COLCX METHODOLOGY FOR REDD+ PROJECTS

MODULE FOR INCREASE OF CARBON RESERVES ACTIVITIES (ICR)

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SUPPORTS

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TABLE OF CONTENT

List of tables

List of Illustrations

1. OBJECTIVES

To provide principles, requirements and guidelines for the development and implementation of REDD+ projects, with emphasis on Increase of Carbon Reserves ICR activities, to ensure adequate quantification, monitoring and reporting of activities aimed at the removal of Greenhouse Gases (GHG), by forest restoration processes in degraded forests. The general considerations of this module follow the principles of the REDD+ methodology and the ColCX standard.

In addition to the elements provided by the REDD+ methodology, this module considers the following elements:

- Mechanism for assessing and supporting the additionality of an ICR project.
- Criteria for determining the baseline scenario considering ecological restoration principles.
- Additional requirements for monitoring, follow-up and control of restoration activities.

2. SCOPE OF THE METHODOLOGY

This module can be applied by any type of entity, person or institution that wishes or intends to establish a project that helps mitigate the effects of climate change through the establishment of projects whose main activities are REDD+, hereinafter referred to as GHGMP. This REDD+ activity consists of the removal of GHGs based on the conservation, preservation and sustainable use of natural forests. To support the increase in carbon reserves, the following concepts associated with ecological restoration must be considered:

2.1 Ecological integrity

It is a concept that goes hand in hand with the forest definition thresholds for each country; this is normally constructed based on ecosystem attributes. Ecosystem attributes are function, structure and composition. Composition translates into the elements that make up an ecosystem, such as species of flora, fauna, fungi, microbiota, among others; structure corresponds to the spatial arrangement of these species within the ecosystem, such as the presence of dominant species, tree strata and diversity; finally, function, which is the product of the interaction of the elements of the ecosystem and depends on its structure; these can be perceived mainly as ecosystem services of support or regulation. Ecosystem attributes can be evaluated on different scales[1]:

- The genetic scale has to do with a scale smaller than an individual and deals with all those techniques of identification of biomolecules such as DNA or chlorophyll which are fundamental for the sustainability of forest ecosystems.
- The population scale deals with studies at the level of individuals of the same species and is adjusted to a spatial scale larger than one hectare. However, this depends on the species, its population dynamics and distribution.
- The community scale deals with the interaction between different populations, which are organized in an ecosystem and allow ecosystems to function. For the study of this scale, the use of interaction network techniques is recommended.
- The landscape scale, which deals with study areas larger than 100 hectares, considers concepts such as patch (remnant forests), matrix (cover adverse to patches) and corridors (connections between patches that allow genetic flow).

Since forest ecosystems suffer from the dynamics of loss of their cover and integrity, it is necessary to establish restoration strategies that facilitate their return to a function like that which existed prior to the damage. It should be noted that this methodology is based on the ecosystem service of forest ecosystems as a carbon sink.

[1] Noss, R. F. (1990). Indicators for monitoring biodiversity: a hierarchical approach. *Conservation biology*, *4*(4), 355-364.

2.2 Ecological restoration

It consists of the process of assisting an ecosystem that has been degraded by various factors so that it can recover its functionality, elements similar to a pre-disturbance scenario or so that it can provide ecosystem services to generate wellbeing for society[2]. The National Plan for Restoration defines two types of ecological restoration:

a. Active or assisted restoration. This involves the introduction and maintenance of species and vegetation cover, which requires the application of silvicultural practices for the management of successional trajectories[3]. From the ecological restoration point of view, these practices can be the introduction of species, the reintroduction of species, translocations and biological corridors[4].
b. Passive or spontaneous restoration. It is the regeneration of an ecosystem by itself when the factors generating degradation are suppressed [5].

On the other hand, this document also defines the types of ecological restoration:

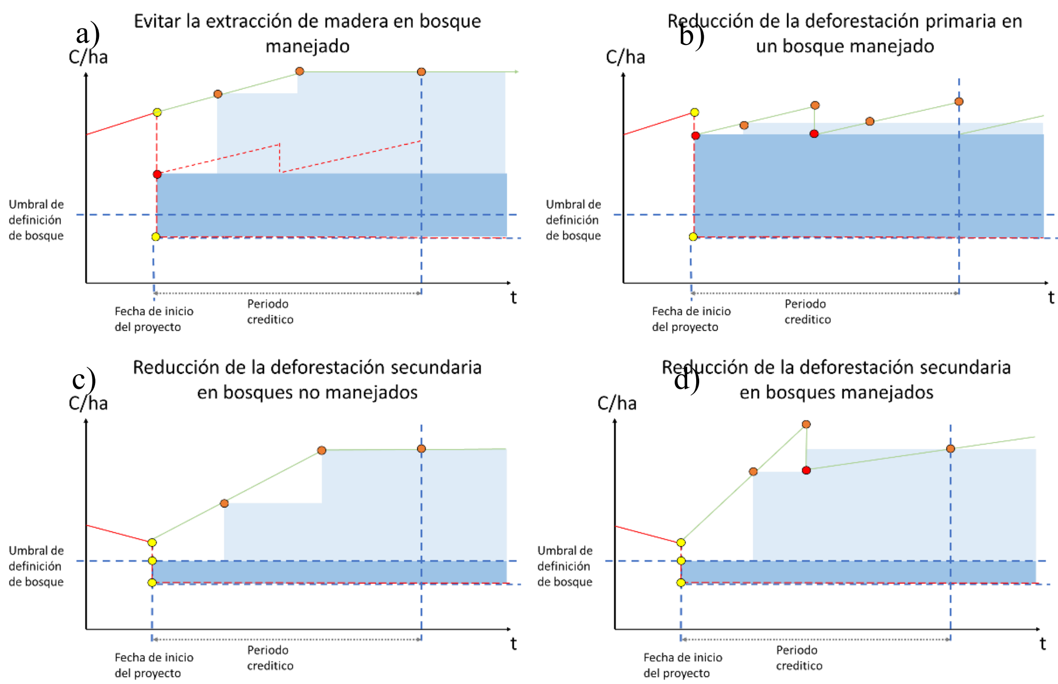
1) **Restoration:** Aims to restore the degraded territory to its pre-disturbance attributes, initiating or accelerating the necessary processes so that the territory acquires the composition, structure and function that it originally had in a pristine state.
2) **Rehabilitation:** Aims to help the ecosystem to partially reestablish its attributes of functionality and structure, based on the use of elements of the initial composition in order to make it productive again, although this ecosystem will not be in composition, structure and function equal to the pristine scenario.

[2] SER, N. Society for ecological restoration international science & policy working group. 2004.
[3] SALAMANCA, B.; CAMARGO, G. Protocolo distrital de restauración ecológica. *Convenio DAMA–Fundación Bachaqueros, Bogotá*, 2000, vol. 402.
[4] SIMBERLOFF, Daniel y col. Corredores de movimiento: ¿gangas de conservación o malas inversiones? *Biología de la conservación*, 1992, vol. 6, no 4, pág. 493-504.
[5] PEÑA-GONZÁLEZ, Natalia. Programa de monitoreo de restauración para áreas con aislamiento perimetral. 2017.

3) **Recovery:** The objective is to guide the ecosystem to recover its productivity and provision of environmental services, although not necessarily reaching the composition, structure and function of the scenario without degradation or destruction, such recovery is carried out in highly degraded ecosystems and does not aim to reach the pristine state of the original ecosystem.

Projects implementing this methodology must comply with each of the legal requirements established within the country and consider the pillars of REDD+ activities described by the UNFCCC[6].

The following are the cases where this methodology is applicable:



[6] UNFCCC (2023). Plataforma web de la Convención Marco de las Naciones Unidas sobre el Cambio Climático REDD+. En: https://redd.unfccc.int/

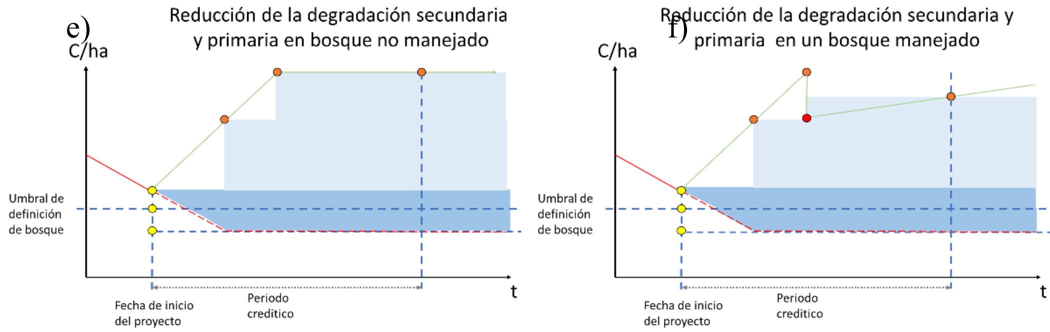


***Illustration 1** Temporal limits of a GHGMP, yellow dots show measures required in the scenario without project, red dots show measures required in the scenario with project, orange dots show measures required when carbon reserves increase is quantified. In green the line shows carbon stock projections. The red line shows the historical carbon stock, and the dotted red line shows the baseline projections. The dark blue box shows the carbon offsets that can be obtained from REDD activities, and the light blue box shows the carbon offsets that can be obtained from ICR activities[7].*

3. APPLICABLE ACTIVITIES

This methodology contemplates the Increase of Carbon Reserves (ICR) only applies to restoration and rehabilitation activities in permanent forest, i.e. only species of the reference ecosystem can be used and the objective of restoring the carbon reservoirs to a previous state must always be kept.

This methodology allows the use of active and passive ecological restoration techniques, if these activities are additional, and their implementation is adequately supported from the project start date.

The ecological scale at which to work will depend on the size of the project, however, it is only applicable to the population, community and landscape scales.

[7] Pedroni, L. VCS Methodology VM0015 V 1.1, v.1.1 Methodology for Avoided Unplanned Deforestation; Carbon Decisions International: Washington, DC, USA; p. 184. Rescatado el 12/27/2021 de: https://verra.org/wp-content/uploads/2018/03/VM0015 V 1.1-Methodology-for-Avoided-Unplanned-Deforestation-v1.1.pdf

4. APPLICABILITY CONDITIONS

This methodology is applicable under the following conditions:

- Areas of degraded permanent forest are presented in the year of initiation (forest remaining in this category for ten (10) years prior to the project start date), according to the official definition of forest in each country.
- It must be proven by means of the corresponding documentation that the owner or owners of the property or properties are the legal owners of the total land area where the GHGMP will be carried out or have the right to use the land and that these properties do not present legal or other types of disputes.
- Stressors, limiting agents and how they are influenced by the underlying drivers and causes of deforestation and forest degradation should be clearly identified.
- Only applies to degraded forests whose stressors, limiting and enhancing agents do not allow their ecological succession to occur without project activities.
- If management areas with forest harvesting authorization are included, only unplanned forest degradation reduction activities apply.

This methodology is not applicable under the following conditions:

- Projects that only include GHG removal activities through ecological restoration or revegetation.
- Forest covers dominated by periodically flooded natural ecosystems, such as wetlands, paramos, mangroves, among others, with soils with high organic matter content.

5. ICR AREA ELIGIBILITY

For the eligibility of the area of a GHGMP, the following criteria must be taken into account:

- The areas where the activities are carried out must demonstrate ownership by the proponents of the property, collective territory or properties, this is guaranteed by legal documentation that shows that the owners are legal owners of the total amount of land where the GHGMP will be carried out or have the right to use the land for the duration of the project; it must also be demonstrated that these properties do not present legal or other types of disputes.

- Prior to the start date of ICR activities, the permanent forest should be clearly stratified according to the history of disturbance, with permanent plots defined to identify changes in carbon reservoirs.

- ICR activities can only be implemented in areas of permanent forest.

6. TEMPORAL AND SPATIAL LIMITS

The temporal and spatial limits of GHGMP allow establishing the area and temporality in which economic benefits can be obtained by COLCERS for the removal and/or reduction of GHG.

6.1 Time Limits

The time limits of the project must be defined in the Project Design Document (PDD) and the following aspects must be considered in the PDD:

6.1.1 Project start date

In the case of ICR activities, this is the date on which the first GHGMP action aimed at the ecological restoration of the permanent forest is implemented. This date is established on the basis of a concrete, sustainable and traceable action that generates an increase in carbon stocks in the reservoirs. The project start date can be a maximum of 5 years prior to the date of submission for validation to the VVB.

6.1.2 Pre-disturbance historical period of analysis

This is a minimum period of 10 years prior to the start date of the GHGMP in which the agents of deforestation and/or forest degradation must be identified in detail and how they interact with the stressors and limiting agents. This is the period in which the dynamics of disturbance are analyzed to generate ecological restoration strategies.

6.1.3 Retroactive period

It is a period of maximum 5 years prior to the start date of the GHGMP, where if the proponent is able to demonstrate year after year the maintenance or implementation of REDD+ activities, in a sufficient and integrated manner, it may obtain carbon credits prior to the validation date, if and solely if the project achieves its certification taking into account the date of submission of the validation to the VVB.

6.1.4 Projection period

Corresponds to the period in which projections are made based on indicators such as the MAI. This is done by estimating the estimated carbon stock gain of degraded forests.

6.1.1 Credit period

This is the period in which the baseline scenario has not been revalidated and therefore corresponds to a period of no more than 10 years and includes the verification periods in which monitoring of GHG removals by the degraded natural forest is carried out. The crediting period can be revalidated as many times as the lifetime period allows.

6.1.2 Lifetime

Corresponds to the time in which the proponent of the GHGMP commits, by means of a legal agreement, to carry out the activities formulated in the PDD and obtain the expected results. This period must be equal to or greater than 30 years.

