

# METHODOLOGICAL DOCUMENT AFOLU SECTOR

## Quantification of GHG Emission Reductions from REDD+ Projects

PROCLIMA®

VERSION 2.2 | February 5, 2021

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PROCLIMA. 2021. METHODOLOGICAL DOCUMENT AFOLU SECTOR. Quantification of GHG Emission Reductions from REDD+ Projects. Version 2.2. February 5, 2021. 60 p. Bogotá, Colombia. <http://www.proclima.net.co>

## Table of contents

<b>1</b>	<b>Introduction .....</b>	<b>8</b>
1.1	Objectives .....	8
<b>2</b>	<b>Version and validity .....</b>	<b>9</b>
<b>3</b>	<b>Scope.....</b>	<b>9</b>
<b>4</b>	<b>Conditions of applicability .....</b>	<b>9</b>
<b>5</b>	<b>Normative references.....</b>	<b>10</b>
<b>6</b>	<b>Terms and definitions.....</b>	<b>11</b>
<b>7</b>	<b>Carbon pools and GHG sources .....</b>	<b>16</b>
7.1	Carbon pools .....	16
7.2	Source of emissions.....	17
<b>8</b>	<b>Spatial and temporal limits.....</b>	<b>18</b>
8.1	Eligible areas for REDD+ projects.....	18
8.1.1	Adding areas after validation.....	18
8.2	Reference region for baseline estimation .....	19
8.3	Leakage area .....	19
8.4	Temporal limits and analysis period.....	20
8.4.1	Historical period of deforestation .....	20
8.4.2	REDD+ project emissions reduction .....	20
<b>9</b>	<b>Identification of the baseline scenario and additionality .....</b>	<b>20</b>
<b>10</b>	<b>Causes and drivers of deforestation and forest degradation .....</b>	<b>25</b>
10.1	Spatial and temporal dimensions .....	26
10.2	Context .....	26
10.3	Key actors, interests, and motivations.....	27
10.4	Economic activities and their importance.....	27
10.5	Direct and indirect impact.....	27
10.6	Relations and synergies.....	27

10.7	Deforestation and forest degradation chain of events .....	27
<b>11</b>	<b>REDD+ activities.....</b>	<b>28</b>
<b>12</b>	<b>Safeguards REDD+.....</b>	<b>28</b>
<b>13</b>	<b>GHG emission reduction from REDD+ activities .....</b>	<b>34</b>
13.1	Uncertainty management .....	34
13.2	Activity data .....	34
13.2.1	Deforestation.....	34
	Estimating historical rate of deforestation .....	34
	Historical annual deforestation in the reference region .....	35
	Projected annual deforestation in the REDD+ project scenario .....	35
	The projected annual deforestation in the REDD+ Project is estimated with the equation: ....	35
	Annual historical deforestation in the leakage area.....	36
	Projected annual deforestation in the leakage area in the project scenario.....	36
	Estimating deforestation from modeling .....	37
	Projected annual deforestation in the REDD+ project scenario.....	38
	Projected annual deforestation in the leakage area in the project scenario.....	38
13.2.2	Forest degradation .....	39
	Historical annual forest degradation in the project area in the baseline scenario .....	40
	Historical annual forest degradation in leakage area in the baseline scenario .....	41
	Annual projected forest degradation in the project area in the REDD+ project scenario .....	42
	Annual projected forest degradation in leakage area in the project scenario .....	43
13.3	Emission factors .....	44
13.3.1	Deforestation.....	44
	Factor emission of biomass total carbon.....	44
	Soil organic carbon emission factor.....	45
	Total carbon emission factor .....	45
13.3.2	Forest degradation.....	46
13.4	GHG emissions in the analysis period.....	47
13.4.1	Deforestation .....	47

13.4.2	Forest degradation .....	48
13.5	Expected GHG emissions reduction in the project scenario .....	50
13.5.1	Project reduction emission due to avoided deforestation .....	50
13.5.2	Project reduction emission due to avoided forest degradation.....	50
<b>14</b>	<b>Monitoring plan .....</b>	<b>51</b>
14.1	Monitoring of the project boundary.....	51
14.2	Monitoring of the REDD+ activities implementation.....	52
14.3	Monitoring of the REDD+ Safeguards.....	52
14.4	Monitoring of the project permanence .....	53
14.5	Monitoring of the project emissions.....	53
14.5.1	Activity data .....	53
	Annual deforestation in the project area.....	53
	Annual deforestation in the leakage area.....	54
	Annual degradation in the project area.....	54
	Annual degradation in the leakage area.....	55
14.5.2	GHG emissions in the monitoring period.....	56
	Deforestation.....	56
14.5.3	Total project emissions reduction.....	57
	Deforestation.....	57
	Forest degradation .....	58
14.6	Quality control and quality assurance procedures .....	58
14.6.1	Review of the information processing.....	59
14.6.2	Data recording and archiving system.....	59

## List of tables

<i>Table 1. Carbon pools selected for the accounting of carbon stock changes</i> .....	17
<i>Table 2. Emission sources and GHGs selected for accounting</i> .....	17
<i>Table 3. Safeguards REDD+</i> .....	29
<i>Table 4. Fragmentation classes</i> .....	40
<i>Table 5. Fragmentation class transition (ha)</i> .....	40
<i>Table 6. Aboveground biomass, belowground biomass, and total with their equivalents in C and CO<sub>2</sub>e, for the five Colombian biomes.</i> .....	45
<i>Table 7. Soil organic carbon (SOC), SOC<sub>20year</sub>, and SOC<sub>eq</sub> for the five Colombian biomes</i> .....	45
<i>Table 8. Aboveground biomass per fragmentation class</i> .....	46
<i>Table 9. Difference in aboveground biomass by fragmentation type</i> .....	46
<i>Table 10. Monitoring of the REDD+ activities implementation</i> .....	52
<i>Table 11. Monitoring of the REDD+ Safeguards</i> .....	52

## Acronyms and abbreviations

AFOLU	Agriculture, Forestry and Other Land Uses
AB	Aboveground biomass
ANLA	National Environmental Licensing Authority (Autoridad Nacional de Licencias Ambientales)
A/R (AR)	Afforestation and reforestation
AE	Annual emission
BB	Belowground biomass
BT	Total biomass
BCC	Biomass carbon content
CDM	Clean Development Mechanism
CF	Carbon fraction of the dry matter
CH <sub>4</sub>	Methane
CMNUCC	United Nations Framework Convention on Climate Change
CO <sub>2</sub>	Carbon dioxide
CO <sub>2e</sub>	Carbon dioxide equivalent
CT	Total carbon dioxide equivalent; tCO <sub>2e</sub> ha <sup>-1</sup>
FAO	Food and Agriculture Organization of the United Nations
FSC	Change in the surface covered by forest
GHG	Greenhouse Gases
GIS	Geographic Information System
ICONTEC	Colombian Institute of Technical Standards and Certification (Instituto Colombiano de Normas Técnicas y Certificación)
IDEAM	Institute of Hydrology, Meteorology and Environmental Studies (Instituto de Hidrología, Meteorología y Estudios Ambientales)
INGEI	National Greenhouse Gas Inventory (Inventario Nacional de Gases Efecto Invernadero)
IPCC	Intergovernmental Panel on Climate Change (Panel Intergubernamental de Expertos sobre Cambio Climático)
NREF	Forest Reference Emission Level (Nivel de Referencia de Emisiones Forestales)
N <sub>2</sub> O	Nitrous oxide
NTC	Colombian Technical Norm (Norma Técnica Colombiana)
REDD+	Reducing Emissions from deforestation, forest degradation and forest conservation, sustainable management or enhancement of forest carbon stocks.
SMByC	Forest and carbon monitoring system (Sistema de monitoreo de bosques y carbono)
SOC	Soil organic carbon
QA/QC	Quality Control/Assurance Control
VCC	Verified Carbon Credits

## 1 Introduction

This Methodology provides holders of GHG mitigation initiatives REDD+ projects the best practices related to procedures, models, parameters, and data to quantify GHG emission reductions attributable to REDD+ project activities.

For the application of this Methodology, it is a necessary condition that the areas in the project boundaries present a forest cover that has remained stable for at least ten years counted backward from the start date of the initiative.

The holders of initiatives applying this Methodology may choose to exclude or include the quantification of certain carbon pools.

The Methodology covers aspects related to the definition of REDD+ activities, spatial and temporal limits, causes and agents of deforestation and forest degradation, identification of the baseline scenario and additionality, management of uncertainty in the quantification of baseline and mitigation results, risk and leakage management and non-permanence management, as well as compliance with REDD+ safeguards.

This Methodology contemplates the estimation of historical deforestation and forest degradation, following the procedures applied by the country for the estimation of emission reductions, to facilitate nesting at sub-national levels or, at the national level defined by the country as part of its strategy for the estimation of emission reductions from avoided deforestation and forest degradation.

Initiative holders may submit methodological deviations to adjust the estimation of emission reductions to specific project characteristics as long as the approval process by PROCLIMA<sup>1</sup> is completed.

This Methodology must be used by GHG mitigation initiatives to be certified and registered with the "Certification and Registration Program for GHG Mitigation Initiatives and other Greenhouse Gas Projects". PROCLIMA Program.

### 1.1 Objectives

The objectives of this methodological document (from now on referred to as this Methodology) are:

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<sup>1</sup> Prior to validation of the REDD+ project, the project holder must submit a detailed proposal for methodological deviation that includes an analysis in compliance with a) the principles set forth in ISO 14064-2:2006; numeral 3, or that which updates it and b) the requirements of resolution 1447 of August 01, 2018, or that which updates it. PROCLIMA will review the proposal and if it contains sufficient information for the evaluation, will assign an expert for the review. The outcome of the review will indicate whether the methodological deviation is feasible and the additional aspects to be included in the final version of the project document.



- (a) provide requirements for quantification of GHG Emission Reductions from GHG from REDD+ projects;
- (b) present the methodological requirements for the baseline identification for REDD+ projects;
- (c) endow the methodological requests to demonstrate additionality of REDD+ projects;
- (d) describe the requirements for the monitoring and follow-up of REDD+ projects;
- (e) establish requirements related to non-permanence and leakages;
- (f) facilitate the articulation of the Project accounting with national accounting;

## **2 Version and validity**

This document constitutes Version 2.2. February 5, 2021.

The present version may be adjusted periodically and intended users should ensure that they are using the document's updated version.

The GHG mitigation initiatives holders have a transition period of three months to use the updated version after publication.

