in the provided fields of its ClimateProjects account.

Process for Performance Certification
No monitoring for requirement 2. For requirement 3 the project developer shall update the amount of fertiliser used - in accordance with the figures submitted in its 'Annual Reports'.

Process for New Area Certification
See Design Certification.

For all types of certification the project developer can also submit its 'MU Report' by creating a spread sheet with the calculations instead of using the ClimateProjects software.

2.4 Baseline

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.

2. 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. 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[1], regional or national default values shall be found which state 'tree' and 'non-tree' biomass of these vegetation types.

International default values[2] from the IPCC shall only be used if no other values are available.

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

   Baseline MU,t [tCO2/ha] = Baseline Eligible planting area [tCO2] / Eligible planting area [ha]

The Baseline is deducted in the first year (t=1).

5. The Baseline is not subject to monitoring.

6. Process:

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

[2] International default values   International *default values* are found e.g. in the *IPCC Guidelines for National GHG Inventories*:
http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_04_Ch4_Forest_Land.pdf

The project Developer shall undertake the following process based on the type of certification that is being pursued:

Process for Design Certification
For the Design Certification the project developer shall provide documentation using the template 'Baseline'. The resulting figures of this documentation shall be submitted to the projects ClimateProjects account.

Process for Performance Certification
For the Performance Certification the project developer is not required to update the template 'Baseline'.

Process for New Area Certification
For the New Area Certification the project developer shall update the existing filled-in template 'Baseline' with the information from the new areas added. The new information shall be clearly distinguishable by the use of a different colour. The existing version of the template shall be used. The resulting figures of this documentation shall be submitted to the projects ClimateProjects account.

For all types of certification the project developer can also submit its 'Modelling Units Report' by creating a spreadsheet with the calculations instead of using the ClimateProjects software.

2.5 Leakage

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.

These four categories are used in the formulas below.

Note that only the 'tree biomass' affected by these activity shifts shall be considered.

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

Leakage MU,t [tCO2/ha] = Leakage Project area [tCO2] / Eligible planting area [ha]

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

3. 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.

4. **Formula for category (a), (b) and (c)**

Leakage Project area [tCO2] = Area [ha] * % of activity-shift [%] * CO2-stock [tCO2/ha]

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

CO2-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 CO2-stock = the average stock of 'tree biomass' of a natural forest in the projects host-country

Formula for category (d)

Leakage Project area [tCO2] = Displaced heads [head] * Grazing capacity [ha/head] * CO2-stock [tCO2/ha]

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

CO2-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 CO2-stock = the average stock of 'tree biomass' of a natural forest in the project's host-country

5. Process

The project Developer shall undertake the following process based on the type of certification that is being pursued:

Process for Design Certification
For the Design Certification the project developer shall provide documentation using the template 'Leakage'. The resulting figures of this documentation shall be submitted to the projects ClimateProjects account.

Process for Performance Certification

For the Performance Certification the project developer is not required to update the template 'Leakage'.

Process for New Area Certification
For the New Area Certification the project developer shall update the existing filled-in template 'Leakage' with the information from the new areas added. The new information shall be clearly distinguishable by the use of a different colour. The existing version of the template shall be used. The resulting figures of this documentation shall be submitted to the projects ClimateProjects account.

2.6 Co2-Fixation

1. The yearly (t) CO2-Fixation is determined at the level of Modelling Unit (MU) during the crediting period.

2. For every MU a growth-model and conversion factors (see chapter '5.2 Conversion Procedure') shall be determined.

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 tCO2. For the conversion the chapter '5.2 Conversion Procedure' shall be followed.

The conversion factors are not subject to monitoring.

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

5. A realistic survival-rate shall be reflected in the growth-model.

6. Process

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

Process for Design Certification
For the Design Certification the project developer shall provide documentation using the template 'CO2-Fixation'. Where useful, the supporting documents should contain a spreadsheet file with the growth-models of the Modelling Units. The resulting figures of this documentation shall be submitted to the projects ClimateProjects account.

Process for Performance Certification
For the Performance Certification the project developer shall update the existing filled-in template 'CO2-Fixation' based on the information of the 'Forest Inventory'. The most recent version of the template shall be used. The resulting figures of this documentation shall be used to update the projects ClimateProjects account.

Process for New Area Certification
For the New Area Certification the project developer shall update the existing filled-in template 'CO2-Fixation' with the information from the new areas added. The new information shall be clearly distinguishable by the use of a different colour. The existing version of the template shall be used. The resulting figures of this documentation shall be submitted to the projects ClimateProjects account.

For all types of certification the project developer can also submit its 'Modelling Units Report' by creating a spreadsheet with the calculations instead of using the ClimateProjects software.

7. Long term co2-fixation

The long-term CO_2-Fixation shall be determined depending on the silvicultural method applied / envisioned (see options below).
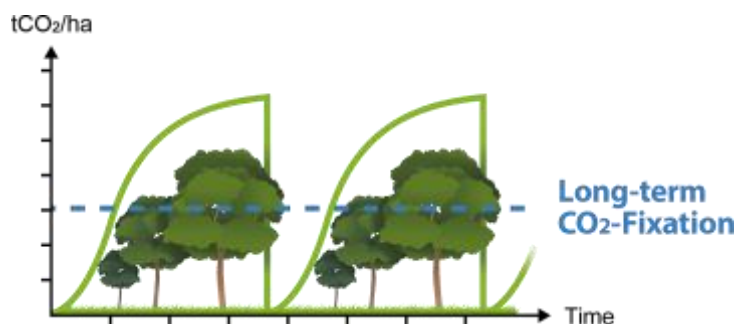
Option 1 - Selective harvesting or Conservation forest
If the silvicultural method applied/envisioned is selective harvesting[1] or conservation forest[2], the long-term CO_2-fixation is determined by the 'tree biomass' when a MU reaches its equilibrium.

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

Option 2 - Rotation forestry
If the silvicultural method applied/envisioned is 'rotation forestry', the long-term CO_2-Fixation is the average 'tree biomass' of a MU during the planting start and the end of the crediting period.

$$CFMU, long\_term = \frac{\sum_{t=1}^{T} CFMU,t}{T}$$

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[1] Selective harvesting   Selective harvesting is done through the continuous harvest of single trees or groups of trees by maintaining forest on the area.

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

CFMU, long-term = [tCO2/ha] Long-term CO2-fixation of a MU

CFMU, t = [tCO2/ha] CO2-fixation of a MU in year t

T= [ ] Number of years between the planting start and the end of the crediting period

T = 1, 2, 3, … Years

2.7 Forest Inventory

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

2. For the forest inventories the guidelines of the BioCarbon Fund[1] or CarbonFix[2] shall be followed.

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

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

5. The number of sample plots of a forest inventory shall be sufficient to meet a MU precision with a maximum error of $\pm20\%$ at a 90% confidence interval. Where the error is above 20%, the additional difference shall be deducted (see example below).

Example:

A forest inventory determined the mean 'Stem volume' of a MU at 100 m³/ha with an error of 23%.
The error is 3% higher than required: 3% * 100 m³/ha = 3 m³/ha
The mean 'Stem volume' which can be accounted for is: 100 - 3 = 97 m³/ha

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[1] BioCarbonFund   www.winrock.org/ecosystems/files/winrock-biocarbon_fund_sourcebook-compressed.pdf
[2] CarbonFix   www.carbonfix.info/chameleon//outbox//public/216/Forest-Inventory-Guideline.pdf