6.1.3 Verification period

Time period in years, defined in the crediting period, in which actions and GHG inventories due to GHG emission reductions or removals are evaluated, this period is no longer than 60 months. The information subject to verification must come from official sources, primary project information that demonstrates integrity and consistency or from recognized sources that can objectively provide certainty of the realization of REDD+ activities of the activities formulated in the PDD.

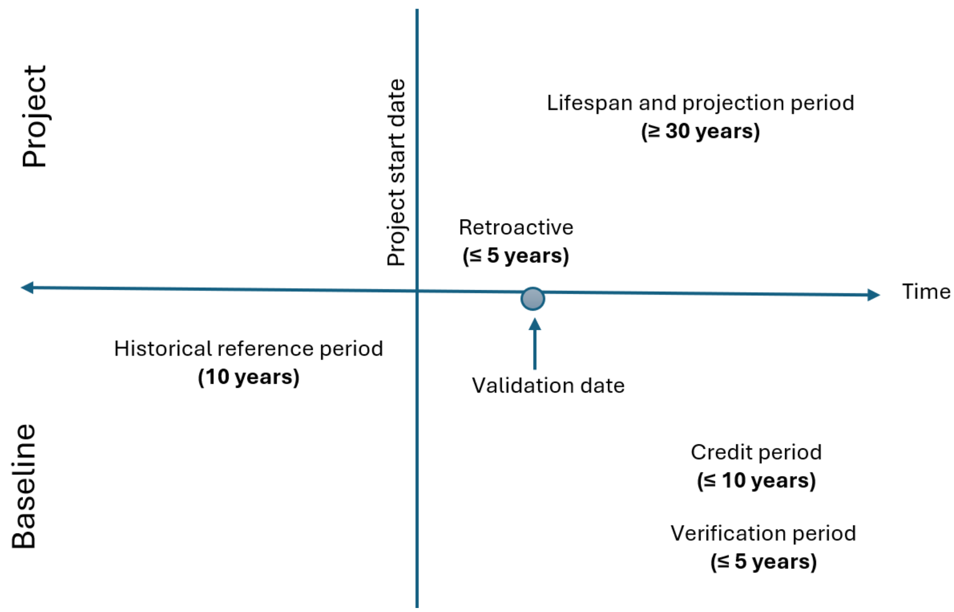


Illustration 2 *Time limits of a GHGMP*

6.2 Spatial Limits

The GHGMP must identify and delimit the areas that are subject to monitoring according to the REDD+ activities developed. The spatial limits of a GHGMP for the ICR activity are as follows:

6.2.1 Project area

This area corresponds to parcels or tracts of land over which the project proponent has the legal right to land tenure and therefore can carry out REDD+ activities. This right must be held by the proponent from the project start date. The project area where ICR is submitted only corresponds to areas of permanent forest that has been degraded. It must be considered that all forest areas that are planned to be deforested for the construction of infrastructure, transmission lines, or activities that have an environmental license, must be subtracted from the project area. The following criteria must be considered to identify the project area:

- Name or names of properties or areas.
- Spatial delimitation of the project area. It can be presented in different vector formats that are applicable in a GIS (e.g., shp, Geopackage, kml, among others).
- Describe the current situation of land tenure and legal ownership of the territory.
- List all participants and their roles within the GHGMP.

6.2.1.1 Grouped projects

Apply the considerations of the framework methodology.

6.2.2 Reference Region

This module does not include a reference region.

6.2.3 Potential Leakage Area

The indications of the framework methodology must be followed.

7. APPLICABLE RESERVOIRS

The carbon reservoirs included in the different activities contemplated by this methodology will be those that can be measurable and significant with respect to the GHGMP baseline. The selected reservoirs must be quantified in both the baseline scenario and the project scenario. The following is a list of the reservoirs that could be included in a GHGMP.

Table 1 Reservoirs applicable to ICR activities.

Reservoir	ICR	Description
Aerial biomass	Yes	This reservoir should be included. It corresponds to the living biomass found on the ground, including stems, branches, bark and foliage. Expected to be maintained in conserved forest cover or to increase in areas where forest cover is established.
Belowground biomass	Yes	All living root biomass. Excludes fine roots less than 2 mm in diameter. Expected to be maintained in conserved forest cover or to increase in areas where forest cover is established.
Deadwood	Opt	Includes dead aboveground biomass, dead roots and stumps of individuals 10 cm or more in diameter. Must be significant and adequately accounted for, can be monitored.
Leaf litter	Opt	Includes all aboveground dead plant biomass less than 10 cm in diameter. It must be justified as a significant reservoir and for its inclusion it must be possible to monitor it.
Soil Organic Carbon	Opt	Comprises all organic carbon stored in the soil; the depth of estimation must be justified by the proponent. Must be meaningful and adequately justified, can be monitored.
Timber products	No	It relates to the timber products generated as a consequence of harvesting, extraction, transport and transformation of timber

Reservoir	ICR	Description
		individuals, understanding that the harvesting of individuals does not generate the immediate release of stored carbon.

Where: ICR: Increase in Carbon Reserves, Opt: Optional.

8. EMISSION SOURCES

8.1 Unplanned emission reduction activities

All emission sources must be identified in the baseline scenario and for their inclusion it must be demonstrated that they are expected to increase or be significant, coherent and consistent in the time scenarios evaluated (formulation scenario and implementation scenario). For this purpose, the different sources presented below (Table 2), should be evaluated as a minimum, and if significant, they should be monitored in turn in the project scenario. It is recommended to include emission sources that account for more than 5% of the total emissions calculated in the without project and with project scenarios. Any sources that are not significant in terms of GHG emissions should be conservatively excluded and should therefore also be excluded from monitoring in the with-project scenario.

For quantification of source emissions, equations, factors and recommendations from IPCC guidelines[8] [9], For quantification of source emissions, equations, factors and recommendations from IPCC guidelines, FREL methodologies submitted by the host country or GHG inventories consistent with the project area can be used.

[8] IPCC. (2003). Orientación del IPCC sobre las buenas prácticas para UTCUTS. Disponible en: kutt.it/laZFfp

[9] IPCC. (2006). Directrices del IPCC de 2006 para los inventarios nacionales de gases de efecto invernadero. Agricultura, silvicultura y otros usos de la tierra. Disponible en: kutt.it/iLd1fY

Table 2 Emission sources

Source	GHG	Applies Yes/No	Description
Increase in carbon reserves	CO_2	Yes	Emissions related to changes in carbon reservoirs.
	CH_4	Opt.	Only included if it is demonstrated that some type of technology associated with controlled fires is used to establish ecological restoration areas.
	N_2O	Opt.	
Change in land use	CO_2	Yes	Emissions caused by biomass change, if it is necessary to remove forest individuals of exotic or invasive species.
	CH_4	No	Consideration is given to whether fertilizer application practices are in place for ecological restoration.
	N_2O	No	

Where: Opt: Optional

When the information from the historical period regarding forest fires is sufficient and there is traceability of the areas burned for the establishment of agricultural activities, the emissions generated by these fires in terms of methane and nitrous dioxide are calculated following the IPCC guidelines[10]:

$$ECH4eq_i = ECO2eq_i * \frac{11}{44} * RMCH4 * TCH4 \ (1)$$

$ECH4eq_i$: CH_4 emission factor per stratum i burned.
$ECO2eq_i$: Emission factor of stratum i.
$RMCH4$: Methane to carbon molecular ratio constant given by 16/12.
TCHA: Methane emission rate 0.012.

[10] IPCC. (2003). Orientación del IPCC sobre las buenas prácticas para uso del suelo, cambio de uso del suelo y forestería. Disponible en: https://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_files/GPG_LULUCF_FULL.pdf

$$ENO2eq_i = ECO2eq_i * \frac{11}{44} * RMNO2 * TCNO24 * NC \ (2)$$

$ENO2eq_i$: NO_2 emission factor of stratum i burned.
$ECO2eq_i$: Emission factor of stratum i.
$RMNO2$: Molecular ratio constant of nitrogen dioxide and nitrogen given by 44/28.
TCNO24: Methane emission rate0,007.
NC: Nitrogen-carbon ratio 0,01.

9. BASELINE

9.1 Historical analysis of forest use

A geospatial analysis should be carried out to account for the dynamics of historical change of carbon assets in the permanent forest, using the analyses produced in the framework methodology in numeral 11.1.2.

Once the thematic map of forest degradation is available, the degraded forest should be stratified according to the history of disturbance. For this, the limiting and stressing factors must be taken into account first, and then the enhancing elements. The limiting agents are defined as those elements of biotic and abiotic origin that prevent ecological trajectories from being self-sustaining, such as invasion caused by exotic species or the reduction of humidity caused by wind action. On the other hand, stressors are those elements of the biophysical or social environment that can help a more active restoration to occur. For example, the presence of key species or taxonomic groups in the successional process or the presence of economic associations that have the intention of conserving and restoring ecosystems.

Once the stressors and limiting agents have been identified, degraded forests should be stratified according to their interaction. For example, forests with limiting factors such as forests on salinized soils, forests under livestock grazing, forests with presence of exotic species, forests with relative humidity deficit, among others, should be stratified according to their interaction.

This analysis should be complemented with the analysis of drivers, agents and underlying causes of deforestation and forest degradation, trying to emphasize how the agents have caused or contributed to both limiting and stressing agents to be maintained over time by type of degraded forest. For example, the use of pastures for livestock, or the introduction of invasive species such as cattle that depredate natural regeneration, invasive plants that prevent the re-emergence of secondary or primary successions, or the felling of certain trees that serve as windbreaks or shades that prevent the optimal development of the forest (e.g., the process of paramization of the high Andean Forest ecosystem).

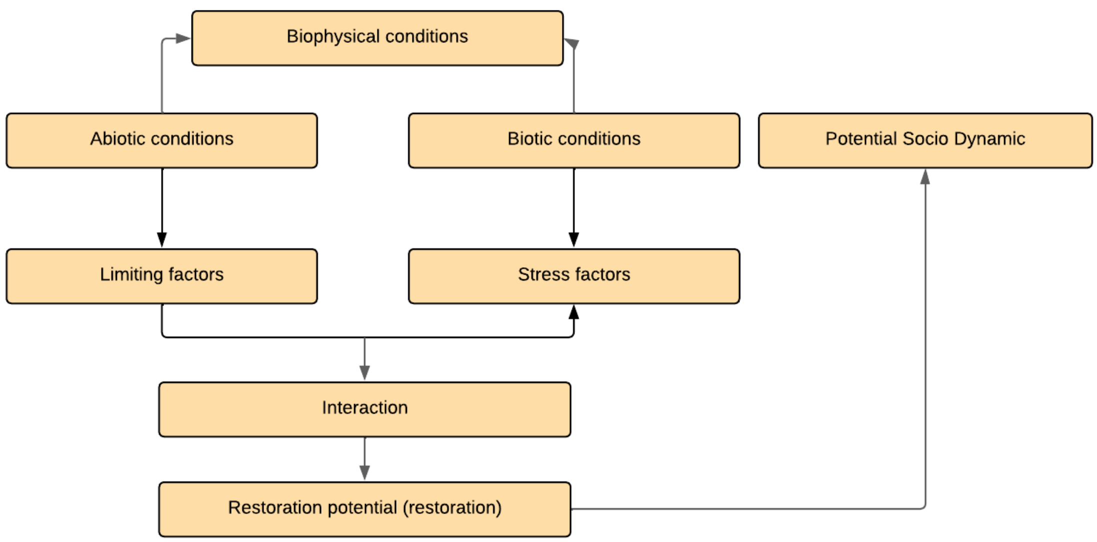


Illustration 3 *Definition of limiting and stressing factors* [11]

In this case, the study should be complemented with participatory social mapping to confirm and reinforce the information available on the dynamics of disturbance of the permanent forest. This study should detail their main characteristics, the limiting or stressing factors associated with them, and how the drivers of deforestation and forest degradation are associated with the disturbance history of each category. Finally, a timeline should be made, which

[11] BACHAQUEROS, Fundación Estación Biológica. Protocolo Distrital de Restauración Ecológica. Guía para la restauración de ecosistemas nativos en las áreas rurales de Santafé de Bogotá. *Alcaldía Mayor de Santafé de Bogotá. Departamento Técnico Administrativo del Medio Ambiente. Dama*, 2000.

is recommended to be participatory, showing how the dynamics of disturbance has been for each type of degraded forest.

9.2 Forest Inventory

Once the degraded forest strata have been confirmed with respect to the disturbance history, a stratified forest inventory is carried out to identify the state of the carbon reservoirs in their initial state; the data of the reservoirs should have an error of 10% and a confidence interval of 95%. The plots identified in this forest inventory should be taken as permanent and their monitoring should be carried out every year.

$$n = \frac{t_{2m-1}^2 \times \sum_{j=1}^{m} P_j S_j^2}{E\%^2 + \frac{(t_{2m-1}^2 \times \sum_{j=1}^{m} P_j S_j^2)}{N}} \quad (3)$$

Where:

n = *Number of parcels required in the sampling to estimate accumulated biomass.*

N = *Maximum total number of possible parcels to be sampled in the whole area.*

t_{2m-1}^2 = *Value of the two-way t-student table, with required precision (confidence) and degrees of freedom.*

P_j = *Relative weight of the area of stratum j with respect to the total area, area of stratum j divided by the project area.*

m = *Total number of strata generated.*

S_J *(ton biomass/ha)* = *Estimated standard deviation of accumulated biomass in stratum j.*

9.3 Emission Factors

The emission factors of the reservoirs and/or emission factors[12] to be used for ICR of the initial state of degraded forests must come from their own source; under no circumstances will reservoirs from other sources, including official sources, be accepted. Emission factors should also be measurable and

[12] Según la decisión 12/CP. 17 de la CMNUCC los NREF/NRF deben ser expresados en toneladas de dióxido de carbono equivalente por año.

verifiable to allow for monitoring, reporting and verification, considering national capabilities in accordance with decision 9/CP.19.