## **3 Scope**

This methodological document constitutes a baseline methodology, quantification of emission reductions, and monitoring of REDD+ projects.

This Methodology is limited to the following REDD+ activities:

- (a) Emission reduction due to deforestation;
- (b) Emission reduction due to forest degradation.

The initiative holders shall use this Methodology to be certified and registered with the Certification and Registration Program for GHG Mitigation Initiatives and other Greenhouse Gas Projects. PROCLIMA® Program.

## **4 Conditions of applicability**

This Methodology is applicable under the following conditions:

- a) the areas in the project boundaries does not correspond to the forest category (as defined by the Forest and Carbon Monitoring System, at the start of the project activities and ten years before the project start date;
- b) the identified causes of deforestation include expansion of the agricultural frontier, mining, timber extraction, and infrastructural expansion;
- c) the causes of forest degradation identified include selective logging, fuelwood extraction, forest fires, forest grazing, and expansion of the agricultural frontier – illicit crops<sup>2</sup>;
- d) no reduction in deforestation or forest degradation is expected to occur in the absence of the Project;
- e) the carbon stock in the organic matter of soil, the litter and deadwood in deforested areas may decrease or remain stable;
- f) the quantification of GHG other than CO<sub>2</sub> should be included in the quantification of emissions caused by forest fires during the monitoring period;
- g) the activities constituting the REDD+ Project shall not result in the violation of any applicable law.

This Methodology allows the inclusion of areas in the Project that correspond to the wetlands category and the lands that contain organic soils. However, the initiative owner must submit to PROCLIMA a methodological approach with activity data, emission factors, and quantification of emission reductions from avoided deforestation and forest degradation that would be applied<sup>3</sup>.

## 5 Normative references

The following references are indispensable for the implementation of this Methodology:

- (a) PROCLIMA® Program. Certification and Registration Program for GHG Mitigation Initiatives and Other Greenhouse Gas Projects;
- (b) current national legislation related to REDD+ projects, or that which modifies or updates it;

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<sup>2</sup> The initiative holder may include causes of degradation other than those described in this numeral through a qualitative and quantitative description of the relationship between the causes of degradation and the project activities. The inclusion of causes of degradation that persist in the project scenario shall not be allowed.

<sup>3</sup> Prior to validation of the REDD+ project, the project holder must submit a detailed proposal that also includes an analysis of compliance with a) the principles set forth in ISO Standard 14064-2:2006; numeral 3 or that which updates it and b) the requirements of resolution 1447 of August 1, 2018, or that norm which updates it. PROCLIMA shall review the approach and indicate whether it is feasible and the additional aspects to be included in the final version of the project document.

- (c) Resolution 1447 of 2018 or that which modifies or updates it;
- (d) Resolution 471 of 2020, or that which modifies or updates it;
- (e) Integral strategy of deforestation control and forest management;
- (f) national interpretation of Social and Environmental Safeguards for REDD+ in Colombia;
- (g) conceptual and methodological guidelines for the characterization of causes and agents of deforestation in Colombia;
- (h) proposed Forest Reference Emission Level for deforestation in the Colombian Amazon Biome for results-based payments for REDD + under the UNFCCC;
- (i) Estimation of forest degradation in Colombia through fragmentation analysis;
- (j) IPCC Guidelines for National Greenhouse Gas Inventories (2006 and 2019). Volume 4. Agriculture, Forestry and Other Land use;
- (k) the guidelines, other orientations, and guides defined by PROCLIMA, in the framework of projects in the AFOLU sector.

## 6 Terms and definitions

### **Additionality**

It is the characteristic that allows demonstrating that the reductions of GHG emissions or removals derived from implementing a GHG mitigation initiative generate a net benefit to the atmosphere in terms of reduced or removed GHG emissions.

Those GHG emission reductions or removals that the GHG mitigation initiative holder demonstrates that would not occur in the absence of the GHG mitigation initiative are considered additional, as described in section 9 of this document.

### **Agents of deforestation**

Individuals, social groups, or institutions (public or private) that, influenced or motivated by a series of factors or underlying causes, decide to convert natural forests to other land cover and land uses, and whose actions are manifested in the territory through one or more direct causes.

## **Agriculture, Forestry and Other Land Use (AFOLU)**

The sector comprises either greenhouse gas emissions or removals attributable to project activities in agriculture, forestry, and other land uses.

### **Baseline scenario**

The baseline scenario is the scenario that reasonably represents the sum of the variations in carbon stocks, included in the project boundaries, that would occur in the absence of the initiative's activities.

### **Carbon fraction**

Tons of carbon per ton of dry biomass.

### **Carbon pools**

A compartment in which carbon stock changes occur in terrestrial ecosystems (aboveground biomass, belowground biomass, deadwood, litter, soil organic matter), as defined in the Guidelines of the Intergovernmental Group of Experts on Climate Change (IPCC) for national greenhouse gas inventories.

### **Core area**

Fragments of a forest with a minimum area of 202 hectares.

### **Direct causes of deforestation**

Direct causes of deforestation<sup>4</sup> are related to human activities that directly affect forests. They include factors that operate at the local scale, different from the initial structural or systemic conditions, which originate in land use and affect forest cover by harvesting the arboreal resource or eliminating it to give way to other uses.

### **Deforestation**

Deforestation is defined as the direct or induced conversion of forest cover to another type of land cover in a given period.

The UNFCCC Decision 11/CP.7 defines deforestation as the direct, human-induced conversion of forested land to non-forested land.

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<sup>4</sup> In the most national and international studies, the term "direct cause" is equated with the concept "driver" of deforestation.

### **Eligible areas**

Areas that meet the condition of forest presence on the reference dates established by the PROCLIMA Program. The areas in the geographical limits of the Project that correspond to the category of forest (according to the definition of the SMyC), at the beginning of the project activities, and ten years before the starting date of the Project.

### **Forest**

Land mainly covered by trees which might contain shrubs, palms, guaduas, grass, and vines, in 190 which tree cover predominates with a minimum canopy density of 30%, a minimum canopy height 191 (in situ) of 5 meters at the time of identification, and a minimum area of 1.0 ha. Tree covers from commercial forest plantations, palm crops, and planted trees for agricultural production are excluded.

This definition is in line with the criteria defined by the UNFCCC in decision 11/CP.7, the definition adopted by Colombia under the Kyoto Protocol (MAVDT, 2002), the definition of forest cover used in National Greenhouse Gas Inventory estimations and reports, and the definition included in the Colombian legend adaptation of the CORINE Land Cover (CLC) methodology.

### **Forest degradation**

Persistent reduction of carbon stocks in forests may be associated with a sustained and measurable decrease in the forest canopy and/or the number of trees per hectare, in which the percentage of forest cover is always greater than 30%.

The IPCC special report on "Definitions and Methodological Options to Inventory Emissions from Direct Human-induced Degradation of Forests and Devegetation of Other Vegetation Types" (2003) suggested the following characterization for forest degradation: A direct, human-induced, long-term loss (persisting for X years or more) or at least Y% of forest carbon stocks [and forest values] since time T and not qualifying as deforestation.

### **Leakages**

Potential emissions that occur outside the project boundaries due to the activities of the GHG mitigation initiative. Leakage means the net change in anthropogenic emissions by sources of greenhouse gases (GHG) that occurs outside the project boundary and is measurable and attributable to the project activity.

### **Non-forest**

Land that has never had a forest cover and cannot support trees or was previously an arboreal cover but changed to a different cover. It includes commercial forest plantations, palm crops, and trees planted for agricultural production.

### **Patch**

Forest fragments with a minimum area of 101 hectares.

### **Perforated**

Limit of non-forest areas, surrounded by forest fragments between 101 and 202 hectares, at a distance from the border of the forest of 100 m.

### **Permanence**

The condition resulting from the project activities whereby the system implemented within its limits extends continuously and over time, removing GHG from the atmosphere.

### **Project Start date**

The start date is when the activities that result in effective GHG emission reductions begin. For REDD+ projects, the start date is when the activities proposed by the Project to demonstrate reduced emissions from deforestation and forest degradation begin. It may be, for example, the start of forest management strategies as also when applicable to forest resource conservation plans. In other words, concrete actions to reduce deforestation.

### **Source, sink, or carbon pool-related**

Source sink or reservoir of GHG with flows of energy or materials to the interior, the exterior, or within the Project.

### **REDD+**

It is an international mitigation mechanism framed in the decisions of the CMNUCC, whose objective is to reduce emissions and remove GHGs through the implementation of activities to reduce emissions from deforestation, forest degradation, and other forestry activities.

### **REDD+ Project**

These are GHG mitigation projects that implement activities aimed at reducing emissions due to deforestation and forest degradation, as well as promoting conservation, sustainable forest management and increasing forest carbon stocks.

### **REDD+ safeguards**

Measures aimed at preventing the affectation of fundamental social, economic, or environmental rights and negative impacts due to the design and implementation of REDD+ activities. Likewise, it includes measures to improve the obtainment and distribution of benefits generated by REDD+ activities.

### **Reference region**

These are the geographic boundaries within which historical patterns of deforestation and forest degradation are analyzed and projected in the project area to obtain forest cover change values in the project area in the baseline scenario.

### **Organic soils**

According to FAO (definition adopted by IPCC)<sup>5</sup>, they are soils with organic carbon content equal to or greater than 12%. Organic soils (e.g., peat and manure) have at least 12 to 20 percent organic matter by mass and thrive under poorly drained wetlands conditions.

Organic soils are identified based on criteria 1 and 2, or 1 and 3 listed below:

1. Organic horizon thickness is greater than or equal to 10 cm. A horizon of less than 20 cm has 12 percent or more organic carbon when mixed to a depth of 20 cm.
2. Soils that are never saturated with water for more than a few days must contain more than 20 percent organic carbon by weight (i.e., about 35 percent organic matter).
3. Soils are subject to water saturation episodes and have either:
  - a) At least 12 percent organic carbon by weight (i.e., about 20 percent organic matter) if the soils have no clay;
  - b) At least 18 percent organic carbon by weight (i.e., about 30 percent organic matter) if the soils have 60% or more clay; or
  - c) An intermediate proportional amount of organic carbon for intermediate amounts of clay.

### **Underlying causes of deforestation**

Underlying causes are factors that reinforce the direct causes of deforestation. They include social, political, economic, technological, and cultural variables, which constitute the initial

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<sup>5</sup> Hiraishi, Takahiko, et al. "2013 supplement to the 2006 IPCC guidelines for national greenhouse gas inventories: Wetlands." *IPCC, Switzerland* (2014).



conditions in the existing structural relationships between human and natural systems. These factors influence the decisions made by agents and help explain why deforestation occurs.