For the development of emission factors, calculations in carbon reservoirs should be considered through inventories that present an error of less than 10%, with a confidence level of 95%; local data should be generated from forest inventories. For the identification of these emission sources, methodological reconstructions of the processes defined by the FREL, GHG inventories or national inventories, applicable to the GHGMP, can be used. When the host country does not have any forest monitoring mechanism, it is not applicable for the development of a GHGMP according to decision 9/CP.19.

$$\Delta BA_i = (BA_{t1} - BA_{t2}) * RM * FC \quad (4)$$

ΔBA_i: Removal or emission factor of the reservoir of aerial biomass in terms of Mg CO_2 per hectare of stratum i.

BA_{t1}: Biomass area at the initial time in terms of Mg of biomass per hectare of stratum i

BA_{t2}: Biomass area at the final time in terms of Mg of biomass per hectare of stratum i.

RM: Carbon dioxide and carbon dioxide molecular ratio constant given by 44/12.

FC: Biomass carbon ratio constant, a value of 0.45, the Nref value, or a value that fits the project area, is recommended.

$$\Delta BS_i = (BS_{t1} - BS_{t2}) * RM * FC \quad (5)$$

ΔBS_i: Belowground biomass reservoir removal or emission factor in terms of Mg of CO_2 per hectare of stratum i.

BS_{t1}: Belowground biomass at the initial time in terms of Mg of biomass per hectare of stratum i.

BS_{t2}: Belowground biomass at the final time in terms of Mg biomass per hectare of stratum i.

RM: Carbon dioxide and carbon dioxide molecular ratio constant given by 44/12.

FC: Biomass carbon ratio constant, a value of 0.45, the Nref value, or a value that fits the project area, is recommended.

$$\Delta MM_i = (MM_{t1} - MM_{t2}) * RM * FC \quad (6)$$

ΔMM_i: Dead biomass reservoir removal or emission factor in terms of Mg CO_2 per hectare of stratum i.

MM_{t1}: Dead biomass at the initial time in terms of Mg of biomass per hectare of stratum i.

MM_{t2}*: Dead biomass in the final time in terms of Mg of biomass per hectare of stratum i.*
RM : Molecular ratio constant of carbon dioxide and carbon given by 44/12.
FC: Biomass carbon ratio constant, a value of 0.45, the Nref value, or a value that fits the project area, is recommended.

$$\Delta LIT_i = (LIT_{t1} - LIT_{t2}) * RM * FC \ (7)$$

ΔLIT_i*: Leaf litter reservoir removal or emission factor in terms of Mg of* CO_2 *per hectare of stratum i.*
LIT_{t1}*: Litterfall at the initial time in terms of Mg of biomass per hectare of stratum i.*
LIT_{t2}*: Litterfall in the final time in terms of Mg of biomass per hectare of stratum i.*
RM : Carbon dioxide and carbon dioxide molecular ratio constant given by 44/12.
FC: Biomass carbon ratio constant, a value of 0.45, the Nref value, or a value that fits the project area, is recommended.

$$\Delta COS_{20i} = \frac{(COS_{t1} - COS_{t2})}{20} * RM * FC \ (8)$$

ΔCOS_{20i}*: Soil organic carbon reservoir removal or emission factor in terms of Mg* CO_2 *per hectare of stratum i.*
ΔCOS_{t1}*: Soil organic carbon at the initial time in terms of Mg carbon per hectare of stratum i.*
ΔCOS_{t2}*: Soil organic carbon at the end time in terms of Mg carbon per hectare of stratum i.*
RM : Carbon dioxide and carbon dioxide molecular ratio constant given by 44/12.
FC: Biomass carbon ratio constant, a value of 0.45, the Nref value, or a value that fits the project area, is recommended.

The following equation is used to calculate the total emission per stratum i:

$$ECO2eq_i = (\Delta BA_i + \Delta BS_i + \Delta LIT_i + \Delta MM_i + \Delta COS_{20i}) \ (9)$$

Where:
$ECO2eq_i$*: Removal or emission factor of stratum I.*
ΔBA_i*: Aerial biomass reservoir removal or emission factor in terms of Mg per hectare of stratum i.*
ΔBS_i*: Belowground biomass reservoir removal or emission factor in terms of Mg* CO_2 *per hectare of stratum i.*

ΔLIT_i: *Leaf litter reservoir removal or emission factor in terms of Mg of* CO_2 *per hectare of stratum i.*

ΔMM_i: *Dead biomass reservoir removal or emission factor in terms of Mg* CO_2 *per hectare of stratum i.*

ΔCOS_{20i}: *20-year soil organic carbon reservoir removal or emission factor in terms of Mg of* CO_2 *per hectare of stratum i.*

10. ADDITIONALITY [13]

10.1 Scope

- This methodology provides a step-by-step approach to how to demonstrate the additionality of a GHGMP that includes ICR activities [14].
- When evaluating this tool, the VVB must assess the credibility and adequacy of the data, rationale, assumptions, justifications and documentation supporting these analyses provided by the GHGMP developer, considering their applicability.
- For an ICR project to be additional, it must meet all the requirements of this methodological section.

10.2 Applicability

This procedure is applicable under the following considerations:

- Applies to passive and active ecological restoration activities aimed at increasing carbon reserves.
- Projects that are derived from legal mandates, national or local regulations that lead to the implementation of a restoration project in permanent forests will not be considered additional. When such policies exist, the developer may conduct an analysis that demonstrates the inoperability or lack of financial, technological and social resources that demonstrate that

[13] Adapted from: CDM (2007). A/R Methodological Tool "Tool for the Demonstration and Assessment of Additionality in A/R CDM Project Activities" (Version 02). Fuente: https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-01-v2.pdf

[14] According to the ColCX Standard, ICR activities are carbon reserves enhancement activities and only apply to areas of permanent forest.

such regulations have not been systematically applied. General regulations such as constitutional articles, precautionary measures or norms that oblige the host country's citizens to take care of the environment or safeguard the nation's natural resources do not apply.

- Projects that are the result of environmental impact compensation, or that already enjoy the benefits of payment for environmental services, are not additional.

To support and demonstrate the additionality of a large-scale GHGMP, the following steps must be followed:

10.3 Step 1: Identification of the successional trajectory scenario without GHGMP

This step is used to identify a scenario showing what the trajectory of the degraded forest would be like without the intervention of the GHGMP:

Sub-step 1a: Identify a credible successional scenario without GHGMP intervention:

The successional scenario without the intervention of the GHGMP must be credible and supportable in such a way that it reflects a likely scenario that accounts for what would occur within the boundaries of the degraded forest in the absence of GHGMP activities. This scenario must be consistent at the level of disturbance trends as a function of limiting and stressing agents in historical natural forests.

The land use scenarios identified should include at least the following:

- Continuation of disturbance trends as a function of limiting and stressing agents prior to the implementation of the GHGMP.
- Disturbances, limiting agents and stressors within the boundaries of the GHGMP.
- Disturbances may be included as a function of limiting and stressing agents from other areas similar to the activities within the boundaries of the GHGMP as long as they occur in locations found in the same river basin in forests with similar ecological conditions in terms of humidity, soil and solar radiation.

To identify whether the successional scenario without the intervention of the GHGMP is credible, the proponent must provide information on historical facts of the territory, surveys, or other documentation from official sources, and may also include information from participatory workshops conducted with the communities. This can include territorial planning documents, policies and regulations that make the disturbances identified as a function of limiting and stressing agents in natural forests credible.

- ***Sub-step 1b.*** Identification of the activities necessary to deal with disturbances, limiting agents and stressors.

List all limiting agents and stressors identified in the successional without the intervention of the credible GHGMP. Show evidence supporting the existence or likelihood of existence of these identified limiting and stressing agents. Justify why there are problems in the identified enhancer agents that prevent them from carrying out restoration strategies.

With the list of all the limiting agents, stressors and explanations of why the enhancing agents do not perform restoration strategies, generate a list of activities necessary to perform an adequate restoration, followed by a justification of their application.

Then, make an analysis showing what this degraded forest would look like in the successional trajectory scenario without GHGMP and with the implementation of the necessary strategies for restoration.

If the scenario that successional scenario without GHGMP intervention is credible is equal to the hypothetical with GHGMP activities, then the project is not additional.

If the successional scenario without the intervention of the credible GHGMP is different from the hypothetical one with GHGMP activities, perform a barrier analysis of the activities necessary for adequate restoration.

10.4 Step 2. Barrier analysis

Determine whether the successional trajectory that would emerge if the project implement restoration activities will face barriers that prevent implementation without the revenue from the sale of GHG credits.

Use the following secondary steps:

- ***Sub-step 2a.*** Identify the barriers that would prevent the implementation of the activities necessary to achieve the proposed successional trajectory.

Establish the existence of barriers that would prevent implementation of the activities necessary to achieve the proposed successional trajectory if the project were not registered as a GHGMP with COLCX. The barriers should not be specific to the GHGMP or the project proponents. Such barriers may include the following, but are not limited to:

a) Barriers to investment:
   i) Financial barriers faced by similar restoration projects that would not occur without funding from international grants, foundations, or the state
   ii) Debt financing capacity is not available for this type of project activity
   iii) Lack of access to credit

b) Institutional barriers, among others:
   i) Risks related to changes in governmental policies or laws
   ii) Lack of enforcement of legislation related to forest restoration or land use

c) Technological barriers, among others:
   i) Lack of access to planting materials
   ii) Lack of equipment and/or infrastructure for the implementation of the technology to be used

d) Barriers related to local tradition, among others:
   i) Traditional knowledge or lack thereof, laws and customs, market conditions, practices, etc.
   ii) Traditional equipment and technology

e) Barriers due to prevailing practice, among others:
   i) The project activity is the “first of its kind”: no project activity of this type is currently in operation in the host country or region.

f) Barriers due to local ecological conditions, among others:

i) Degraded soils (e.g., water/wind erosion, salinization, etc.)
ii) Natural and/or human-induced catastrophic events (e.g., landslides, fires, etc.)
iii) Unfavorable weather conditions (e.g., early/late frost, drought, etc.)
iv) Ubiquitous opportunistic species that impede tree regeneration (e.g., grasses, weeds)
v) Unfavorable course of ecological succession
vi) Biotic pressure in terms of grazing, forage harvesting, etc.

g) Barriers due to social conditions and land use practices, among others:

i) Demographic pressure on land (e.g., increased demand for forest products to meet human needs)
ii) Social conflict between interest groups in the region where the project is being developed
iii) Widespread illegal practices (e.g. illegal grazing, extraction of non-timber products and logging)
iv) Shortage of available workforce to carry out the ecological restoration activity
v) Lack of skilled and/or adequately trained workforce
vi) Lack of organization of local communities

h) Barriers caused by the local organization of communities

i) Barriers related to land tenure, ownership, inheritance and property rights, among others:

i) Communal landownership with a hierarchy of rights for different stakeholders limits the incentives to carry out ecological restoration activity
ii) Lack of adequate land tenure legislation and regulation to support security of tenure
iii) Absence of clearly defined and regulated property rights in relation to natural resource products and services
iv) Formal and informal tenure systems that increase the risks of fragmentation of land tenure
v) The remoteness of ecological restoration activities and the undeveloped roads and infrastructure generate high

transportation costs, which erodes the competitiveness and profitability of this type of activities

vi) Risk of facing high prices for the inputs necessary to carry out the ecological restoration activity

vii) Lack of facilities for germination, sowing, propagation and establishment, which limits the possibilities of carrying out restoration activities

The identified barriers can only be considered sufficient grounds for a demonstration of additionality if they would prevent potential project proponents from carrying out the restoration project activity if the project was not expected to be registered as a GHGMP.

- ***Sub-step 2b.*** Provide evidence to support the identified barriers

Provide documented and transparent evidence, and offer conservative interpretations of this documented evidence, as to how it demonstrates the existence and significance of the identified barriers. Anecdotal evidence may be included but alone is not sufficient proof of barriers. The type of evidence to be provided may include:

i) Relevant legislation, regulatory information or environmental/natural resource management standards, acts or rules

ii) Relevant (sectoral) studies or surveys (e.g., market studies, technology studies, etc.) conducted by universities, research institutions, NGOs, associations, companies, bilateral/multilateral institutions, etc.

iii) Relevant statistical data from national or international statistics

iv) Documentation of relevant market data (e.g., market prices, tariffs, rules, etc.)

v) Written documentation from the company or institution developing or implementing the GHGMP activity or from the GHGMP developer, such as minutes of Board meetings, correspondence, feasibility studies, financial or budgetary information, etc.

vi) Documents prepared by the project developer, contractors or project partners in the context of the proposed project activity or previous similar project implementations

vii) Written documentation of independent expert judgments from governmental/non-governmental agencies related to ecological restoration or individual experts, educational institutions (e.g., universities, technical schools, training centers), professional associations, and others

- ***Sub-step 2c.*** Demonstrate that the identified barriers prevent the activities necessary for adequate restoration from being carried out without climate finance from a GHGMP.

Explain how the identified barriers prevent the implementation of all activities necessary for adequate restoration. If no barriers to adequate restoration are found or their support is weak, the project cannot be considered as additional.

If, on the other hand, the activities necessary for adequate restoration, and only with climate finance from a GHGMP, can be solved, then the ICR project is additional.

11. BASELINE SCENARIO

The baseline scenario is constructed with respect to the estimated emissions that would be incurred if the ecological restoration process is initiated, for example, if fire must be used to initiate a secondary succession process, or if plant material needs to be removed, fertilized, or agronomic or civil engineering techniques used to eliminate or control limiting or stressing factors. GHG removals from ICR activities begin to be quantified once the forest inventory is completed. In any case, for any degraded forest stratum with respect to the identified disturbance history, additionality must be demonstrated.

12. FORMULATION SCENARIO

The formulation scenario is based on projections based on the modeling of the increase in GHG removals, for which secondary studies or own studies can be taken as a reference to show how this trend of increase in stocks would be[15], this multitemporal modeling, by stratum of degraded forest, must be done for the lifetime of the project and replaces the $APBARCfi$ factor in equation 26. An efficiency coefficient must be subtracted from this factor, which must be in the order of 70% to 90% and its choice must be justified by the proponent and is called EF. This is supported by the activities generated by the proponent. The by the factor $(1 - Ef)$ should be multiplied year by year according to the total projected removals.

$$CO2APBARC_{i,t} = (APBARCf_i) * ECO2eq_i \quad (10)$$

$$\Delta CP_{T,t} = \sum CO2APBARC_{i,t} \quad (11)$$

Where:

$CO2APBARC_{i,t}$: Increase in CO_2 equivalent removals from degraded forest of stratum i in year t, from the project area.

$CO2APBARC_t$: Increase in CO_2 equivalent removals from degraded forest of stratum i in year t, from the project area.

$APBARCf_i$: Area of degraded forest stratum i at the start date of the GHGMP, in hectares.

$ECO2eq_i$: Removal factor of the degraded forest stratum i

$$\Delta ARC_{ACTUAL,t} = \Delta CP_{T,t}(1 - Ef) - GEI_{E,t} (12)$$

Where:

$\Delta ARC_{ACTUAL,t}$ (tCO_2e) = These are the projected net removals of CO_2 by sinks at year t, the changes in carbon stocks, as well as their uncertainty, should be made following the guidelines of the A/R TOOL 14[16].

$\Delta CP_{T,t}$ (tCO_2e) = Carbon reserves increases in the project's sinks projected to year t.

[15] Ríos-Camey, J. M., Aguirre-Calderón, O. A., Treviño-Garza, E. J., Jiménez-Pérez, J., Alanís-Rodríguez, E., & Santos-Posadas, H. M. D. L. (2021). Crecimiento e incremento en biomasa y carbono de Pinus teocote Schltdl. et Cham. y Pinus oocarpa Schiede., Guerrero, México. *Revista mexicana de ciencias forestales*, *12*(67), 81-108.

[16] CDM. 2011. Methodological tool Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities. En: ar-am-tool-14-v4.2.pdf (unfccc.int)

$GEI_{E,t}$ *(t) = GHG emissions other than* CO_2 *expressed in* CO_2e *through the corresponding PCG, that occur within the project area and in the vicinity of its boundary area no greater than 3 meters outside. These emissions are caused by establishment and management practices of the project, in year t. They are estimated in accordance with the A/R TOOL 08*[17] *and its* CO_2*equivalence will be made according to the latest IPCC assessment report (AR5).*

Ef *: Project efficiency ratio.*

Once the projection of the increase in removals in the formulation scenario has been estimated, the estimation of COLCERS, COLCX carbon certificates, is made with the following formula:

For the carbon reserves enhancement compartment ICR:

$$COLCERSDef_t = (\Delta ARC_{ACTUAL,t}) - (\Delta ARC_{ACTUAL,t} * RNP) \quad (13)$$

Where:

$COLCERSDef_t$ *: baseline COLCX certificates that are attributable to avoided deforestation activities.*

RNP *: Risk of non-permanence.*

13. IMPLEMENTATION SCENARIO

The calculations for the implementation scenario are the same as for the formulation scenario, except for the values for each carbon reservoir. In the case of aboveground biomass, the CDM AR-TOOL14 tool should be used as a reference, as shown in the following steps[18]. For the other reservoirs, methodologies also endorsed by the CDM, national GHG inventory methodologies, research institutes or scientific methodologies published in indexed scientific journals can be used. In any case, the project developer must present the concepts, assumptions, and methodological steps to calculate carbon removal in each reservoir.

[17] Adaptado de: CDM (2011). A/R Methodological Tool ìEstimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activityî (Version 04.0.0). Fuente: https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-08-v2.pdf

[18] CDM. 2011. Methodological tool Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities. En: ar-am-tool-14-v4.2.pdf (unfccc.int)

13.1 Estimating the change in carbon assets in trees between two points in time

$C_{TREE,t}$ = *Carbon reserve in tree biomass within the project boundary at a given time in year t.*
$\Delta C_{TREE,t}$ = *Carbon assets change in tree biomass within the project boundaries in year t.*

13.1.1 Difference between two independent assets estimates

Carbon assets change and associated uncertainty

$$\Delta C_{TREE} = C_{TREE,t_2} - C_{TREE,t_1} \quad (14)$$

$$u_{\Delta C} = \frac{\sqrt{(u_1 * C_{TREE,t_2})^2 + (u_2 - C_{TREE,t_1})^2}}{|\Delta C_{TREE}|} \quad (15)$$

Where:

ΔC_{TREE} = *Change in carbon assets in trees during the period between two time points t1 and t2; tons CO2e.*
C_{TREE,t_1} = *Estimated carbon stock in trees at time t1; tons of CO2e*
Note 1. In the first check C_{TREE,t_1} *is set equal to the carbon stock in the pre-project tree biomass* ($C_{TREE,t_1} = \Delta C_{TREE\_BSL}$)*.*
Note 2. Even if C_{TREE,t_1} *was made conservative at the time of the pre-check, it is the estimated (undiscounted) value of* C_{TREE,t_1} *that is used here.*
C_{TREE,t_2} = *Carbon assets in trees estimated at time t2; tons of CO2e.*
$u_{\Delta C}$ = *Uncertainty in* ΔC_{TREE}*.*
$u_{1,}u_2$ = *Uncertainties in* C_{TREE,t_1}, C_{TREE,t_1} *respectively.*

13.1.2 Direct estimation of change on remeasurement of sample plots

$$\Delta C_{TREE} = \frac{11}{44} * CF_{TREE} * \Delta B_{TREE} \quad (16)$$

$$\Delta B_{TREE} = A * \Delta b_{TREE} \quad (17)$$

$$\Delta b_{TREE} = \sum_{i=1}^{M} W_i * \Delta b_{TREE,i} \quad (18)$$

$$u_{\Delta C} = \frac{t_{V\,AL} * \sqrt{\sum_{i=1}^{M} W_i^2 * \frac{S_{\Delta,i}^2}{n_i}}}{|\Delta b_{TREE}|} \quad (19)$$

Where:

ΔC_{TREE} = *Change in carbon assets in trees between two successive measurements; tons of CO2e.*
CF_{TREE} = *fraction of carbon in tree biomass; tons of C.*
A default value of 0.47 is used unless transparent and verifiable information can be provided to justify a different value.
ΔB_{TREE} = *Change in tree biomass within biomass estimation strata; ton of dry matter per ha.*
A = *Sum of areas of the biomass estimation strata; ha.*
Δb_{TREE} = *Mean change in tree biomass per hectare within biomass estimation strata; ton dry matter per ha.*
W_i = *Ratio of the area of stratum i to the sum of biomass areas* $i.e.w = A_i/A$; *dimensionless.*
$\Delta b_{TREE,i}$ = *Average change in carbon assets per hectare in tree biomass in stratum i; ton of dry matter per ha.*
$u_{\Delta C}$ = *Uncertainty in* ΔC_{TREE}.
$t_{V\,AL}$ = *Bilateral Student's t-value for 90% confidence level and degrees of freedom equal to n - M, where n is the total number of sample parcels within the tree biomass estimation strata, and M is the total number of tree biomass estimation strata.*
$S^2_{\Delta,i}$ = *Variance of mean change in tree biomass per hectare in stratum i;* $(t\ d.\ m.\ ha^{-1})^2$.
n_i = *Number of sample parcels, in stratum i, in which tree biomass was remeasured.*

The mean change in trees biomass per hectare in a stratum and the associated variance are estimated as follows:

$$\Delta b_{TREE,i} = \frac{\sum_{p=1}^{n_i} \Delta b_{TREE,p,i}}{n_i} \quad (20)$$

$$S^2_{\Delta,i} = \frac{n_i * \sum_{p=1}^{n_i} \Delta b^2{}_{TREE,p,i} - (\sum_{p=1}^{n_i} \Delta b_{TREE,p,i})^2}{n_i * (n_i - 1)} \quad (21)$$

Where:

$\Delta b_{TREE,i}$ = *Average change in tree biomass per hectare in stratum i; ton of dry matter per hectare*
$\Delta b_{TREE,p,i}$ = *Change in the tree biomass per hectare in plot p in stratum i; ton of dry matter per ha.*
$S^2_{\Delta,i}$ = *Variance of mean change in tree biomass per hectare in stratum i;* $(tdm\ ha^{-1})^2$
n_i = *Number of sample parcels, in stratum i, in which tree biomass was remeasured.*

If $\boldsymbol{u}_{\Delta C}$ estimated is greater than 10 percent, $\Delta \boldsymbol{C}_{\boldsymbol{TREE}}$ is made conservative by applying uncertainty discounting according to the procedure provided in Appendix 2 of CDM AR-TOOL14.

The trees biomass per hectare in a sample plot is estimated by applying one of the measurement methods provided in Appendix 1 of CDM AR-TOOL14.

13.1.3 Proportional canopy coverage estimates

This method is applicable only in the formulation scenario estimation of the change in tree carbon assets in the baseline when the pre-project tree canopy cover is less than 20 percent of the tree canopy cover threshold.

The change in carbon assets in trees in the baseline is estimated as follows:

$$\Delta C_{TREE\_BSL} = \sum_{i=1}^{M} \Delta C_{TREE\_BSL,i} \quad (22)$$

$$x\Delta C_{TREE\_BSL} = \frac{44}{11} * CF_{TREE} * \Delta b_{FOREST} * (1 + R_{TREE}) * \Delta C_{TREE_{BSL},i} * A_i \quad (23)$$

Where:

ΔC_{TREE_BSL} = *Average annual change in carbon assets in trees at baseline; t CO2e yr-1.*

$\Delta C_{TREE_{BSL},i}$ = *Mean annual change in tree carbon assets at baseline, in stratum i of baseline; t CO2e yr-1.*

CF_{TREE} = *Carbon fraction of tree biomass; tons of C.*

A default value of 0.47 is used unless transparent and verifiable information can be provided to justify a different value.

Δb_{FOREST} = *Default average annual increment of aboveground biomass in the forest in the region or country where the F/R CDM project activity is located; t dm ha-1 yr-1.*

Values of Δb_{FOREST} *are taken from Table 3A.1.5 of the IPCC Practical Guide for Land Use, Land Use Change and Forestry 2003, unless transparent and verifiable information can be provided to justify different values.*

Note. Tree biomass can reach a steady state where biomass growth becomes zero or negligible, either because of the biological maturity of the trees or because the rate of anthropogenic biomass removal from the area is equal to the rate of biomass growth.

Therefore, this parameter should be taken as zero after the year in which the tree biomass in the baseline reaches a steady state. The year in which the tree biomass in the baseline reaches steady state is taken as the 20th year since the start of the project activity, unless transparent and verifiable information can be provided to justify a different year.

R_{TREE} *= Root-stem ratio for trees in the baseline; dimensionless decrease in carbon reserves in trees; A default value of 0.25 is used unless transparent and verifiable information can be provided to justify a different value.*
$CC_{TREE_{BSL},i}$ *= Baseline tree canopy cover, in baseline stratum i, at the start of the F/R CDM project activity, expressed as a fraction (e.g., 10 percent canopy cover implies = 0.10); dimensionless.*
A_i *= Area of baseline stratum i, delineated based on tree canopy cover at the start of the project activity, ha.*

13.1.4 Demonstration of "non-diminution"

This method is applicable only in the ex-post estimation of the change in tree carbon reserves for the monitoring of project activities. Project participants may, at the time of verification, demonstrate that the biomass of trees in one or more strata has not decreased relative to the biomass of trees at the time of the previous verification, by demonstrating that:

a) No harvesting has occurred in the stratum since the previous verification
b) The stratum was not affected by any disturbance (e.g., pests, fire) that would decrease the carbon reserves in the trees
c) Remote sensing data or inventory data, including participatory inventory or participatory photographic mapping data, demonstrate that the canopy cover of the trees in the stratum has not decreased since the previous verification.

When it is demonstrated that the above three conditions have been met in a stratum, the change in carbon assets in the trees of that stratum since the previous verification can be conservatively estimated as zero.

Note. This method is efficient when project participants are required to submit a verification and certification report at a time when the increase in biomass in the project since the previous verification may not be large enough to justify the cost of conducting an inventory (e.g., when periodic verification and certification is required to revalidate COLCERs already issued and a significant number of new COLCERs are not expected).