## **Wetlands**

The Ramsar Convention on Wetlands defines wetlands as "*areas of marsh, fen, peat, and or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters.*" (Ramsar, 1971)<sup>6</sup>.

IPCC defines wetlands as: "*Wetlands include any land that is covered or saturated by water for all or part of the year, and that does not fall into the Forest Land, Cropland, or Grassland categories. Managed wetlands are restricted to wetlands where the water table is artificially changed (e.g., drained or raised) or those created through human activity*"<sup>7</sup>.

According to IDEAM (2010)<sup>8</sup> – Legend National of Land Cover, Chapter 4, Wetlands: "Includes those covertures consisting of flooded land, which can be temporarily and partially covered by aquatic vegetation, located on the see edges and in the interior of the continent". In addition, the wetlands are grouped into the following two categories: (4.1) Continental wetlands (swampy zones, peatlands, aquatic vegetation on bodies of water) and (4.2) Coastal wetlands (coastal marshes, saltpeper, and sediments exposed in low tide).

## **7 Carbon pools and GHG sources**

### **7.1 Carbon pools**

The Intergovernmental Panel on Climate Change (IPCC) foresees the estimation of carbon stock changes in the following pools: aboveground biomass, belowground biomass, deadwood, litter, and soil organic carbon (SOC). However, the holders of sectoral GHG mitigation projects may choose not to consider one or more carbon pools as long as they provide transparent and verifiable information and demonstrate that such a choice does not increase emission reductions or removals GHG, quantified by the Project.

The selection of carbon pools to quantify changes in carbon stocks at the project boundaries are shown in *Table 1*.

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<sup>6</sup> <http://www.minambiente.gov.co/index.php/component/content/article?id=411:planta-bosques-biodiversidad-y-servicios-ecosistematicos-13#imagenes>

<sup>7</sup> [https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4\\_Volume4/V4\\_07\\_Ch7\\_Wetlands.pdf](https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_07_Ch7_Wetlands.pdf)

<sup>8</sup> IDEAM, 2010. LEYENDA NACIONAL DE COBERTURAS DE LA TIERRA. Metodología CORINE Land Cover adaptada para Colombia Escala 1:100.000. Instituto de Hidrología, Meteorología y Estudios Ambientales. Bogotá, D.C., 72p. Disponible en: [http://siatac.co/c/document\\_library/get\\_file?uuid=a64629ad-2dbe-4e1e-a561-fc16b8037522&groupId=762](http://siatac.co/c/document_library/get_file?uuid=a64629ad-2dbe-4e1e-a561-fc16b8037522&groupId=762)



*Table 1. Carbon pools selected for the accounting of carbon stock changes*

Carbon pool	Whether selected (Yes/No)	Justification/Explanation
Aboveground biomass Arboreal vegetation	Yes	The change in carbon content in this pool is significant according to the national NREF.
Aboveground biomass Non-arboreal vegetation	Optional	Mandatory if the final land use (after the change) consists of the establishment of permanent crops.
Belowground biomass	Yes	The change in carbon content in this pool is significant according to the national NREF.
Deadwood and litter	Optional	Being conservative with the baseline scenario, if the carbon content in this pool is expected to decrease, it can be omitted.
	Optional	If, in the post-deforestation scenario, the carbon content can be increased, it should be included.
Soil organic carbon	Yes	The change in carbon content in this pool is significant according to the national NREF.

## 7.2 Source of emissions

The emission sources and associated GHGs selected for accounting are shown in *Table 2*.

*Table 2. Emission sources and GHGs selected for accounting*

Source	GHG	Whether selected (Yes/No)	Justification/Explanation
Burning of woody biomass <sup>9</sup>	CO <sub>2</sub>	No	CO <sub>2</sub> emissions due to woody biomass combustion are quantified as changes in carbon stocks.
	CH <sub>4</sub>	Yes	CH <sub>4</sub> emission should be included in the presence of fires was identified in the monitoring period.
	N <sub>2</sub> O	Yes	N <sub>2</sub> O emission should be included in the presence of fires was identified in the monitoring period.

<sup>9</sup>The quantification of CH<sub>4</sub> and N<sub>2</sub>O emissions caused by burning woody biomass is estimated based on the guidelines presented in the 2006 IPCC guidelines for national greenhouse gas inventories. Volume 4. Agriculture, forestry and other land uses. Non-CO<sub>2</sub> greenhouse gas emissions from biomass burning.

## 8 Spatial and temporal limits

### 8.1 Eligible areas for REDD+ projects

The REDD+ project holder must demonstrate that the areas within the geographical boundaries of the Project correspond to the forest category (as defined by the Forest and Carbon Monitoring System), at the start of project activities, and ten years before the project start date (defined as a stable forest)<sup>10</sup>

#### 8.1.1 Adding areas after validation

REDD+ project holders may add areas to the Project under the following conditions:

- a) the project owner must identify the project expansion area during the validation process and define the criteria for adding new areas;
- b) the default criteria that a new area must meet to be added to the REDD+ Project are:
  - i) comply with the guidelines of the Certification and Registration Program for GHG Mitigation Initiatives and other Greenhouse Gas Projects, in their most recent version;
  - ii) comply with all the provisions in the Methodological document Quantification of GHG Emission Reductions from REDD+ Projects, in their most recent version;
  - iii) include emission reduction only for validated REDD+ project activities<sup>11</sup>.
  - iv) implement the activities to avoid deforestation and forest degradation, described in the validated project document;
  - v) the additionality, causes, and agents of deforestation or forest degradation, land tenure, and baseline scenario of the new areas should be consistent with the characteristics validated for the initial areas;
  - vi) have a start date later than the start date of the areas included in the validation.

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<sup>10</sup> The cartographic inputs for obtaining the stable forest are available at ([www.ideam.gov.co](http://www.ideam.gov.co)). The detailed description of the methodological process for the generation of information on changes in forest area is available in the Protocol for digital image processing for the quantification of deforestation in Colombia. V 2.0. ([http://www.ideam.gov.co/documents/11769/44688974/Protocolo+de+PDI+para+la+cuantificacion+de+la+deforestacion+en+colombia+v2\\_1\\_.pdf/00b95004-53dd-49f9-ab09-16d8803ccd92?version=1.0](http://www.ideam.gov.co/documents/11769/44688974/Protocolo+de+PDI+para+la+cuantificacion+de+la+deforestacion+en+colombia+v2_1_.pdf/00b95004-53dd-49f9-ab09-16d8803ccd92?version=1.0))

<sup>11</sup> An activity not included in the validation process cannot be included in a new area. e.g., if forest degradation is not included in the validated activities, the Project cannot issue Verified Carbon Credits resultant of avoid forest degradation in the new area added.

- a) Given that the leakage belt may overlap with the validated expansion area in some cases, the project holder should update the leakage belt to include potential deforestation displacements due to the implementation of REDD+ project activities.

## 8.2 Reference region for baseline estimation

The REDD+ project holder shall outline a reference area or region to estimate deforestation and forest degradation that could occur in the project area in the baseline scenario. The reference region may include one or more areas and should be similar to the project area regarding access, drivers and determinants of deforestation, forest types and post-deforestation use and enforceable norms.

The geographic boundaries of the reference region depend on the historical deforestation pressure of the project area and must meet the following criteria:

- (a) the reference region may include all or part of the project area;
- (b) demonstrate that the agents and drivers of deforestation, identified in the reference region, can access the project area;
- (c) demonstrate that the project area is of interest to the agents identified in b, above;
- (d) Land tenure and land use rights should be represented in the reference region, after excluding the project area;
- (e) Exclude areas of restricted access to agents and drivers of deforestation and forest degradation<sup>12</sup>.

## 8.3 Leakage area

Area of a forest<sup>13</sup> where deforestation or forest degradation activity may be displaced, outside the REDD+ project holder's control. That is, areas to which deforestation or forest degradation agents may be displaced due to project activities.

The leakage area is delimited based on the following criteria:

- (a) all areas in the forest that are a range of mobility of the agents identified in section **¡Error! No se encuentra el origen de la referencia..**<sup>14</sup>
- (b) exclude areas of restricted access to deforestation and forest degradation agents.

<sup>12</sup> The document “*Estimación del ajuste por circunstancias nacionales para nivel de referencia de emisiones forestales 2018-2022*” presents an approach for the choosing of areas not susceptible of deforestation.

<sup>13</sup> The forest area must meet the same eligibility criteria as the project area.

<sup>14</sup> The mobility distance of the agents can be determined from secondary studies or from the collection of primary information (participatory rural appraisal).

#### **8.4 Temporal limits and analysis period**

The Project's temporal limits correspond to the periods during which project activities avoid land-use changes, and GHG emission reductions are quantified.

The temporal limits of the Project should be defined considering the following:

- (a) the start date of the Project,
- (b) the quantification period of the reductions,
- (c) monitoring periods.

##### **8.4.1 Historical period of deforestation**

The analysis of the historical rate of deforestation for the reference region and leakage area should be conducted at least two times (project start date and ten years before the project start date).

The analysis of the historical rate of forest degradation for the reference region and the leakage area should be performed for at least two periods: start date - intermediate year - ten years before the start date.

The projection of deforestation and forest degradation in the reference region and leakage area contemplates at least five years from the start date<sup>15</sup>.

##### **8.4.2 REDD+ project emissions reduction**

The project emissions reduction corresponds to the Project's quantification period, that is, the period during which the initiative holder quantifies the GHG emissions reductions or removals, measured against the baseline, to apply to the certification program issuance of Verified Carbon Credits (VCC).

The analysis period for the project area during verification corresponds to the monitoring period.

## **9 Identification of the baseline scenario and additionality**

The Project holders must identify the baseline scenario to demonstrate that the Project is additional. Under the UNFCCC, when selecting the Methodology to determine the baseline

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<sup>15</sup> At each verification, the REDD+ project holder must demonstrate that the project is applying the baseline from the most updated NREF that has been formally submitted by Colombia and evaluated by the UNFCCC.

scenario of a project in the AFOLU<sup>16</sup> sector, the project holder must select the most appropriate among the criteria listed below, justifying the convenience of their choice.

- (a) existing or historical changes, as appropriate, in carbon stocks at project boundaries;
- (b) changes in carbon stocks, within the project boundary, due to land use that represents an attractive course of action considering barriers to investment;
- (c) changes in carbon stocks within the project boundaries, identifying the most likely land use, at the beginning of the Project.