13.2 Estimating the change in carbon assets in trees in one year

The change in tree carbon assets in one year (annual change) between two successive verifications is estimated by assuming a linear change.

$$\Delta C_{TREE_t} = \frac{C_{TREE,t_2} - C_{TREE,t_1}}{T} * 1año \quad (24)$$

Donde

ΔC_{TREE_t} = *Change in carbon assets in trees within the project boundary in year t; tons CO2e*

C_{TREE,t_2} = *Carbon stock in trees within the project boundary at time t2; t CO2e.*

Note. When the estimation of carbon assets in tree biomass at time t2 is carried out by applying different methods in different strata, C_{TREE,t_2} *is set equal to the sum of carbon assets in all strata into which the project area is divided.*

C_{TREE,t_1} = *Carbon stock in trees within the project boundary at time t1; t CO2e.*

Note. When the estimation of carbon assets in tree biomass at time t2 is carried out by applying different methods in different strata, C_{TREE,t_1} *is set equal to the sum of carbon assets in all strata into which the project area is divided.*

T = Time elapsed between two successive estimates (T=t2 - t1); years

Note 1. The value of T does not have to be an integer (e.g., an interval of 4 years and 5 months implies T = 4.417 years).

Note 2. Estimating the change in tree carbon assets by proportional canopy cover results in an estimate of the annual change and, therefore, this equation is not applicable with this method.

13.3 Estimation of carbon assets in trees at a given point in time

Carbon reserves in trees at a given time are estimated using one of the following methods or a combination of these methods:

a) Estimation by measurement of sample parcels
b) Estimation through modeling of tree growth and stand development
c) Estimate for canopy coverage provided
d) Updating of old stock by independent measurement of change

When the estimation is carried out using methods (a), (c) or (d) above, the date of the last measurement of the sample parcel, or canopy cover estimation, is considered as the date of carbon assets estimation, even if the entire measurement process is spread over a period.

When the estimation of carbon assets in trees at a given time in year t is carried out by applying different methods in different strata, the value of $\Delta \boldsymbol{C}_{\boldsymbol{TREE}_t}$ is set equal to the sum of carbon reserves in all strata into which the project area was divided.

13.3.1 Estimation by measurement of sample parcels

According to this method, the carbon reserve in trees is estimated based on sample parcel measurements. Sample parcels are installed in one or more strata. Two sampling designs are available:

a) Stratified random sampling
b) Double sampling

13.3.1.1 Stratified Random Sampling

According to this method, random sampling plots are installed in the strata (e.g., systematic sampling with random start) and they are measured.

The average tree carbon assets within the tree biomass estimation strata and the associated uncertainty are estimated as follows (all time-dependent quantities are related to the time of measurement)

$$C_{TREE} = \frac{44}{12} * CF_{TREE} * B_{TREE} \quad (25)$$

$$B_{TREE} = A * b_{TREE} \quad (26)$$

$$B_{TREE} = \sum_{i=1}^{M} W_i * b_{TREE,i} \quad (27)$$

$$u_{\Delta C} = \frac{t_{V\,AL} * \sqrt{\sum_{i=1}^{M} W_i^2 * \frac{S_{\Delta,i}^2}{n_i}}}{b_{TREE}} \quad (28)$$

Where:

C_{TREE} = Carbon reserve in trees in the tree biomass estimation strata; tons CO2e.
CF_{TREE} = fraction of carbon in tree biomass; tons of C.
A default value of 0.47 is used unless transparent and verifiable information can be provided to justify a different value.
B_{TREE} = Tree biomass in the tree biomass estimation strata; ton of dry matter per ha.
A = Sum of areas of the tree biomass estimation strata; ha.
b_{TREE} = Average tree biomass per hectare in the tree biomass estimation strata; ton of dry matter per ha.
W_i = Ratio of the area of stratum i to the sum of biomass áreas $i.e. w = A_i/A$; dimensionless.
$b_{TREE,i}$ = Average tree biomass per hectare in stratum i; ton of dry matter per ha.
u_C = Uncertainty in C_{TREE}.
$t_{V\,AL}$ = Bilateral Student's t-value for 90% confidence level and degrees of freedom equal to n - M, where n is the total number of sample parcels within the tree biomass estimation strata, and M is the total number of tree biomass estimation strata.
$S_{\Delta,i}^2$ = Variance of mean change in tree biomass per hectare in stratum i; (t d. m. $ha^{-1})^2$.
n_i = Number of sample parcels in stratum i.

The average tree biomass per hectare in a stratum and the associated variance are estimated

$$b_{TREE,i} = \frac{\sum_{p=1}^{n_i} b_{TREE,p,i}}{n_i} \quad (29)$$

$$S_i^2 = \frac{n_i * \sum_{p=1}^{n_i} b^2{}_{TREE,p,i} - \left(\sum_{p=1}^{n_i} b_{TREE,p,i}\right)^2}{n_i * (n_i - 1)} \quad (30)$$

Where:

$b_{TREE,i}$ = Average tree biomass per hectare in stratum i; ton of dry matter per ha.
$b_{TREE,p,i}$ = Tree biomass per hectare in parcel p in stratum i; ton dry matter per ha.
S_i^2 = Variance of average tree biomass per hectare in stratum i; (tdm $ha^{-1})^2$
n_i = Number of sample parcels, in stratum i.

If $u_{\Delta C}$ estimated is greater than 10 percent, C_{TREE} is made conservative by applying uncertainty discounting according to the procedure provided in Appendix 2 of CDM AR-TOOL14.

Tree biomass per hectare in a sample plot is estimated by applying one of the measurement methods provided in Appendix 1 of CDM AR-TOOL14.

13.3.1.2 Double Sampling

With this method, a secondary variable is measured in all sample parcels of a stratum and tree biomass is measured in a subset of the same sample plots. The mean biomass and its variance are estimated from the parcel biomass values measured in the subsample and are fitted by regressing the parcel biomass values against the observed parcel values of the secondary variable in the subsample.

This method is applicable only if there is a linear relationship between the parcel biomass values and the parcel values of the secondary variable (i.e., the best fit curve is a straight line) within the range of values.

Note. This method is efficient when the spatial distribution of tree biomass in the area is very heterogeneous and does not show 'block patterns' at a significant scale and, therefore, does not allow the delimitation of strata. The method is most efficient when the cost of obtaining the secondary variable values is low compared to the cost of measuring parcel biomass, and the correlation between the secondary variable and the measured plot biomass values is high.

Equations (12) to (15) are also applied in this method to aggregate the mean and its variance over the strata. However, for each stratum where double sampling is applied, the following equations apply instead of Equations (16) and (17)

$$\Delta b_{TREE,i} = \frac{\sum_{p=1}^{n_i} b_{TREE,p,i}}{n_i} + \beta * (\bar{X}' - \bar{x}) \quad (31)$$

$$S_i^2 = \frac{n_i * \sum_{p=1}^{n_i} b^2{}_{TREE,p,i} - (\sum_{p=1}^{n_i} b_{TREE,p,i})^2}{n_i * (n_i - 1)} * (1 - (1 - \alpha) * \rho^2 \quad (32)$$

Where:

$\Delta b_{TREE,i}$ = *Average tree biomass per hectare in strata i; t dm ha-1*

$b_{TREE,p,i}$ = *Tree biomass per hectare on parcel p of stratum i; t dm ha-1*
n_i = *Number of sample parcels in the subsample*
β = *Slope of the regression line of tree biomass per hectare in a sample parcel against the value of the secondary variable of the parcel*
$\bar{X}'$ = *Mean value of the secondary variable across all sample plots*
$\bar{x}$ = *Mean value of the secondary variable in the subsample of sample parcels in which tree biomass is also measured*
S_i^2 = *Variance of average tree biomass per hectare in stratum i*
α = *Ratio between the number of sample parcels in the sub-sample and the number of sample parcels in the sample (α <1)*
ρ = *Correlation coefficient between the secondary variable and tree biomass per hectare in a sample parcel, estimated in all sample parcels of the subsample.*

Tree biomass per hectare in a sample plot is estimated by applying one of the measurement methods provided in Appendix 1 of CDM AR-TOOL14.

If $\boldsymbol{u_C}$ estimated is greater than 10 percent, $\boldsymbol{C_{TREE}}$ se is made conservative by applying uncertainty discounting according to the procedure provided in Appendix 2 of CDM RA-TOOL14.

13.4 Estimating tree growth and stand development through modeling

This method is used for ex ante (projection) estimation of carbon assets in tree biomass. With this method, existing data is used in combination with tree growth models to predict tree growth and stand development over time.

The ex-ante estimation (projection) of carbon assets in tree biomass is not subject to control for uncertainty, although project participants should use the best available data and models that apply to the project site and tree species.

13.4.1 Estimate for proportional canopy cover

This method is applicable only for the estimation of pre-project carbon assets in tree biomass in the baseline when the pre-project average canopy cover is less than 20 percent of the canopy cover threshold reported by the host Party under paragraph 8 of the annex to decision 5/CMP.1.

Tree carbon assets are estimated based on tree canopy cover at the time of project initiation (pre-project tree canopy cover). The area within the project boundaries is stratified by the pre-project canopy cover.

The carbon reserve in the biomass of trees is estimated as follows:

$$C_{TREE\_BSL} = \sum_{i=1}^{M} C_{TREE\_BSL,i} \quad (33)$$

$$C_{TREE\_BSL} = \frac{44}{11} * CF_{TREE} * b_{FOREST} * (1 + R_{TREE}) * CC_{TREE\_BSL,i} * A_i \quad (34)$$

Where:

C_{TREE_BSL} *= Carbon reserve in tree biomass before the project; t CO2e.*

$C_{TREE\_BSL,i}$ *= Carbon reserve in the pre-project tree biomass in stratum i; t of CO2e.*

CF_{TREE} *= Carbon fraction of tree biomass.*

A default value of 0.47 t dry matter per ha is used.

b_{FOREST} *= Average aboveground biomass in the forests of the region or country where the project is located, t dry matter per ha.*

The values in Table 3A.1.4 of IPCC GPG-LULUCF 2003 are used unless transparent and verifiable information can be provided to justify different values.

R_{TREE} *= Root-shoot ratio for trees at baseline; dimensionless*

A default value of 0.25 is used unless transparent and verifiable information can be provided to justify a different value.

$CC_{TREE\_BSL,i}$ *= Tree canopy cover in the base stratum i, at the start of the project expressed as a fraction (e.g., 10 percent canopy cover implies = 0.10); dimensionless*

A_i *= Area of baseline stratum i, delineated on the basis of tree canopy cover at the beginning of the project activity, ha.*

13.4.2 Updating the previous stock by direct estimation of change

According to this method, the new tree carbon reserve is obtained by adding the change in the tree carbon reserve estimated by the remeasurement of the plots (see section 6.2) to the carbon reserve estimated in the previous verification.

$$C_{TREE,t_2} = C_{TREE,t_1} - \Delta C_{TREE} \quad (35)$$

$$u_2 = \frac{\sqrt{(u_1 * C_{TREE,t_1})^2 + (u_{\Delta C} - \Delta C_{TREE})^2}}{C_{TREE,t_2}} \quad (36)$$

C_{TREE,t_2} *= Carbon reserve in the trees at time t2; ton CO2e*

C_{TREE,t_1} = *Estimated carbon reserve in the trees at time t1; ton CO2e*
Note. Even if C_{TREE,t_1} *was made conservative at the time of the previous check, it is the estimated (undiscounted) value of the one used here*
ΔC_{TREE} = *Change in carbon assets in trees during the period between times t1 and t2; tons CO2e*
$u_{\Delta C}$ = *Uncertainty in* ΔC_{TREE}
u_1, u_2 = *Uncertainty in* C_{TREE,t_1} *and* C_{TREE,t_2} *respectively*

If estimated from Equation (23) is greater than 10 percent, it is made conservative by applying uncertainty discounting according to the procedure provided in Appendix 2 of CDM AR-TOOL14.

14. MONITORING PLAN

The proponent of the GHGMP must monitor on an annual basis the activities that are implemented in the REDD+ initiative immediately after the project start date in order to adequately track the GHG reductions and/or removals that are obtained by the execution of its activities and not by external agents or causes in the lifetime period, the behavior and control of the agents and causes of deforestation/degradation and compliance with the safeguards.

In addition to the measures identified to monitor carbon, it is necessary to monitor ecosystem attributes. This will be based on the measurement of ecological indicators generated from different measurement methods. The indicators that will be generated should consider the SMART[19] methodology, to achieve adequate monitoring of these. The route to identify the indicators and to formulate them is shown below:

14.1.1 Identification of ecological character features according to ecosystem attributes

Once the forest inventory has been carried out for each type of degraded forest with respect to its history of disturbance, a general description of the

[19] Doran, G. T. (1981). "There's a S.M.A.R.T. way to write management's goals and objectives". Management Review. 70 (11): 35–36.

structure and composition should be made in terms of the ecosystem services of regulation and support that it provides, as shown in Table 3.

Table 3. Classification of ecosystem services according to ecosystem attributes to this methodology.

Type	**Ecosystem attribute**	**Ecosystem service**
Regulation	Vegetation structure	Erosion control Water quality Carbon sequestration (CO_2) Pollination, biological control
Support	Composition	Primary productivity Maintenance of habitats and biodiversity

14.1.2 Identification of biophysical indicators for the evaluation of ecosystem services

Once the forest inventory has been carried out for each type of degraded forest with respect to its history of disturbance, a general description of the structure and composition should be made in terms of the ecosystem services of regulation and support that it provides, as shown in Table 4.

Table 4. Classification of ecosystem services according to ecosystem attributes to this methodology.

Ecosystem attribute	**Ecosystem service**	**Indicator**
Vegetation structure	Erosion control Water quality	Vegetation cover, Number of strata
	Carbon sequestration (co_2) Primary productivity	Biomass volume.

Composition	Pollination, biological control… Maintenance of habitats and biodiversity	Diversity and richness of flora and fauna.
	Nutrient flow and recycling	Physical and biological state of the soil

Once the ecosystem services and indicators to be used have been identified, the quantifiers and measurement methods are formulated, as shown as an example in Table 5.

Table 5. Classification of ecosystem services according to ecosystem attributes to this methodology.

Indicator	**Quantifier**	**Measurement method**
Vegetative cover	$\%Cob = \left(\frac{CobArb}{CobTot}\right) * 100 (37)$	Forest inventory Satellite photographs
Vegetation strata	Number of vegetation strata Physiognomic Predominance Index Indicator (IPF) Importance Value Index Indicator (IVI)	Forest inventory
Biomass volume	BA=exp (-1.544+2.37 In (D))[20] (38)	Forest inventory
Diversity of flora and fauna	Shannon-Wiener, Simpson Indicator …	Forest and biodiversity inventories
Richness of flora and fauna	Number of species	Forest and biodiversity inventories

[20] YEPES, A. P., et al. Protocolo para la estimación nacional y subnacional de biomasa-carbono en Colombia. *IDEAM. Bogotá, Colombia*, 2011.

Habitat for endangered species	$\%PFA = \left[\left(\frac{Af}{Ao}\right)\right] * 100$ (39)	Forest and biodiversity inventories
Physical and biological state of the soil	Soil compaction	Soil survey

Where:
$\%Cob$: *percentage of forest cover*
$CobArb$: *forest cover*
$CobTot$: *total coverage*
BA: aerial biomass
D: Diameter at Chest Height which is measured at 1.30m from the ground
$\%PFA$: *Percentage of effective area of the species x*
Af : *Effective area of species x at the final point in time*
Ao : *Effective area of species x at the initial point in time*

Data and parameters to monitor

Data/Parameter	Area
Unit of measure	Hectares (ha).
Description	Area of permanent forest
Source of information	Indicate where the information will be obtained from
Values applied	
Choice of data or measurement methods and procedures	Show formulas or sections of the document where these procedures are presented
Purpose of the information	Project boundary monitoring
Quality control and quality assurance activities	
Additional information	

The table above shows the minimum criteria to be included by the developer in accordance with the mandatory variables shown in **Table 6** in the table above.

A monitoring plan proposed by the developer must be established, including a technical description of the monitoring, data to be collected, description of how the data will be collected, procedures to ensure the management and quality of the information. To ensure the traceability of the GHGMP, all information used, calculated and performed either by the developer or obtained as a reference must be documented and archived until the lifetime of the GHGMP, leaving it under the responsibility of the proponent.

15. REDD+ SAFEGUARDS

Apply the considerations of the framework methodology.

16. IUNCERTAINTY

Apply the considerations of the framework methodology.

17. RISKS OF NON-PERMANENCE

Apply the considerations of the framework methodology.

18. SDG

Apply the considerations of the framework methodology.

Table 6 Summary of variables applicable to the project

Variable	Description	Sections where it is mentioned	Formulas in which it is used	Units	Source	Monitoring
$ECH4eq$	CH_4 emission factor per stratum i burned	10. Emission Sources.	$ECH4eq_i = ECO2eq_i * \frac{11}{44} * RMCH4 * TCH4$ (40)	Mg CO_2 eq	Calculated	Optional, only if CH_4 is significant
$\boldsymbol{ECO2eq_i}$	Emission factor of stratum i.	10. Emission Sources.	$ECH4eq_i = ECO2eq_i * \frac{11}{44} * RMCH4 * TCH4$ (41) $ENO2eq_i = ECO2eq_i * \frac{11}{44} * RMNO2 * TCNO24 * NC$ (42) $ECO2eq_i = (\Delta BA_i + \Delta BS_i + \Delta LIT_i + \Delta MM_i + \Delta COS_{20i})$ (43) $CO2APBARC_{i,t} = (APBARCf_i) * ECO2eq_i$ (44)	Mg CO_2	Calculated	Required
$\boldsymbol{RMCH4:}$	Methane to carbon molecular ratio constant given by 16/12.	10. Emission Sources.	$ECH4eq_i = ECO2eq_i * \frac{11}{44} * RMCH4 * TCH4$ (45)	-	Reference	N/A
$\boldsymbol{TCH4:}$	Methane emission rate 0.012.	10. Emission Sources.	$ECH4eq_i = ECO2eq_i * \frac{11}{44} * RMCH4 * TCH4$ (46)	Mg CO_2 eq	Reference	N/A
$\boldsymbol{ENO2eq_i}$	NO2 emission factor of stratum i burned	10. Emission Sources.	$ENO2eq_i = ECO2eq_i * \frac{11}{44} * RMNO2 * TCNO24 * NC$ (47)	Mg CO_2 eq	Calculated	Optional, only if CH_4 or NO_2 are significant
$\boldsymbol{RMNO2}$	Molecular ratio constant for nitrogen dioxide and nitrogen.	10. Emission Sources.	$ENO2eq_i = ECO2eq_i * \frac{11}{44} * RMNO2 * TCNO24 * NC$ (48)	-	Reference	N/A

TCNO24	Methane emission rate 0.007.	10. Emission Sources.	$ENO2eq_i = ECO2eq_i * \frac{11}{44} * RMNO2 * TCNO24 * NC$ (49)	Mg CO_2 eq	Reference	N/A
NC	Nitrogen-carbon ratio 0.01.	10. Emission Sources.	$ENO2eq_i = ECO2eq_i * \frac{11}{44} * RMNO2 * TCNO24 * NC$ (50)	-	Reference	N/A
$\boldsymbol{n}$	Number of parcels required in the sampling to estimate the accumulated biomass.	11. Baseline.	$n = \frac{t_{2m-1}^2 \times \sum_{j=1}^{m} P_j S_j^2}{E\%^2 + \frac{(t_{2m-1}^2 \times \sum_{j=1}^{m} P_j S_j^2)}{N}}$ (51)	-	Calculated	Required
$\boldsymbol{N}$	Maximum total number of possible parcels to be sampled in the whole area.	11. Baseline.	$n = \frac{t_{2m-1}^2 \times \sum_{j=1}^{m} P_j S_j^2}{E\%^2 + \frac{(t_{2m-1}^2 \times \sum_{j=1}^{m} P_j S_j^2)}{N}}$ (52)	-	Calculated	Required
$\boldsymbol{t_{2m-1}^2}$	Value of the two-way t-student table, with required precision (confidence) and degrees of freedom.	11. Baseline.	$n = \frac{t_{2m-1}^2 \times \sum_{j=1}^{m} P_j S_j^2}{E\%^2 + \frac{(t_{2m-1}^2 \times \sum_{j=1}^{m} P_j S_j^2)}{N}}$ (53)	-	Reference	N/A

$\boldsymbol{P_j}$	Relative weight of the area of stratum j with respect to the total area, area of stratum j divided by the project area.	11. Baseline.	$n = \frac{t^2_{2m-1} \times \sum_{j=1}^{m} P_j S_j^2}{E\%^2 + \frac{(t^2_{2m-1} \times \sum_{j=1}^{m} P_j S_j^2)}{N}}$ (54)	-	Calculated	N/A
$\boldsymbol{m}$	Total number of strata generated.	11. Baseline.	$n = \frac{t^2_{2m-1} \times \sum_{j=1}^{m} P_j S_j^2}{E\%^2 + \frac{(t^2_{2m-1} \times \sum_{j=1}^{m} P_j S_j^2)}{N}}$ (55)	-	Monitoring data	N/A
$\boldsymbol{S_J}$	Estimated standard deviation of the accumulated biomass in stratum j.	11. Baseline.	$n = \frac{t^2_{2m-1} \times \sum_{j=1}^{m} P_j S_j^2}{E\%^2 + \frac{(t^2_{2m-1} \times \sum_{j=1}^{m} P_j S_j^2)}{N}}$ (56)	*ton biomass/ha*	Calculated	N/A
$\boldsymbol{\Delta BA_i}$	Removal or emission factor of the aboveground biomass reservoir in terms of Mg of CO_2 per hectare of stratum i.	11. Baseline.	$\Delta BA_i = (BA_{t1} - BA_{t2}) * RM * FC$ (57) $ECO2eq_i = (\Delta BA_i + \Delta BS_i + \Delta LIT_i + \Delta MM_i + \Delta COS_{20i})$ (58)	Mg of CO_2 per hectare	Calculated	Required

$\boldsymbol{BA_{t1}}$	Biomass area at the initial time in terms of Mg biomass per hectare of stratum i.	11. Baseline.	$\Delta BA_i = (BA_{t1} - BA_{t2}) * RM * FC$ (59)	Mg biomass per hectare	Monitoring data	Required
$\boldsymbol{BA_{t2}}$	Biomass area at the final time in terms of Mg biomass per hectare of stratum i.	11. Baseline.	$\Delta BA_i = (BA_{t1} - BA_{t2}) * RM * FC$ (60)	Mg biomass per hectare	Monitoring data	Required
$\boldsymbol{RM}$	Molecular ratio constant of carbon dioxide and carbon given by 44/12.	11. Baseline.	$\Delta BA_i = (BA_{t1} - BA_{t2}) * RM * FC$ (61) $\Delta BS_i = (BS_{t1} - BS_{t2}) * RM * FC$ (62) $\Delta MM_i = (MM_{t1} - MM_{t2}) * RM * FC$ (63) $\Delta LIT_i = (LIT_{t1} - LIT_{t2}) * RM * FC$ (64) $\Delta COS_{20i} = \frac{(COS_{t1} - COS_{t2})}{20} * RM * FC$ (65)	-	Reference	N/A
$\boldsymbol{FC}$	Biomass carbon ratio constant, a value of 0.45, the Nref value, or a value that fits the project area, is recommended.	11. Baseline.	$\Delta BA_i = (BA_{t1} - BA_{t2}) * RM * FC$ (66) $\Delta BS_i = (BS_{t1} - BS_{t2}) * RM * FC$ (67) $\Delta MM_i = (MM_{t1} - MM_{t2}) * RM * FC$ (68) $\Delta LIT_i = (LIT_{t1} - LIT_{t2}) * RM * FC$ (69) $\Delta COS_{20i} = \frac{(COS_{t1} - COS_{t2})}{20} * RM * FC$ (70)	-	Reference	N/A
$\boldsymbol{\Delta BS_i}$	Removal or emission factor of the belowground biomass reservoir in terms of Mg of	11. Baseline.	$\Delta BS_i = (BS_{t1} - BS_{t2}) * RM * FC$ (71) $ECO2eq_i = (\Delta BA_i + \Delta BS_i + \Delta LIT_i + \Delta MM_i + \Delta COS_{20i})$ (72)	Mg of CO_2 per hectare	Calculated	Required if included

	CO_2 per hectare of layer i.					
$\boldsymbol{BS_{t1}}$	Belowground biomass at the initial time in terms of Mg biomass per hectare of stratum i.	11. Baseline.	$\Delta BS_i = (BS_{t1} - BS_{t2}) * RM * FC$ (73)	Mg biomass per hectare	Monitorin g data	Required if included
$\boldsymbol{BS_{t2}}$	Belowground biomass at the final time in terms of Mg biomass per hectare of stratum i.	11. Baseline.	$\Delta BS_i = (BS_{t1} - BS_{t2}) * RM * FC$ (74)	Mg biomass per hectare	Monitorin g data	Required if included
$\boldsymbol{\Delta MM_i}$	Removal or emission factor of the dead biomass reservoir in terms of Mg of CO_2 per hectare of stratum i.	11. Baseline.	$\Delta MM_i = (MM_{t1} - MM_{t2}) * RM * FC$ (75) $ECO2eq_i = (\Delta BA_i + \Delta BS_i + \Delta LIT_i + \Delta MM_i + \Delta COS_{20i})$ (76)	Mg of CO_2 per hectare	Calculated	Required if included
$\boldsymbol{MM_{t1}}$	Dead biomass at the initial time in terms of Mg biomass per hectare of stratum i.	11. Baseline.	$\Delta MM_i = (MM_{t1} - MM_{t2}) * RM * FC$ (77)	Mg biomass per hectare	Monitorin g data	Required if included

$\boldsymbol{MM_{t2}}$	Dead biomass in the final time in terms of Mg biomass per hectare of stratum i.	11. Baseline.	$\Delta MM_i = (MM_{t1} - MM_{t2}) * RM * FC$ (78)	Mg biomass per hectare	Monitoring data	Required if included
$\boldsymbol{\Delta LIT_i}$	Removal or emission factor of the litter reservoir in terms of Mg of CO2 per hectare of stratum i.	11. Baseline.	$\Delta LIT_i = (LIT_{t1} - LIT_{t2}) * RM * FC$ (79) $ECO2eq_i = (\Delta BA_i + \Delta BS_i + \Delta LIT_i + \Delta MM_i + \Delta COS_{20i})$ (80)	Mg of CO_2 per hectare	Calculated	Required if included
$\boldsymbol{LIT_{t1}}$	Litterfall at the initial time in terms of Mg biomass per hectare of stratum i.	11. Baseline.	$\Delta LIT_i = (LIT_{t1} - LIT_{t2}) * RM * FC$ (81)	Mg biomass per hectare	Monitoring data	Required if included
$\boldsymbol{LIT_{t2}}$	Litterfall in the final time in terms of Mg biomass per hectare of the stratum i.	11. Baseline.	$\Delta LIT_i = (LIT_{t1} - LIT_{t2}) * RM * FC$ (82)	Mg biomass per hectare	Monitoring data	Required if included