For this Methodology's application, it is recommended to use what is stated in literal (c) above. However, the REDD+ Project holder may use either of the other two approaches, as long as appropriate explanation and justification for the selected option are presented.

The initiative holder shall demonstrate with reliability that all the assumptions, justifications, and documentation considered are adequate to identify the baseline scenario.

The initiative holder must identify the baseline scenario through the following steps<sup>17</sup>:

#### **PASO o. Project start date**

The date on which the activities effective GHG emission reductions begin.

Determine the project start date, describe this selection, and present evidence that proves the project starting date. Show that the start date is defined within the five (5) years prior to the project validation.

#### **STEP 1. Identification of alternative land-use scenarios**

This step consists of identifying the most probable land-use scenarios, which could be the baseline scenario, through the following sub-steps:

##### *Sub-step 1a. Identification of probable land use alternatives in the project areas*

Identify realistic and credible land use alternatives in the project areas in the absence of the proposed project activity. The alternatives must be feasible considering the relevant national and sectoral circumstances and policies, considering historical land uses in the Project's area

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<sup>16</sup> In the Executive Board Decisions, it is noted: Afforestation and Reforestation, however, the scope of this methodology also applies to REDD+ Projects.

<sup>17</sup> Adapted of "Combined tool to identify the baseline scenario and demonstrate additionality" (Report EB35, Annex 19).

of influence, economic practices, and economic tendencies in the region. These alternatives must include at least the following activities:

- (a) continuation of previous land use (before Project);
- (b) REDD+ projects without the emission reduction certification;
- (c) other plausible and credible land-use alternatives concerning location, size, funding, experience requirements, among others. These may include alternatives that represent common practices land use in the region where the Project is located.

Result of sub-step 1a. List of probable land use alternatives in the project area in the absence of the REDD+ Project.

*Sub-step 1b. Consistency of land use alternatives with applicable laws and regulations*

The applicable laws and regulations are given by national and sectoral policies related to natural resources, the REDD+ activities, and the land use change activities. Show that all land use alternatives identified in sub-step 1a comply with all applicable statutory and mandatory regulatory requirements.

If a land-use alternative does not comply with all mandatory applicable laws and regulations, demonstrate that, based on a careful analysis of current practice (in the region where the Law is mandatory or regulation applies), the systematically applicable mandatory legal or regulatory requirements are not met.

Remove from the land-use scenarios identified in sub-step 1a any land use alternatives that do not comply with applicable mandatory laws and regulations unless you can demonstrate that such alternatives result from systematic failure to comply with the mandatory laws and regulations.

Result of sub-step 1b. List of possible land-use alternatives that comply with the legislation and mandatory norms and regulations, considering their compliance in the region or country, for national and sectoral policies.

If the list resulting from sub-step 1b is empty or contains only one land-use scenario, the Project is not additional.

**STEP 2. Barrier analysis**

Determine if the REDD+ Project faces barriers that:

- (a) prevents or limits the implementation of this kind of GHG mitigation project; and,

- (b) they do not prevent the implementation of at least one of the probable land use alternatives.

Apply the following sub-steps:

*Sub-step 2a. Identify the barriers that would prevent the project implementation*

Identify realistic and credible barriers that prevent the Project's realization if it did not contemplate participation in the carbon market. The barriers should not be specific for the project participants but should apply to the project activity. Such barriers may include, among others:

Investment barriers, *inter alia*:

- Debt funding is not available for this type of Project;
- No private capital is available due to real or perceived risks associated with national or foreign direct investment in the country where the Project is to be implemented;
- Lack of access to credit;

Institutional barriers, *inter alia*:

- Risk related to changes in government policies or laws;
- Lack of enforcement of land-use-related legislation.

Barriers due to social conditions, *inter alia*:

- Demographic pressure on the land (e.g., increased demand on land due to population growth);
- Social conflict among interest groups in the region where the Project takes place;
- Widespread illegal practices (e.g., illegal grazing, illicit crops, non-timber product extraction, and tree felling);
- Lack of skilled and properly trained labor force;
- Lack of organization of local communities.

Barriers relating to land tenure, ownership, inheritance, and property rights, *inter alia*:

- Communal land ownership with a hierarchy of rights for different stakeholders limits the incentives to undertake the project activities;
- Lack of suitable land tenure legislation and regulation to support the security of tenure;
- Absence of clearly defined and regulated property rights about natural resource products and services;



- Formal and informal tenure systems that increase the risks of fragmentation of landholdings.

The barriers identified constitute sufficient evidence to demonstrate the project additionality, only if they prevent the potential initiative holders from doing the Project if it does not participate in the carbon market.

The GHG project holder must provide transparent and documented evidence and offer conservative interpretations of how it demonstrates the existence and significance of the identified barriers. The type of evidence to be provided may include:

- (a) relevant legislation, regulatory information or environmental and natural resource management norms, acts or rules;
- (b) relevant studies or surveys, for example, studies by institutions such as universities, research institutions, associations, companies, bilateral or multilateral agencies;
- (c) relevant statistical data from national or international statistics;
- (d) written documentation from the company or institution developing or implementing the Project;
- (e) activities of the project holder or developer project, such as minutes from Board meetings, correspondence, feasibility studies, financial or budgetary information;
- (f) documents prepared by the project developer, contractors, or project partners in the context of the proposed project activity or similar previous project implementations;
- (g) written documentation of independent expert judgments from agriculture, forestry, and other land-use related Government and Non-Government bodies or individual experts, educational institutions (e.g., universities, technical schools, training centers), professional associations, and others.

*Sub-step 2 b. Demonstrate that the identified barriers would not prevent the implementation of at least one of the identified land use alternatives (except the project activity):*

If the identified barriers also affect other identified alternatives, the project holder must demonstrate how they are less affected than they affect the Project. To be precise, it must explain how the identified barriers do not prevent the implementation of at least one land use alternatives. Any alternative, which prevents the barriers identified in Sub-step 2a, is not a viable alternative and should be removed from the analysis. At least one viable alternative (other than the Project) should be identified.



The baseline scenario shall be the one that is not affected by the barriers identified in sub-step 2a.

If one of Sub-steps 2a or 2b is not fulfilled, the Project cannot be considered additional through the barrier analysis.

If both Sub-steps (2a and 2b) are satisfied, proceed to Step 3 (Impact of project registration).

### **STEP 3. Impact of the project registration**

Explain how certification and registration of the Project, and the associated benefits and incentives derived from this, would lessen the impact of the identified barriers (Step 2) and enable the Project to proceed. The benefits and incentives can be of various types, such as:

- GHG emission reduction by project activities;
- The financial benefit from the VCC sale, including the certainty and predefined timing of the proceeds;
- Build capacity in the entities in charge of land use planning in the project area to ensure the implementation of REDD+ activities;
- Attract new stakeholders to implement new technologies and practices.

If Step 3 is met, the Project does not correspond to the baseline scenario and is therefore additional.

If Step 3 is not met, the Project is not additional.

## **10 Causes and drivers of deforestation and forest degradation**

The project holder shall identify, describe and analyze the causes and agents of deforestation and forest degradation in the project area as input for:

- (a) design measures and actions to mitigate deforestation and forest degradation (REDD+ activities); and,
- (b) delimit the reference region.

The following is a description of the key elements to develop a characterization of deforestation's causes and agents, as suggested by IDEAM<sup>18</sup> and the UN-REDD Program<sup>19</sup>.

### 10.1 Spatial and temporal dimensions

Deforestation and forest degradation have spatial and temporary dimensions that shall be characterized. The spatial dimension helps to know and analyze the phenomenon's location and extent (project area and proposed reference region). The temporal dimension allows understanding deforestation and forest degradation in terms of its historical antecedents, current dynamics, and probable future behavior (historical period of deforestation and forest degradation).

### 10.2 Context

An adequate characterization of the causes and agents of deforestation and forest degradation in a particular area implies recognizing and understanding the socio-environmental surrounding of the phenomenon and analyzing its influence on the dynamics of deforestation and forest degradation.

- a) The *territorial context* refers to the biophysical environment and how societies relate and construct their living space. It includes elements such as occupation, land use, social interaction, and legal and regulatory aspects that govern these dynamics.
- b) The *sociocultural context* is based on the relationships between societies and how different human groups interact and organize themselves to live and establish production in the community.
- c) The *economic context* refers to using the means of production to generate and trade goods and services, which in aggregate contribute to the (economic) growth of a region.
- d) The *historical context* conditions the other types of context described above, as it is based on the construction of human societies as a process that occurs and changes in time and space. Of particular relevance are the processes of occupation and production in the territory by different human groups.

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<sup>18</sup> González, J. Cubillos, A., Chadid, M., Arias, M., Zúñiga, E., Cubillos, M., Joubert, F. Pérez, I. Lineamientos conceptuales y metodológicos para la caracterización de causas y agentes de la deforestación en Colombia. Instituto de Hidrología, Meteorología y Estudios Ambientales – IDEAM. Ministerio de Ambiente y Desarrollo Sostenible. Programa ONU-REDD Colombia. Bogotá, 2018.

<sup>19</sup> The present methodology accepts the use of the Minimum Characterization Scenario (MCS).

### 10.3 Key actors, interests, and motivations

The deforestation and forest degradation processes involve multiple official actors, non-governmental organizations and civil society. Within this group are the agents of deforestation and forest degradation and those actors that indirectly promote forest transformation processes. It is essential to characterize the interests or motivations that determine their decisions and their relationships with other key actors. In this sense, it is necessary to include in the analysis the underlying causes of deforestation and forest degradation identified for the project area, pointing out their importance within the group of factors that motivate agents to deforest or degrade.

Each key actor involved in the dynamics of deforestation and forest degradation has a degree of responsibility and influence and a geographic expression that shall be characterized and related to the phenomenon of deforestation or forest degradation.

### 10.4 Economic activities and their importance

Activities that directly cause deforestation and/or degradation should be characterized in terms of the spatial patterns associated with their presence, but also in terms of their economic and socio-cultural importance for the agents of deforestation or degradation and other key stakeholders involved. It is clear that activities with a high level of socio-cultural practices require different measures and actions than those where economic benefit prevails over other interests.

### 10.5 Direct and indirect impact

Each cause and agent have a differential impact on forests. The impact can be assessed qualitatively or quantitatively. Quantitative estimation of impacts can be made using a spatial analysis that determines the relationship between the identified cause and the calculated deforestation forest degradation. Qualitative estimations can be made through the use of stakeholder participation in the territory.

### 10.6 Relations and synergies

The project holder must identify and analyze the interactions and synergies between all elements and actors to define REDD+ activities.