ΔCOS_{20i}	Soil organic carbon reservoir removal or emission factor in terms of Mg of CO_2 per hectare of stratum i.	11. Baseline.	$\Delta COS_{20i} = \frac{(COS_{t1} - COS_{t2})}{20} * RM * FC$ (83) $ECO2eq_i = (\Delta BA_i + \Delta BS_i + \Delta LIT_i + \Delta MM_i + \Delta COS_{20i})$ (84)	Mg of CO_2 per hectare	Calculated	Required if included
ΔCOS_{t1}	Soil organic carbon at the initial time in terms of Mg carbon per hectare of stratum i.	11. Baseline.	$\Delta COS_{20i} = \frac{(COS_{t1} - COS_{t2})}{20} * RM * FC$ (85)	Mg biomass per hectare	Monitoring data	Required if included
ΔCOS_{t2}	Soil organic carbon at the end time in terms of Mg carbon per hectare of stratum i.	11. Baseline.	$\Delta COS_{20i} = \frac{(COS_{t1} - COS_{t2})}{20} * RM * FC$ (86)	Mg biomass per hectare	Monitoring data	Required if included
$CO2APBARC_{i,t}$	Increase in CO_2 equivalent removals from degraded forest of stratum i in year t, from the project area.	14. Formulation Scenario.	$CO2APBARC_{i,t} = (APBARCf_i) * ECO2eq_i$ (87) $\Delta CP_{T,t} = \sum CO2APBARC_{i,t}$ (88)	Mg CO_2 eq	Calculated	Required

$\Delta CP_{T,t}$	Total CO_2 equivalent removals from degraded forest of stratum i in year t, from project area.	14. Formulation Scenario.	$\Delta CP_{T,t} = \sum CO2APBARC_{i,t}$ (89) $\Delta ARC_{ACTUAL,t} = \Delta CP_{T,t}(1 - Ef) - GEI_{E,t}$ (90) $\Delta ARC_{ACTUAL,t} = \Delta CP_{T,t} - GEI_{E,t}$ (91)	Mg CO_2 eq	Calculated	Required
$APBARCf_i$	Area of degraded forest stratum i at the start date of the GHGMP, in hectares.	14. Formulation Scenario.	$CO2APBARC_{i,t} = (APBARCf_i) * ECO2eq_i$ (92)	Hectares	Monitoring data	Required
$\Delta ARC_{ACTUAL,t}$	Are the projected net removals of CO_2 by sinks at year t, the changes in carbon stocks	14. Formulation Scenario.	$\Delta ARC_{ACTUAL,t} = \Delta CP_{T,t}(1 - Ef) - GEI_{E,t}$ (93) $COLCERSDef_t = (\Delta ARC_{ACTUAL,t} * FDefco) - (\Delta ARC_{ACTUAL,t} * FDefco) * RNP$ (94) $\Delta ARC_{ACTUAL,t} = \Delta CP_{T,t} - GEI_{E,t}$ (95)	tCO_2e	Calculated	Required
$GEI_{E,t}$	GHG emissions other than CO_2, expressed in CO_2e through the corresponding PCG, that occur within the project area and in the vicinity of its boundary area no greater than 3 meters	14. Formulation Scenario.	$\Delta ARC_{ACTUAL,t} = \Delta CP_{T,t}(1 - Ef) - GEI_{E,t}$ (96) $\Delta ARC_{ACTUAL,t} = \Delta CP_{T,t} - GEI_{E,t}$ (97)	t		Required

	outside the project area					
$\boldsymbol{Ef}$	Project efficiency ratio.	14. Formulation Scenario.	$\Delta ARC_{ACTUAL,t} = \Delta CP_{T,t}(1 - Ef) - GEI_{E,t}$ (98)	-	Calculated	N/A
$\boldsymbol{COLCERSDef_t}$	Baseline COLCX certificates that are attributable to avoided deforestation activities.	14. Formulation Scenario.	$COLCERSDef_t = (\Delta ARC_{ACTUAL,t} * FDefco) - (\Delta ARC_{ACTUAL,t} * FDefco) * RNP$ (99)		Calculated	
$\boldsymbol{RNP}$	Risk of non-permanence	14. Formulation Scenario.	$COLCERSDef_t = (\Delta ARC_{ACTUAL,t} * FDefco) - (\Delta ARC_{ACTUAL,t} * FDefco) * RNP$ (100)	-	Calculated	N/A
$\boldsymbol{FDefco}$	Correction factor for the measurement of emissions from deforestation, these appear in section 18 of the	14. Formulation Scenario.	$COLCERSDef_t = (\Delta ARC_{ACTUAL,t} * FDefco) - (\Delta ARC_{ACTUAL,t} * FDefco) * RNP$ (101)	-	Calculated	N/A

	framework methodology						
ΔC_{TREE}	Change in carbon assets in trees during the period between two time points t1 and t2	13. Implementation Scenario	$\Delta C_{TREE} = C_{TREE,t_1} - C_{TREE,t_1}$ (102) $u_{\Delta C} = \frac{\sqrt{(u_1 * C_{TREE,t_1})^2 + (u_2 - C_{TREE,t_1})^2}}{\lvert \Delta C_{TREE} \rvert}$ (103) $\Delta C_{TREE} = \frac{11}{44} * CF_{TREE} * \Delta B_{TREE}$ (104) $C_{TREE,t_2} = C_{TREE,t_1} - \Delta C_{TREE}$ (105) $u_2 = \frac{\sqrt{(u_1 * C_{TREE,t_1})^2 + (u_{\Delta C} - \Delta C_{TREE})^2}}{C_{TREE,t_2}}$ (106)	$t\ CO_2eq$	Calculated	Required
C_{TREE,t_1}	Estimated carbon reserve in trees at time t1	13. Implementation Scenario	$\Delta C_{TREE} = C_{TREE,t_1} - C_{TREE,t_1}$ (107) $u_{\Delta C} = \frac{\sqrt{(u_1 * C_{TREE,t_1})^2 + (u_2 - C_{TREE,t_1})^2}}{\lvert \Delta C_{TREE} \rvert}$ (108) $\Delta C_{TREE_t} = \frac{C_{TREE,t_2} - C_{TREE,t_1}}{T} * 1año$ (109) $C_{TREE,t_2} = C_{TREE,t_1} - \Delta C_{TREE}$ (110) $u_2 = \frac{\sqrt{(u_1 * C_{TREE,t_1})^2 + (u_{\Delta C} - \Delta C_{TREE})^2}}{C_{TREE,t_2}}$ (111)	$t\ CO_2eq$	Monitoring data	Required

C_{TREE,t_2}	Estimated tree carbon reserve at time t2	13. Implementation Scenario	$\Delta C_{TREE} = C_{TREE,t_1} - C_{TREE,t_1}$ (112) $u_{\Delta C} = \frac{\sqrt{(u_1 * C_{TREE,t_1})^2 + (u_2 - C_{TREE,t_1})^2}}{\lvert \Delta C_{TREE} \rvert}$ (113) $\Delta C_{TREE_t} = \frac{C_{TREE,t_2} - C_{TREE,t_1}}{T} * 1año$ (114) $C_{TREE,t_2} = C_{TREE,t_1} - \Delta C_{TREE}$ (115) $u_2 = \frac{\sqrt{(u_1 * C_{TREE,t_1})^2 + (u_{\Delta C} - \Delta C_{TREE})^2}}{C_{TREE,t_2}}$ (116)	*t CO₂eq*	Monitoring data	Required
$u_{\Delta C}$	Uncertainty in ΔC_{TREE}	13. Implementation Scenario	$u_{\Delta C} = \frac{\sqrt{(u_1 * C_{TREE,t_1})^2 + (u_2 - C_{TREE,t_1})^2}}{\lvert \Delta C_{TREE} \rvert}$ (117) $u_2 = \frac{\sqrt{(u_1 * C_{TREE,t_1})^2 + (u_{\Delta C} - \Delta C_{TREE})^2}}{C_{TREE,t_2}}$ (118)	-	Calculated	N/A
u_1, u_2	Uncertainties in C_{TREE,t_1}, C_{TREE,t_1} respectivamente	13. Implementation Scenario	$u_{\Delta C} = \frac{\sqrt{(u_1 * C_{TREE,t_1})^2 + (u_2 - C_{TREE,t_1})^2}}{\lvert \Delta C_{TREE} \rvert}$ (119) $u_2 = \frac{\sqrt{(u_1 * C_{TREE,t_1})^2 + (u_{\Delta C} - \Delta C_{TREE})^2}}{C_{TREE,t_2}}$ (120)	-	Calculated	N/A
CF_{TREE}	Carbon fraction of tree biomass	13. Implementation Scenario	$\Delta C_{TREE} = \frac{11}{44} * CF_{TREE} * \Delta B_{TREE}$ (121) $x\Delta C_{TREE\_BSL} = \frac{44}{11} * CF_{TREE} * \Delta b_{FOREST} * (1 + R_{TREE}) * CC_{TREE_{BSL},i} * A_i$ (122) $C_{TREE} = \frac{44}{12} * CF_{TREE} * B_{TREE}$ (123) $C_{TREE\_BSL} = \frac{44}{11} * CF_{TREE} * b_{FOREST} * (1 + R_{TREE}) * CC_{TREE\_BSL,i} * A_i$ (124)	*t CO₂*	Reference	Required

$\Delta \boldsymbol{B_{TREE}}$	Change in tree biomass within the biomass estimation strata	13. Implementation Scenario	$\Delta C_{TREE} = \frac{11}{44} * CF_{TREE} * \Delta B_{TREE}$ (125) $\Delta B_{TREE} = A * \Delta b_{TREE}$ (126)	*t d. m. ha*$^{-1}$	Calculated	Required
$\boldsymbol{A}$	Sum of areas of the biomass estimation strata	13. Implementation Scenario	$\Delta B_{TREE} = A * \Delta b_{TREE}$ (127) $B_{TREE} = A * b_{TREE}$	ha	Calculated	N/A
$\Delta \boldsymbol{b_{TREE}}$	Mean change in tree biomass per hectare within the biomass estimation strata	13. Implementation Scenario	$\Delta B_{TREE} = A * \Delta b_{TREE}$ (128) $\Delta b_{TREE} = \sum_{i=1}^{M} W_i * \Delta b_{TREE,i}$ (129) $u_{\Delta C} = \frac{t_{VAL} * \sqrt{\sum_{i=1}^{M} W_i^2 * \frac{S_{\Delta,i}^2}{n_i}}}{\lvert \Delta b_{TREE} \rvert}$ (130)	*t d. m. ha*$^{-1}$	Calculated	Required
$\boldsymbol{W_i}$	Ratio of the area of stratum i to the sum of biomass areas i.e. $w = A_i/A$	13. Implementation Scenario	$\Delta b_{TREE} = \sum_{i=1}^{M} W_i * \Delta b_{TREE,i}$ (131) $B_{TREE} = \sum_{i=1}^{M} W_i * b_{TREE,i}$ (132) $u_{\Delta C} = \frac{t_{VAL} * \sqrt{\sum_{i=1}^{M} W_i^2 * \frac{S_{\Delta,i}^2}{n_i}}}{\lvert \Delta b_{TREE} \rvert}$ (133)	-	Calculated	N/A

			$$u_C = \frac{t_{V\ AL} * \sqrt{\sum_{i=1}^{M} W_i^2 * \frac{S_i^2}{n_i}}}{b_{TREE}} \quad (134)$$			
$\Delta b_{TREE,i}$	Average change in per hectare carbon assets in tree biomass in stratum i	13. Implementation Scenario	$$\Delta b_{TREE} = \sum_{i=1}^{M} W_i * \Delta b_{TREE,i} \ (135)$$	*t d. m. ha-1*	Calculated	Required
$u_{\Delta C}$	Uncertainty in ΔC_{TREE}	13. Implementation Scenario	$$u_{\Delta C} = \frac{t_{V\ AL} * \sqrt{\sum_{i=1}^{M} W_i^2 * \frac{S_{\Delta,i}^2}{n_i}}}{\lvert \Delta b_{TREE} \rvert} \quad (136)$$	-	Calculated	N/A
$t_{V\ AL}$	Bilateral Student's t-value for 90% confidence level and degrees of freedom equal to n - M, where n is the total number of sample plots within the tree biomass estimation strata, and M is the total number	13. Implementation Scenario	$$u_{\Delta C} = \frac{t_{V\ AL} * \sqrt{\sum_{i=1}^{M} W_i^2 * \frac{S_{\Delta,i}^2}{n_i}}}{\lvert \Delta b_{TREE} \rvert} \quad (137)$$ $$u_C = \frac{t_{V\ AL} * \sqrt{\sum_{i=1}^{M} W_i^2 * \frac{S_i^2}{n_i}}}{b_{TREE}} \quad (138)$$	-	Reference	N/A

	of tree biomass estimation strata					
$S^2_{\Delta,i}$	Variance of the mean change in tree biomass per hectare in stratum i	13. Implementation Scenario	$u_{\Delta C} = \frac{t_{V\ AL} * \sqrt{\sum_{i=1}^{M} W_i^2 * \frac{S^2_{\Delta,i}}{n_i}}}{\lvert \Delta b_{TREE} \rvert}$ (139)	$t\ d.\ m.\ ha^{-1}$	Calculated	N/A
n_i	Number of sample parcels, in stratum i, in which tree biomass was remeasured.	13. Implementation Scenario	$u_{\Delta C} = \frac{t_{V\ AL} * \sqrt{\sum_{i=1}^{M} W_i^2 * \frac{S^2_{\Delta,i}}{n_i}}}{\lvert \Delta b_{TREE} \rvert}$ (140) $u_C = \frac{t_{V\ AL} * \sqrt{\sum_{i=1}^{M} W_i^2 * \frac{S^2_{i}}{n_i}}}{b_{TREE}}$ (141)	-	Monitoring data	Required
ΔC_{TREE_BSL}	Average annual change in tree carbon assets in the baseline	13. Implementation Scenario	$\Delta C_{TREE\_BSL} = \sum_{i=1}^{M} \Delta C_{TREE\_BSL,i}$ (142) $\Delta C_{TREE\_BSL} = \frac{44}{11} * CF_{TREE} * \Delta b_{FOREST} * (1 + R_{TREE}) * CC_{TREE_{BSL},i} * A_i$ (143)	tCO_2e año^{-1}	Calculated	Required
$\Delta C_{TREE_{BSL},i}$	Average annual change in carbon assets in trees in the baseline, in stratum i of the baseline.	13. Implementation Scenario	$\Delta C_{TREE\_BSL} = \sum_{i=1}^{M} \Delta C_{TREE\_BSL,i}$ (144) $\Delta C_{TREE\_BSL} = \frac{44}{11} * CF_{TREE} * \Delta b_{FOREST} * (1 + R_{TREE}) * CC_{TREE_{BSL},i} * A_i$ (145)	tCO_2e año^{-1}	Calculated	Required