### 10.7 Deforestation and forest degradation chain of events

The analysis of chain and events seeks to identify the relationships between major groups of agents and causes to try to explain the sequence of events that usually leads to the loss of forest and forest degradation in a particular area.

For each activity that causes forest loss or forest degradation, a causal chain of at least 3 links must be identified, which is composed of a different sequence of events or conditions that result in the occupation of the territory, as follows:

- a) identify each of the activities that generate forest loss or forest degradation. If possible, these should be grouped according to the most common direct causes of;
- b) identify the agents associated with the actions and direct causes of deforestation or forest degradation established;
- c) identify the underlying causes that promote or facilitate agents' decisions to carry out actions resulting in forest loss or forest degradation.

## **11 REDD+ activities**

REDD+ activities should be designed based on the results of causes and agents of deforestation and forest degradation analysis. Likewise, they shall consider what has been established by the communities in the community life plans (in indigenous territories) and ethno-development plans (in afro communities). In the case of peasant territories, based on participatory construction. The design of each REDD+ activity shall include, at a minimum, the following:

- a) activity ID;
- b) relationship between activity and direct or underlying cause;
- c) compliance with life plans or ethno-development plans;
- d) consultation mechanism for the definition of REDD+ activities;
- e) responsibility and role of the actors involved in the implementation of the activity;
- f) implementation schedule;
- g) indicators to report the activity's progress, including name, type<sup>20</sup>, goal<sup>21</sup>, measurement unit, and responsible for measurement.

## **12 Safeguards REDD+**

The implementation of the REDD+ activities has the potential to generate benefits to communities and the environment and reduce GHG emissions. However, there may be some

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<sup>20</sup> Result, product, or impact

<sup>21</sup> Expected value and time for compliance

social and environmental risks associated with its implementation. In this sense, REDD+ safeguards are measures aimed at preventing the affectation of fundamental social, economic, or environmental rights and the occurrence of negative impacts due to the design and implementation of REDD+ activities. They also include measures to improve the procurement and distribution of benefits generated by REDD+ activities.

In the national interpretation of the safeguards for REDD+, 15 safeguard elements have been defined in Colombia. They are numbered with a letter that refers to the Cancun safeguard to which they correspond and a number that identifies it. The national interpretation organizes the safeguard elements into three themes: institutional, social and cultural, and environmental and territorial.

The REDD+ project holder must demonstrate compliance with all the safeguards presented in Table 3, including the definition of indicators for monitoring, reporting, and verification.<sup>22</sup>

Table 3. Safeguards REDD+

Thematic	Safeguard Cancun	National safeguard	Description
Institutional	A. Consistent with national forestry programs and agreements. international	1. Correspondence with national legislation	<p>The Project is developed within the framework of the National Forestry Development Plan, international conventions, and agreements signed by Colombia in the areas of Forests, Biodiversity, and Climate Change, as well as the national policies corresponding to these agreements.</p> <p>All proposed REDD+ Policies, actions, and measures must be in correspondence with:</p> <ul style="list-style-type: none"> <li>• international agreements signed by Colombia.</li> <li>• national legislation (the Constitution, laws, and decrees).</li> <li>• national policies, programs, and projects.</li> </ul>
	B. Transparency and effectiveness of forest governance structures	2. Transformation and access to the information	<p>Stakeholders have transparent, accessible, and practical information related to REDD+ actions in the information platforms or media determined.</p> <p>If there are ethnic groups involved and do not speak Spanish well, it should be ensured that</p>

<sup>22</sup> Camacho A., Lara I., Guerrero R. D. 2017. "Interpretación Nacional de las Salvaguardas Sociales y Ambientales para REDD+ en Colombia" MADS, WWF Colombia, ONU REDD Colombia. Bogotá-Colombia.

Thematic	Safeguard Cancun	National safeguard	Description
			<p>there are interpreters for their language in the consultation and information areas for their language and understanding. Be clear in reporting on:</p> <ul style="list-style-type: none"> <li>• which entity is in charge of formulating and implementing the measure;</li> <li>• what are the benefits to be delivered to the communities in the territory</li> <li>• the commitments made by the parties involved in the implementation of the measures</li> </ul>
		3. Accountability	<p>The institutions and actors present reports on their administration on REDD+ activities to the partners involved, institutions, and the general public, including information on applying and compliance with safeguards.</p> <p>Those in charge of implementing REDD+ activities must convene accountability spaces where management reports are presented: what has been done, how it has been done, how much has been spent and how the resources have been invested, what the results are.</p> <p>Should be included the information on the status of implementation of safeguards for risk mitigation and benefit enhancement.</p> <p>Stakeholders are committed to attending these informative forums. Accountability reports must be public and accessible to diverse stakeholders.</p>
		4. Recognition of forest governance structures	<p>REDD+ actions are developing under the existing forest governance structures established by the regulations and by establishing the necessary structures among the actors involved in the process (strengthening or creating new structures can be a mechanism for implementing governance).</p> <p>In some cases where various stakeholders are involved, it may be necessary to establish new arrangements or articulation mechanisms for decision making. These may include forestry roundtables, follow-up committees, or the</p>

Thematic	Safeguard Cancun	National safeguard	Description
			creation of spaces for dialogue with the community action boards.
		5.Capacity building	<p>The strengthening of the technical, legal, and administrative governance capacities of the actors directly involved is guaranteed so that the parties can make documented, analyzed, and informed decisions.</p> <p>It is necessary to account with programs that contribute to the capacity building of the actors involved as required in each case:</p> <ul style="list-style-type: none"> <li>• technical capacities: training in REDD+, climate change, forest governance, sustainable forest management, conservation, monitoring, and sustainable production models, among others.</li> <li>• legal skills: training in national legislation and international agreements related to these issues.</li> <li>• administrative skills: training in tools for project follow-up, resource management, and accountability.</li> </ul>
Social and cultural	C. Respect for the traditional knowledge and rights of the communities	6.Free, prior and informed consent	When a measure or action affects or may directly affect one or more ethnic groups, the national provisions on consultation and free, prior, and informed consent established in legislation and jurisprudence must be applied, as well as the guidelines issued by the Ministry of the Interior as the competent entity in this area, with the support of the control agencies.
		7.Respect traditional knowledge	<p>The traditional knowledge systems and ethnic and local peoples' and communities' visions of the territory are recognized, respected, and promoted, as established in national legislation and compliance with international agreements.</p> <p>For the development of any initiative to reduce deforestation, the different cultures that inhabit the territories must be considered, respecting their forms of understanding and relating to the environment so that the communities' traditions, uses, and customs are not affected.</p>



Thematic	Safeguard Cancun	National safeguard	Description
		8. Benefit-sharing	The participation and fair and equitable sharing of benefits generated by policies, measures, and actions to reduce deforestation for ethnic and local peoples and communities, and of all those benefits derived from traditional knowledge, innovations, and practices for the conservation and sustainable use of forests, their diversity and Ecosystem Services are guaranteed.
		9. Territorial rights	The collective and individual territorial rights of ethnic and local peoples and communities are respected; also, their cultural, economic, and spiritual use and significance. For this purpose, the land tenure arrangements in the areas where REDD+ measures and actions are expected to be implemented must be known, and decisions must be made accordingly.
	D. Full and effective participation	10. Participation	The right to all stakeholders' full and effective participation is respected to ensure governance and adequate decision-making on REDD+. Each stakeholder group's participation structures, especially communities, shall be recognized and respected under national legislation and international agreements signed by Colombia.
Environmental and territorial	E. Conservation and benefits	11. Forests conservation and their biodiversity	REDD+ projects support forest conservation and the implementation of measures established for this purpose. REDD+ projects developed in the country should not be detrimental to the conservation of forests and the biodiversity that they harbor.
		12. Provision of environmental goods and services	REDD+ projects support the provision and enjoyment of ecosystem services. The implementation of REDD+ projects must not directly or indirectly affect ecosystems' benefits, known as ecosystem services (provisioning, supporting, regulating, and cultural), for example, water supply, soil, and biodiversity.
	F. Prevent reversion risks	13. Environmental	REDD+ initiatives support the consolidation of land-use and environmental management



Thematic	Safeguard Cancun	National safeguard	Description
		and territorial planning	<p>instruments provided for in the legislation, focusing on conservation and sustainable forest management.</p> <p>REDD+ initiatives in the country recognize, respect, adapt or strengthen the measures and instruments of territorial and environmental planning defined by national legislation. It is also ideal for encouraging citizen participation in the formulation and adjustment of these instruments following land use.</p> <p>The specific forms of land use planning of ethnic groups and local communities must also be recognized to support their permanence over time.</p>
		14.Sectoral planning	<p>Sectoral REDD+ actions are proposed based on environmental and territorial planning instruments and legislation related to the conservation of forests and their biodiversity.</p> <p>When a sector defines and implements REDD+ actions, these must be articulated with national legislation that protects forests, their conservation, and the diversity that they harbor.</p>
	G. Avoid emission displacement	15.Forestry control and surveillance to prevent emissions displacement.	<p>REDD+ initiatives incorporate measures to reduce emissions displacement in their design and ensure opportune monitoring and control when emissions displacement occurs.</p> <p>Community monitoring, articulated with early warning systems for deforestation, and the activation of protocols that allow for timely responses, can be decisive in ensuring that the problems associated with forest loss and forest degradation do not spread to other places.</p>

Source: Camacho et al. (2017)<sup>23</sup>

<sup>23</sup> Camacho A., Lara I., Guerrero R. D. 2017. "Interpretación Nacional de las Salvaguardas Sociales y Ambientales para REDD+ en Colombia" MADS, WWF Colombia, ONU REDD Colombia. Bogotá-Colombia

## 13 GHG emission reduction from REDD+ activities

### 13.1 Uncertainty management

According to GOF-C-GOLD (2016)<sup>24</sup>, uncertainty is a property of a parameter estimate and reflects the degree of lack of knowledge of the true parameter value because of factors such as bias, random error, quality and quantity of data, state of knowledge of the analyst, and knowledge of underlying processes. Uncertainty can be expressed as a percentage confidence interval relative to the mean value. For example, if the area of forest land converted to cropland (mean value) is 100 ha, with a 95% confidence interval ranging from 90 to 110 ha, we can say that the area estimate's uncertainty is  $\pm 10\%$ .<sup>25,26</sup>

Under the PROCLIMA Program, uncertainty management is determined by the accuracy of the maps used to estimate activity data values and the application of discounts<sup>27</sup> in emission factors. For activity data, the accuracy should be greater than 90%. The accuracy assessment should be made from the use of field observations or analysis of high-resolution imagery. For emission factors, an uncertainty of 10% is acceptable for the use of average carbon values (assessment should be done per repository). If the uncertainty is greater than 10%, the 95% confidence interval's lower value should be applied<sup>28</sup>.

### 13.2 Activity data

#### 13.2.1 Deforestation

The data of change in forest (CCF) area constitutes the activity data for deforestation estimation. This Methodology proposes two approaches for estimating activity data: from historical average and modeling. The initiative holder may choose one of the two approaches to quantify the activity data.

#### Estimating historical rate of deforestation

The project holder must perform the forest analysis to non-forest change between at least two dates (start date and ten years prior to the start date)<sup>29</sup>.

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<sup>24</sup> GOF-C-GOLD, 2016, A sourcebook of methods and procedures for monitoring and reporting anthropogenic greenhouse gas emissions and removals associated with deforestation, gains and losses of carbon stocks in forests remaining forests, and forestation. GOF-C-GOLD Report version COP22-1, (GOF-C-GOLD Land Cover Project Office, Wageningen University, The Netherlands). Disponible en: [http://www.gofcgold.wur.nl/redd/sourcebook/GOF-C-GOLD\\_Sourcebook.pdf](http://www.gofcgold.wur.nl/redd/sourcebook/GOF-C-GOLD_Sourcebook.pdf).

<sup>25</sup> The project holder should describe how it addressed the GOF-C-GOLD (2016) guidelines in estimating uncertainty.

<sup>26</sup> It is not necessary to estimate the uncertainty associated with the values defined in the NREF.

<sup>27</sup> The discounts are different from and in addition to the 15% reserve provided for in section 11.8 of the PROCLIMA Program

<sup>28</sup> The project holder may use data from scientific studies that have a data uncertainty of less than 20%.

<sup>29</sup> The cartographic inputs for obtaining deforestation by period are available at ([www.ideam.gov.co](http://www.ideam.gov.co)).

Only the areas for which forest is detected on the first date and no forest on the second date are considered to calculate the area deforested between two dates so that there is a certainty that the event occurred in the period analyzed (gross deforestation).

Forest losses detected after one or several dates without information<sup>30</sup> should not be included in the calculation to avoid overestimated rates in which the areas without information increase due to different factors, like periods of high cloud cover or failures in the satellite programs' sensors that take the images.

### **Historical annual deforestation in the reference region**

The following equation estimates annual historical deforestation in the reference region:

$$FSC_{yr} = \left( \frac{1}{t_2 - t_1} \right) \times (A_1 - A_2)$$

Where:

$FSC_{yr}$  = Annual change in the surface covered by forest in the reference region; ha

$t_2$  = Final year of the reference period; yr

$t_1$  = Initial year of the reference period; yr

$A_1$  = Forest surface in the reference region in the initial moment; ha

$A_2$  = Forest surface in the reference region in the final moment; ha

The Forest surface change (FSC) corresponds to the historical rate of the reference region deforestation and is the value used to represent the expected forest loss in the baseline scenario.

### **Projected annual deforestation in the REDD+ project scenario**

The projected annual deforestation in the REDD+ Project is estimated with the equation:

$$FSC_{REDD+project,yr} = FSC_{bl,yr} \times (1 - \%DD)$$

Where:

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<sup>30</sup> Complementary information may be used to reduce the area without information. Detailed information about the methodology, the relevance of the use of the selected information source and the evaluation of the accuracy of the image classification should be presented.

$FSC_{REDD+project,yr}^{31}$  = Annual change in the surface covered by forest in the project scenario; ha

$FSC_{bl,yr}$  = Annual change in the surface covered by forest in the baseline scenario; ha

%DD = Projected decrease in deforestation due to the implementation of REDD+ activities

### Annual historical deforestation in the leakage area

The annual historical deforestation in the leakage area is estimated with the equation:

$$FSC_{lk,yr} = \left( \frac{1}{t_2 - t_1} \right) \times (A_{1lk} - A_{2lk})$$

Where:

$FSC_{lk,yr}$  = Annual change in the surface covered by forest in the leakage area; ha

$t_2$  = Final year of the reference period; yr

$t_1$  = Initial year of the reference period; yr

$A_{1lk}$  = Forest surface in the leakage area in the initial moment; ha

$A_{2lk}$  = Forest surface in the leakage area in the final moment; ha

### Projected annual deforestation in the leakage area in the project scenario

The projected annual deforestation in the leakage area in the project REDD+ scenario is estimated with the equation:

$$FSC_{REDD+project,f,yr} = FSC_{lk,bl} \times (1 + \%E_{lk})$$

Where:

$FSC_{REDD+project,yr}$  = Annual change in the surface covered by forest in leakage area in the project scenario; ha

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<sup>31</sup> The proposed reference level of forest emissions from deforestation in Colombia for payment for REDD+ results under the UNFCCC considers a calculation of the adjustment for national circumstances. The project holder may adjust the value of  $FSC_{REDD+project,yr}$  following the guidelines in the annex for estimating the national circumstances adjustment ([https://redd.unfccc.int/files/31122019\\_anexo\\_circunstancias\\_nref\\_nal\\_v7.pdf](https://redd.unfccc.int/files/31122019_anexo_circunstancias_nref_nal_v7.pdf)).

$FSC_{lk,bl}$  = Annual change in the surface covered by forest in leakage area in the baseline scenario; ha

$\%E_{lk}$  = Percentage of emissions increase in the leakage area due to the implementation of REDD+ activities. The use of a default value of 10% is allowed in this Methodology.

### Estimating deforestation from modeling

The estimation of deforestation may be carried out through spatial modeling, which allows the generation of future scenarios based on multi-temporal historical analysis. To obtain the surface that is deforested in the baseline scenario and its location. The use of the DinamicaEGO<sup>32</sup> software is suggested.

To appraise the project deforestation dynamics, the following steps must be completed<sup>33</sup>:

- (a) Calculate transition matrices<sup>34</sup>: forest/non-forest information is used to describe forest changes from discrete periods. The forest/non-forest layers are required at the start date, ten years before the start date, and one year in between;
- (b) Calculate ranges to categorize continuous variables and their weights of evidence: Transition probabilities and weights are obtained for the variables with the greatest influence on forest change, and significant variables are determined. The project holder should select biophysical and socioeconomic variables that may be determinants of the agents and drivers of deforestation and consistent with the results of section 10.
- (c) Identify the correlation between maps: the spatial correlation between the study variables is identified. The final variables must be independent. Therefore, with correlation (Cramer's index greater than 0.5<sup>35</sup>), one of the variables shall be eliminated.
- (d) Build and run the simulation model: a simulated forest/non-forest layer is generated for the intermediate year. Selection of values for expansion (common in frontier deforestation) and new patches (common in mosaic deforestation) from historical deforestation behavior is required.

<sup>32</sup> Free access program used successfully in several projects for the projection of land use changes. The program and its instructions for use can be downloaded at: <https://csr.ufmg.br/dinamica/>.

<sup>33</sup> The project holder must present the methodological description and the results of each of the steps.

<sup>34</sup> To calculate the area deforested between two dates, only the areas for which forest is detected on the first date and non-forest on the second date are taken into account, so that there is certainty that the event occurred in the time period analyzed (gross deforestation).

<sup>35</sup> Espinoza-Mendoza, Victoria. "DINAMICA EGO: UNA HERRAMIENTA GRATUITA PARA MODELAR Y BRINDAR SOPORTE EN EL ANÁLISIS DE CCUS." <http://cgp.org.pe/web/b3-08/>

- (e) Model validation: the simulated layer is compared with the real one considering the spatial coincidence under different tolerance levels.
- (f) Deforestation trajectory projection: the calibrated and validated model is used to create the future annual deforestation in the reference region ( $FSC_r$ ) and in the project area ( $FSC_p$ ) in the without-project scenario.

Projected annual deforestation in the REDD+ project scenario

The projected annual deforestation in the project scenario is estimated with the following equation:

$$FSC_{REDD+project,yr} = FSC_{yr} \times (1 - \%DD)$$

Where:

- $FSC_{REDD+project,yr}$ <sup>36</sup> = Annual change in the surface covered by forest in the project scenario; ha
- $FSC_{yr}$  = Annual change in the surface covered by forest in the without-project scenario; ha
- %DD = Projected decrease in deforestation due to the implementation of REDD+ activities

Projected annual deforestation in the leakage area in the project scenario

The projected annual deforestation in the leakage area in the project REDD+ scenario is estimated with the following equation:

$$FSC_{lk,p,yr} = FSC_{lk,bl,yr} \times (1 + \%E_{lk})$$

Where:

- $FSC_{lk,p,yr}$  = Annual change in the surface covered by forest in leakage area in the project scenario; ha
- $FSC_{lk,bl}$  = Annual change in the surface covered by forest in leakage area in the baseline scenario; ha

<sup>36</sup> The proposed reference level of forest emissions from deforestation in Colombia for payment for REDD+ under the UNFCCC considers a national circumstances adjustment calculation. The project holder may adjust the value of  $FSC_{REDD+project,yr}$  following the guidelines in the annex for the estimation of the national circumstance's adjustment ([https://redd.unfccc.int/files/3122019\\_anexo\\_circunstancias\\_nref\\_nal\\_v7.pdf](https://redd.unfccc.int/files/3122019_anexo_circunstancias_nref_nal_v7.pdf)).

$\%E_{lk}$  = Percentage of emissions increase in the leakage area due to the implementation of REDD+ activities. The use of a default value of 10% is allowed in this Methodology.

### 13.2.2 Forest degradation

Forest degradation implies a negative impact on carbon stocks. The estimation of this impact must be calculated through variables that can be measurable in areas where the extension, canopy cover, and minimum height remain above the forest definition thresholds. To monitoring the forest degradation in Colombia, the Forest and Carbon Monitoring System (SMByC) has proposed to define this process as "a persistent reduction of carbon stocks stored in forests that may be associated with a sustained and measurable decrease of the forest canopy and the number of trees per hectare, always being the percentage of forest cover greater than 30%".<sup>37</sup>

Given the lack of historical biomass data to establish appropriate reference points and the limited capacity for estimating and monitoring forest degradation using remote sensing, it has been proposed to estimate and monitor this process using a local reference point representing low or no degradation has comparable biophysical characteristics.