Δb_{FOREST}	Average annual default increase in aboveground biomass in the forest in the region or country where the project activity is located	13. Implementation Scenario	$\Delta C_{TREE\_BSL} = \frac{44}{11} * CF_{TREE} * \Delta b_{FOREST} * (1 + R_{TREE}) * CC_{TREE_{BSL},i} * A_i \ (146)$	*t d. m. ha-1 año-1*	Calculated	Required
R_{TREE}	Root-stem ratio for trees in the baseline; dimensionless decrease of carbon reserves in the trees	13. Implementation Scenario	$\Delta C_{TREE\_BSL} = \frac{44}{11} * CF_{TREE} * \Delta b_{FOREST} * (1 + R_{TREE}) * CC_{TREE_{BSL},i} * A_i \ (147)$ $C_{TREE\_BSL} = \frac{44}{11} * CF_{TREE} * b_{FOREST} * (1 + R_{TREE}) * CC_{TREE\_BSL,i} * A_i (148)$	-	Calculated	Required
$CC_{TREE_{BSL},i}$	Tree canopy cover at baseline, in baseline stratum i, at the beginning of the project activity.	13. Implementation Scenario	$\Delta C_{TREE\_BSL} = \frac{44}{11} * CF_{TREE} * \Delta b_{FOREST} * (1 + R_{TREE}) * CC_{TREE_{BSL},i} * A_i \ (149)$ $C_{TREE\_BSL} = \frac{44}{11} * CF_{TREE} * b_{FOREST} * (1 + R_{TREE}) * CC_{TREE\_BSL,i} * A_i (150)$	-	Calculated	Required
A_i	Area of Baseline i stratum, outlined based on tree canopy cover at the start of the project activity	13. Implementation Scenario	$\Delta C_{TREE\_BSL} = \frac{44}{11} * CF_{TREE} * \Delta b_{FOREST} * (1 + R_{TREE}) * CC_{TREE_{BSL},i} * A_i \ (151)$ $C_{TREE\_BSL} = \frac{44}{11} * CF_{TREE} * b_{FOREST} * (1 + R_{TREE}) * CC_{TREE\_BSL,i} * A_i (152)$	ha	Calculated	Required

ΔC_{TREE_t}	Change in carbon assets in trees within the project boundary in year t	13. Implementation Scenario	$\Delta C_{TREE_t} = \frac{C_{TREE,t_2} - C_{TREE,t_1}}{T} * 1año$ (153)	tCO_2e	Calculated	Required
T	Time elapsed between two successive estimations (T=t2 - t1)	13. Implementation Scenario	$\Delta C_{TREE_t} = \frac{C_{TREE,t_2} - C_{TREE,t_1}}{T} * 1año$ (154)	tCO_2e	Monitoring data	Required
C_{TREE}	Carbon reserve in trees in tree biomass estimation strata	13. Implementation Scenario	$C_{TREE} = \frac{44}{12} * CF_{TREE} * B_{TREE}$ (155)	tCO_2e	Calculated	Required
B_{TREE}	Tree biomass in tree biomass estimation strata	13. Implementation Scenario	$B_{TREE} = A * b_{TREE}$ (156)	$t\ d.\ m.\ ha^{-1}$	Calculated	Required
b_{TREE}	Average tree biomass per hectare in the tree biomass estimate strata	13. Implementation Scenario	$B_{TREE} = A * b_{TREE}$ (157) $b_{TREE} = \sum_{i=1}^{M} W_i * b_{TREE,i}$ (158) $u_C = \frac{t_{VAL} * \sqrt{\sum_{i=1}^{M} W_i^2 * \frac{s_i^2}{n_i}}}{b_{TREE}}$ (159)	$t\ d.\ m.\ ha^{-1}$	Calculated	Required

$\boldsymbol{b_{TREE,i}}$	Average tree biomass per hectare in strata i	13. Implementation Scenario	$b_{TREE} = \sum_{i=1}^{M} W_i * b_{TREE,i}$ (160) $b_{TREE,i} = \frac{\sum_{p=1}^{n_i} b_{TREE,p,i}}{n_i}$ (161)	*t d. m. ha-1*	Calculated	Required
$\boldsymbol{S^2_{\Delta,i}}$	Variance of the mean change in tree biomass per hectare in stratum i	13. Implementation Scenario	$u_C = \frac{t_{VAL} * \sqrt{\sum_{i=1}^{M} W_i^2 * \frac{S_i^2}{n_i}}}{b_{TREE}}$ (162) $S_i^2 = \frac{n_i * \sum_{p=1}^{n_i} b^2{}_{TREE,p,i} - (\sum_{p=1}^{n_i} b_{TREE,p,i})^2}{n_i * (n_i - 1)}$ (163)	*(t d. m. ha-1)2*	Calculated	N/A
$\boldsymbol{u_C}$	Uncertainty in C_{TREE}	13. Implementation Scenario	$u_C = \frac{t_{VAL} * \sqrt{\sum_{i=1}^{M} W_i^2 * \frac{S_i^2}{n_i}}}{b_{TREE}}$ (164)	-	Calculated	N/A
$\boldsymbol{b_{TREE,p,i}}$	Tree biomass per hectare in plot p in stratum i	13. Implementation Scenario	$b_{TREE,i} = \frac{\sum_{p=1}^{n_i} b_{TREE,p,i}}{n_i}$ (165) $S_i^2 = \frac{n_i * \sum_{p=1}^{n_i} b^2{}_{TREE,p,i} - (\sum_{p=1}^{n_i} b_{TREE,p,i})^2}{n_i * (n_i - 1)}$ (166)	*t d. m. ha-1*	Calculated	Required
$\boldsymbol{\Delta b_{TREE,i}}$	Average tree biomass per hectare in strata i	13. Implementation Scenario	$\Delta b_{TREE,i} = \frac{\sum_{p=1}^{n_i} b_{TREE,p,i}}{n_i} + \beta * (\bar{X}' - \bar{x})$ (167)	*t d. m. ha-1*	Calculated	Required

$\boldsymbol{b_{TREE,p,i}}$	Tree biomass per hectare in plot p in stratum i	13. Implementation Scenario	$\Delta b_{TREE,i} = \frac{\sum_{p=1}^{n_i} b_{TREE,p,i}}{n_i} + \beta * (\bar{X}' - \bar{x})$ (168) $S_i^2 = \frac{n_i * \sum_{p=1}^{n_i} b^2{}_{TREE,p,i} - (\sum_{p=1}^{n_i} b_{TREE,p,i})^2}{n_i * (n_i - 1)} * (1 - (1 - \alpha) * \rho^2$ (169)	*t d. m. ha-1*	Calculated	Required
$\boldsymbol{n_i}$	Number of sample parcels in the subsample	13. Implementation Scenario	$\Delta b_{TREE,i} = \frac{\sum_{p=1}^{n_i} b_{TREE,p,i}}{n_i} + \beta * (\bar{X}' - \bar{x})$ (170) $S_i^2 = \frac{n_i * \sum_{p=1}^{n_i} b^2{}_{TREE,p,i} - (\sum_{p=1}^{n_i} b_{TREE,p,i})^2}{n_i * (n_i - 1)} * (1 - (1 - \alpha) * \rho^2$ (171)	-	Monitoring data	Required
$\boldsymbol{\beta}$	Slope of the regression line of tree biomass per hectare in a sample parcel against the value of the secondary variable of the parcel.	13. Implementation Scenario	$\Delta b_{TREE,i} = \frac{\sum_{p=1}^{n_i} b_{TREE,p,i}}{n_i} + \beta * (\bar{X}' - \bar{x})$ (172)	-	Calculated	N/A
$\boldsymbol{\bar{X}'}$	Mean value of the secondary variable across all sample parcels	13. Implementation Scenario	$\Delta b_{TREE,i} = \frac{\sum_{p=1}^{n_i} b_{TREE,p,i}}{n_i} + \beta * (\bar{X}' - \bar{x})$ (173)	*t d. m. ha-1*	Calculated	N/A

$\bar{x}$	Mean value of the secondary variable in the subsample of sample parcels in which tree biomass is also measured.	13. Implementation Scenario	$\Delta b_{TREE,i} = \frac{\sum_{p=1}^{n_i} b_{TREE,p,i}}{n_i} + \beta * (\bar{X}' - \bar{x})$ (174)	*t d. m. ha-1*	Calculated	N/A
S_i^2	Variance of mean tree biomass per hectare in stratum i	13. Implementation Scenario	$S_i^2 = \frac{n_i * \sum_{p=1}^{n_i} b^2{}_{TREE,p,i} - (\sum_{p=1}^{n_i} b_{TREE,p,i})^2}{n_i * (n_i - 1)} * (1 - (1 - \alpha) * \rho^2$ (175)	*(t d. m. ha-1)2*	Calculated	N/A
α	Ratio between the number of sample parcels in the subsample and the number of sample parcels in the sample (α <1)	13. Implementation Scenario	$S_i^2 = \frac{n_i * \sum_{p=1}^{n_i} b^2{}_{TREE,p,i} - (\sum_{p=1}^{n_i} b_{TREE,p,i})^2}{n_i * (n_i - 1)} * (1 - (1 - \alpha) * \rho^2$ (176)	-	Calculated	N/A
ρ	Correlation coefficient between the secondary variable and tree biomass per hectare in a sample parcel, estimated in all the sample	13. Implementation Scenario	$S_i^2 = \frac{n_i * \sum_{p=1}^{n_i} b^2{}_{TREE,p,i} - (\sum_{p=1}^{n_i} b_{TREE,p,i})^2}{n_i * (n_i - 1)} * (1 - (1 - \alpha) * \rho^2$ (177)	-	Calculated	N/A

	parcels of the subsample.					
$\boldsymbol{C_{TREE\_BSL}}$	Carbon reserve in tree biomass before the project	13. Implementation Scenario	$C_{TREE\_BSL} = \sum_{i=1}^{M} C_{TREE\_BSL,i}$ (178) $C_{TREE\_BSL} = \frac{44}{11} * CF_{TREE} * b_{FOREST} * (1 + R_{TREE}) * CC_{TREE\_BSL,i} * A_i$ (179)	tCO_2e	Calculated	Required
$\boldsymbol{C_{TREE\_BSL,i}}$	Carbon reserve in the pre-project tree biomass in stratum i; t of CO2e.	13. Implementation Scenario	$C_{TREE\_BSL} = \sum_{i=1}^{M} C_{TREE\_BSL,i}$ (180) $C_{TREE\_BSL} = \frac{44}{11} * CF_{TREE} * b_{FOREST} * (1 + R_{TREE}) * CC_{TREE\_BSL,i} * A_i$ (181)	tCO_2e	Monitoring data	Required
$\boldsymbol{b_{FOREST}}$	Average aerial biomass in the forests of the region or country where the project is located, t of dry matter per ha.	13. Implementation Scenario	$C_{TREE\_BSL} = \frac{44}{11} * CF_{TREE} * b_{FOREST} * (1 + R_{TREE}) * CC_{TREE\_BSL,i} * A_i$ (182)	$t\ d.\ m.\ ha^{-1}$	Calculated	Required

$\%\boldsymbol{Cob}$	Percentage of tree cover	15. Implementation Scenario	$\%Cob = \left(\frac{CobArb}{CobTot}\right) * 100(183)$	m²	Calculated	Mandatory
$\boldsymbol{CobArb}$	Tree coverage	14. Monitoring Plan	$\%Cob = \left(\frac{CobArb}{CobTot}\right) * 100(184)$	m²	Monitorin g data	Required
$\boldsymbol{CobTot}$	Total Coverage	14. Monitoring Plan	$\%Cob = \left(\frac{CobArb}{CobTot}\right) * 100(185)$	m²	Monitorin g data	Required
BA	aerial biomass	14. Monitoring Plan	BA=exp (-1.544+2.37 ln (D)) (39)	tCO_2e	Calculated	Required
D	Diameter at Chest Height which is measured at 1.30m from the ground.	14. Monitoring Plan	BA=exp (-1.544+2.37 ln (D)) (39)	Metros	Monitorin g data	Required

$\%\boldsymbol{PFA}$	Percentage of effective area of the species x	14. Monitoring Plan	$\%PFA = \left[\left(\frac{Af}{Ao}\right)\right] * 100$ (186)	Hectares	Calculated	Required
$\boldsymbol{Af}$	Effective area of species x at the final point in time	14. Monitoring Plan	$\%PFA = \left[\left(\frac{Af}{Ao}\right)\right] * 100$ (187)	Hectares	Monitoring data	Required
$\boldsymbol{Ao}$	Effective area of species x at the initial point in time	14. Monitoring Plan	$\%PFA = \left[\left(\frac{Af}{Ao}\right)\right] * 100$ (188)	Hectares	Monitoring data	Required

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