To define the forest degradation activity data, the project holder must apply the Methodology for estimating forest degradation in Colombia proposed by the Forest and Carbon Monitoring System (SMByC), which is based on determining the changes in aboveground biomass present in different forest cover categories, assigned through a fragmentation analysis<sup>38</sup>. The Methodology and results associated with the following steps<sup>39</sup> should be described:

- a) Layers of natural forest cover used:
  - (i) year closest to the biomass map utilized
  - (ii) initial year of the reference period
  - (iii) final year of the reference period
  - (iv) intermediate year between the start and end of the reference period. If benchmark (i) is different from (ii) and (iii), then layer (i) can be used as the intermediate year.

<sup>37</sup> Ramírez-Delgado J.P., Galindo G.A., Yepes A.P., Cabrera E. Estimación de la degradación de bosques de Colombia a través de un análisis de fragmentación. Instituto de Hidrología, Meteorología y Estudios Ambientales – IDEAM, Ministerio de Ambiente y Desarrollo Sostenible – MADS, Programa ONU-REDD Colombia. Bogotá, 2018.

<sup>38</sup> The project holder may propose a methodological deviation (section 1) to quantify the avoided degradation emission reductions in the scenario with project.

<sup>39</sup> The base information produced by the SMByC should be used.



- b) Forest fragmentation for each layer used: processing with the *Landscape Fragmentation Tool* is suggested to facilitate the project results with national estimates<sup>40</sup>.
- c) Fragmentation classes: the result of the areas per fragmentation class each year evaluated should be presented according to Table 4.

Table 4. Fragmentation classes

Class	Area (ha)			
	Year biomass	Year 1	Year 2	Year 3
Core				
Perforated				
Patch				

- d) Precision analysis reduces the uncertainty of the estimation of forest degradation. This analysis should include corroboration of fragmentation classes, with information from additional remote sensing and field monitoring points<sup>41</sup>.
- e) Transitions between the fragmentation classes:
  - (i) primary degradation: core to patch
  - (ii) secondary degradation: perforated to patch

Table 5. Fragmentation class transition (ha)

Class Year 1/Class Year 2	Perforated	Patch
Core		
Perforated		

Historical annual forest degradation in the project area in the baseline scenario

The following equations estimate the annual historical forest degradation in the baseline scenario<sup>42</sup>:

$$PFD_{bl,yr} = \left( \frac{1}{t_2 - t_1} \right) \times (A_{core,bl} - A_{c-p,bl})$$

<sup>40</sup> The minimum distance to the forest to be used is 100m.

<sup>41</sup> The project holder can use the following study as a guide for accuracy analysis of activity data: Finegold, Y., Ortmann, A., Lindquist, E., d'Annunzio, R., & Sandker, M. (2016). Map accuracy assessment and area estimation: a practical guide. Rome: Food and Agriculture Organization of the United Nations.

<sup>42</sup>The area reported as degraded is that with a degradation trend in the two periods of analysis. That is, areas that move from a primary to a secondary class in one period and then return to a primary class will not be considered degraded.



Where:

$PFD_{bl,yr}$  = Annual historical primary forest degradation in baseline scenario; ha

$t_1$  = Initial year of the reference period; yr

$t_2$  = Final year of the reference period; yr

$A_{core,bl}$  = Area in core class of the reference region, in the year of the start of the reference period; ha

$A_{c-p,bl}$  = Reference region area that changes from the core to patch in the final year of the reference period; ha

And,

$$SFD_{bl,yr} = \left( \frac{1}{t_2 - t_1} \right) \times (A_{perforated,bl} - A_{perforated-patch,bl})$$

Where:

$SFD_{bl,yr}$  = Annual secondary forest degradation in baseline scenario; ha

$t_1$  = Initial year of the reference period; yr

$t_2$  = Final year of the reference period; yr

$A_{perforated,bl}$  = Area in a perforated class of the reference region, in the initial year of the reference period; ha

$A_{per-par,bl}$  = Area in the reference region that change from perforated to patch in the final year of the reference period; ha

Historical annual forest degradation in leakage area in the baseline scenario

The following equations estimate annual historical forest degradation in baseline scenario:

$$PFD_{bl,lk,yr} = \left( \frac{1}{t_2 - t_1} \right) \times (A_{core,bl,lk} - A_{c-p,bl,lk})$$

Where:

$PFD_{bl,lk,yr}$  = Annual primary forest degradation in leakage area; ha

$t_1$  = Initial year of the reference period; yr

$t_2$  = Final year of the reference period; yr

$A_{core,bl,lk}$  = Area in core class in the leakage area, in the initial year of the reference period; ha

$A_{c-p,bl,lk}$  = Leakage area that changes from the core to patch in the final year of the reference period; ha

And,

$$SFD_{bl,lk,yr} = \left( \frac{1}{t_2 - t_1} \right) \times (A_{perforated,bl,lk} - A_{perforated-patch,bl,lk})$$

Where:

$SFD_{lk,yr}$  = Annual secondary forest degradation in leakage area; ha

$t_1$  = Initial year of the reference period; yr

$t_2$  = Final year of the reference period; yr

$A_{perforated,bl,lk}$  = Area in perforated class in the leakage area, in the initial year of the reference period; ha

$A_{perforated-patch,bl,lk}$  = Area in the leakage area that changes from perforated to patch in the final year of the reference period; ha

Annual projected forest degradation in the project area in the REDD+ project scenario

The projected forest degradation in the project area in the project scenario is estimated with the following equations:

$$PFD_{REDD+project,yr} = PFD_{bl} \times (1 - \%PFD)$$

Where:

$PFD_{REDD+project,yr}$  = Annual primary forest degradation in the project area, in project scenario; ha

$PFD_{bl}$  = Historical primary forest degradation in the without project scenario; ha

$\%PFD$  = Projected decrease in primary forest degradation due to the implementation of REDD+ activities

And,

$$SFD_{REDD+project,yr} = SFD_{bl} \times (1 - \%SFD)$$

Where:

- $SFD_{REDD+project,yr}$  = Annual secondary forest degradation in project scenario; ha  
 $SFD_{bl}$  = Historical secondary forest degradation in the without project scenario; ha  
 $\%SFD$  = Projected decrease in secondary forest degradation due to the implementation of REDD+ activities

Annual projected forest degradation in leakage area in the project scenario

The annual projected forest degradation in leakage area is estimated with the following equations:

$$PFD_{lk,yr} = PFD_{lk} \times (1 + \%E_{lk})$$

Where:

- $PFD_{lk,yr}$  = Annual primary forest degradation in leakage area, in the project scenario; ha  
 $PFD_{lk}$  = Historical primary forest degradation in leakage area in the without project scenario; ha  
 $\%E_{lk}$  = Percentage of emissions increase in the leakage area due to the implementation of REDD+ activities. The use of a default value of 10% is allowed in this Methodology.

And,

$$SFD_{lk,yr} = SFD_{lk} \times (1 + \%E_{lk})$$

Where:

- $SFD_{lk,yr}$  = Annual secondary forest degradation in leakage area, in the project scenario; ha  
 $SFD_{lk}$  = Historical secondary forest degradation in leakage area in the project scenario; ha  
 $\%E_{lk}$  = Percentage of emissions increase in the leakage area due to the implementation of REDD+ activities. The use of a default value of 10% is allowed in this Methodology.

### 13.3 Emission factors

#### 13.3.1 Deforestation

Emission factors vary, depending on the carbon pool being quantified. The Methodology presents the values for aboveground biomass, belowground, and soil carbon pools established by the national NREF<sup>43</sup>. If the REDD+ project holder intends to use additional pools, they must provide a detailed description of their estimation by IPCC guidelines and demonstrate that their use does not lead to an overestimation of emissions in the baseline.

##### Factor emission of biomass total carbon

Total biomass (TB) is estimated from the sum of aboveground biomass (AB) and belowground biomass (BB). The carbon content of total biomass (CCB) is the TB product and the carbon fraction of dry matter (CF<sup>44</sup>). The carbon dioxide equivalent content in the total biomass ( $CO_{2eq}$ ) is the product of CCB and the molecular ratio constant between carbon (C) and carbon dioxide (CO<sub>2</sub>). Then, the estimation of  $CO_{2eq}$  is done according to the equation:

$$CO_{2eq} = CCB \times \frac{44}{12}$$

Where:

$CO_{2eq}$  = Carbon dioxide equivalent content in the total biomass; tCO<sub>2e</sub> ha<sup>-1</sup>

TB = Total biomass; t ha<sup>-1</sup>

44/12 = The molecular ratio constant between carbon (C) and carbon dioxide (CO<sub>2</sub>)

According to the NREF assumptions, it is assumed that all carbon contained in the aboveground and belowground biomass is emitted in the same year that the deforestation event occurs.

Table 6 presents the carbon values in the total biomass in each of the five natural regions or Colombian biomes.

<sup>43</sup> The REDD+ Project holder shall select the emission factors from the most updated NREF that has been formally submitted by Colombia and evaluated by the UNFCCC.

<sup>44</sup> Carbon fraction of the dry matter is 0,47, according to IPCC (2006)

Table 6. Aboveground biomass, belowground biomass, and total with their equivalents in C and CO<sub>2e</sub>, for the five Colombian biomes.

Biome	AB (t ha <sup>-1</sup> )	BB (t ha <sup>-1</sup> )	TB (t ha <sup>-1</sup> )	CCB (tC ha <sup>-1</sup> )	CCBeq (tCO <sub>2e</sub> ha <sup>-1</sup> )
Amazon	258	57	315	148	544
Andes	154	35	189	89	326
Caribbean	130	30	160	75	277
Orinoco	86	21	106	50	183
Pacific	140	32	173	81	298

\*Aboveground biomass (AB) belowground biomass (BB), total biomass (TB), carbon dioxide equivalent (in total biomass by biome).

Source: [https://redd.unfccc.int/files/02012019\\_nref\\_colombia\\_v8.pdf](https://redd.unfccc.int/files/02012019_nref_colombia_v8.pdf)

### Soil organic carbon emission factor

To estimating emissions from deforestation of the soil, a gross emission is assumed where the soil organic carbon (SOC) is emitted in equal proportions for 20 years once the deforestation event occurs (Table 7). According to the following equation, the annual rate of carbon emissions in 20 years (SOC<sub>20years</sub>) was calculated by dividing the SOC of each natural region by 20.

$$SOC_{eq} = \frac{SOC}{20} \times \frac{44}{12}$$

Where:

$SOC_{eq}$  = Carbon dioxide equivalent in organic soils; tCO<sub>2e</sub> ha<sup>-1</sup>

$SOC$  = Soil organic carbon content; tC ha<sup>-1</sup>

Table 7. Soil organic carbon (SOC), SOC<sub>20year</sub>, and SOC<sub>eq</sub> for the five Colombian biomes

Biome	SOC (tC ha <sup>-1</sup> )	SOC <sub>20years</sub> (tC ha <sup>-1</sup> )	SOC <sub>eq</sub> (tCO <sub>2e</sub> ha <sup>-1</sup> )
Amazon	74,0	3,7	13,6
Andes	125,0	6,25	22,9
Caribbean	101,0	5,05	18,5
Orinoco	65,0	3,25	11,9
Pacific	92,0	4,6	16,9

### Total carbon emission factor

The total carbon emission factor includes the carbon dioxide equivalent emission per hectare deforested, including the biomass and organic soil carbon, according to the following equation:

$$TC_{eq} = CBeq + SOC_{eq}$$

Where:

$TCeq$  = Total carbon dioxide equivalent; tCO<sub>2e</sub> ha<sup>-1</sup>

$CBeq$  = Carbon dioxide equivalent contained in total biomass; tCO<sub>2e</sub> ha<sup>-1</sup>

$SOceq$  = Carbon dioxide equivalent contained in organic soils; tCO<sub>2e</sub> ha<sup>-1</sup>

### 13.3.2 Forest degradation

Emission factors are estimated from the mean aboveground biomass<sup>45</sup> for each fragmentation class (Table 8) and the average aboveground biomass differences concerning transitions between fragmentation classes (Table 9).

*Table 8. Aboveground biomass per fragmentation class*

Fragmentation class	Average biomass per class (tC ha <sup>-1</sup> )
Core	
Perforated	
Patch	

*Table 9. Difference in aboveground biomass by fragmentation type*

Transition ID	Fragmentation classes transition	Average difference in aboveground biomass (tC ha <sup>-1</sup> )
1	Core - patch	
2	Perforated - patch	

Total forest biomass is the sum of aboveground forest biomass and belowground forest biomass. The forest must be stratified by ecological zone to obtain the total biomass by fragmentation class transition.

$$DTBi = DAB \times (1 + R)$$

Where:

$DTBi$  = Difference total biomass transition  $i$ ; t ha<sup>-1</sup>

$DAB$  = Average difference in aboveground biomass transition  $i$ ; tC ha<sup>-1</sup>

$R$  = Belowground/aboveground biomass ratio; ton d.m.<sup>-1</sup>

$i$  = Degradation type; 1-primary degradation, 2-secondary degradation

<sup>45</sup> Values of the national biomass map available when applying the methodology.

The carbon in total biomass is the product of total biomass and the carbon fraction, according to the following equation:

$$DTCBi = DTBi \times CF$$

Where:

$DTCBi$  = Difference total carbon biomass; tC ha<sup>-1</sup>

$DTBi$  = Difference total biomass; t ha<sup>-1</sup>

$CF$  = Carbon fraction; 0,47

$i$  = Degradation type; 1-primary degradation, 2-secondary degradation

The equivalent carbon dioxide contained in the DTB is the product between the DBCF and the molecular ratio constant between carbon (C) and carbon dioxide (CO<sub>2</sub>), according to the following equation:

$$DTBCO_{2eq} = DCTBi \times \frac{44}{12}$$

Where:

$DTBCO_{2eq}$  = Carbon dioxide equivalent in the difference of total biomass per hectare; tCO<sub>2e</sub> ha<sup>-1</sup>

$DCTBi$  = Carbon content in the difference of total biomass; tC ha<sup>-1</sup>

$i$  = Degradation type; 1-primary degradation, 2-secondary degradation

## 13.4 GHG emissions in the analysis period

### 13.4.1 Deforestation

The annual emission due to deforestation in the baseline scenario is estimated with the following equation:

$$AE_{bl,yr} = AD_{bl,yr} \times TCO_{2eq}$$

Where:



- $AE_{bl,yr}$  = Annual emission in the baseline scenario; tCO<sub>2</sub> ha<sup>-1</sup>  
 $AD_{bl,yr}$  = Historical annual deforestation in the baseline scenario; ha  
 $TCO_{2eq}$  = Total carbon dioxide equivalent; tCO<sub>2e</sub> ha<sup>-1</sup>

The annual emission due to deforestation in the project scenario is estimated with the following equation:

$$AE_{REDD+project,yr} = AD_{REDD+project} \times TCO_{2eq}$$

Where:

- $AE_{REDD+project,yr}$  = Annual emission in the project scenario; tCO<sub>2</sub> ha<sup>-1</sup>  
 $AD_{REDD+project}$  = Projected deforestation with project activities; ha  
 $TCO_{2eq}$  = Total carbon dioxide equivalent; tCO<sub>2e</sub> ha<sup>-1</sup>

The annual emission due to deforestation in the leakage area is estimated as follow:

$$AE_{lk,yr} = AD_{lk,yr} \times CO_{2eq}$$

Where:

- $AE_{lk,yr}$  = Annual emission in the leakage area; tCO<sub>2</sub> ha<sup>-1</sup>  
 $AD_{lk,yr}$  = Annual projected deforestation in leakage area; ha  
 $TCO_{2eq}$  = Total carbon dioxide equivalent; tCO<sub>2e</sub> ha<sup>-1</sup>

#### 13.4.2 Forest degradation

The annual emission due to forest degradation in the baseline scenario is estimated with the following equation:

$$AE_{fd,bl,yr} = (PFD_{bl,yr} \times DTBCO_{2eq,1}) + (SFD_{bl,year} \times DTBCO_{2eq,2})$$

Where:

- $AE_{fd,bl,yr}$  = Annual emission due to degradation in the baseline scenario; tCO<sub>2</sub> ha<sup>-1</sup>  
 $PFD_{bl,year}$  = Annual primary forest degradation in the baseline scenario; ha

- $SFD_{bl,year}$  Annual secondary degradation in the baseline scenario; ha
- $DTBCO_{2eq,1}$  = Carbon dioxide equivalent in the difference of total biomass per hectare, in the class of primary degradation; tCO<sub>2e</sub> ha<sup>-1</sup>
- $DTBCO_{2eq,2}$  = Carbon dioxide equivalent in the difference of total biomass per hectare, in the class of secondary degradation; tCO<sub>2e</sub> ha<sup>-1</sup>
- 1,2 = Degradation type; 1-primary degradation, 2-secondary degradation

The annual emission due to degradation in the project scenario is estimated as follow:

$$AE_{fd,REDD+project,yr} = (PFD_{fd,REDD+project,yr} \times DTBCO_{2eq,1}) + (SFD_{REDD+project,year} \times DTBCO_{2eq,2})$$

Where:

- $AE_{fd,REDD+project,yr}$  = Annual emission due to degradation in the project scenario; tCO<sub>2</sub> ha<sup>-1</sup>
- $PFD_{REDD+project,year}$  = Annual primary forest degradation in the project scenario; ha
- $SFD_{REDD+project,year}$  = Annual secondary degradation in the project scenario; ha
- $DTBCO_{2eq,1}$  = Carbon dioxide equivalent in the difference of total biomass per hectare, in the class of primary degradation; tCO<sub>2e</sub> ha<sup>-1</sup>
- $DTBCO_{2eq,2}$  = Carbon dioxide equivalent in the difference of total biomass per hectare, in the class of secondary degradation; tCO<sub>2e</sub> ha<sup>-1</sup>
- 1,2 = Degradation type; 1-primary degradation, 2-secondary degradation

The annual emission by degradation in the leakage area is calculated, following the equation:

$$AE_{fd,lk,yr} = (PFD_{lk,yr} \times DTBCO_{2eq,1}) + (SFD_{lk,year} \times DTBCO_{2eq,2})$$

Where:

- $AE_{fd,lk,yr}$  = Annual emission due to degradation in the leakage area; tCO<sub>2</sub> ha<sup>-1</sup>
- $PFD_{lk,year}$  = Annual primary forest degradation in the leakage area; ha
- $SFD_{lk,year}$  = Annual secondary degradation in the leakage area; ha
- $DTBCO_{2eq,1}$  = Carbon dioxide equivalent in the difference of total biomass per hectare, in the class of primary degradation; tCO<sub>2e</sub> ha<sup>-1</sup>

$DTBCO_{2eq,2}$  = Carbon dioxide equivalent in the difference of total biomass per hectare, in the class of secondary degradation; tCO<sub>2e</sub> ha<sup>-1</sup>

$_{1,2}$  = Degradation type; 1-primary degradation, 2-secondary degradation

### 13.5 Expected GHG emissions reduction in the project scenario

#### 13.5.1 Project reduction emission due to avoided deforestation

The emission reduction due to avoided deforestation is estimated with the following equation:

$$ER_{DEF,REDD+project} = (t_2 - t_1) \times (AE_{DEF,bl,yr} - AE_{DEF,REDD+project,yr} - AE_{DEF,lk,yr})$$

Where:

$ER_{DEF,REDD+project}$  = Emission reduction due to avoided deforestation; tCO<sub>2e</sub>

$t_2$  = Final year of the reference period; yr

$t_1$  = Initial year of the reference period; yr

$AE_{bl,yr}$  = Annual emission by deforestation in the baseline scenario; tCO<sub>2e</sub>

$AE_{REDD+project}$  = Annual emission by deforestation in the project scenario; tCO<sub>2e</sub> ha<sup>-1</sup>

$AE_{lk,yr}$  = Annual emission by deforestation in the leakage area; tCO<sub>2e</sub> ha<sup>-1</sup>

#### 13.5.2 Project reduction emission due to avoided forest degradation

The emission reduction due to avoided forest degradation is estimated with the following equation:

$$ER_{FD,REDD+project} = (t_2 - t_1) \times (AE_{FD,bl,yr} - AE_{FD,REDD+project,yr} - AE_{FD,lk,yr})$$

Where:

$ER_{FD,REDD+project}$  = Emission reduction due to avoided forest degradation; tCO<sub>2e</sub>

$t_2$  = Final year of the reference period; yr

$t_1$  = Initial year of the reference period; yr

$AE_{FD,bl,yr}$  = Annual emission by forest degradation in the baseline scenario; tCO<sub>2e</sub>

$AE_{FD,REDD+project,yr}$  = Annual emission by forest degradation in the project scenario;  
tCO<sub>2</sub> ha<sup>-1</sup>

$AE_{FD,lk,yr}$  = Annual emission by forest degradation in the leakage area; tCO<sub>2</sub>  
ha<sup>-1</sup>

## 14 Monitoring plan

The project holders must describe the procedures established to follow-up the project activities, the safeguards compliance, and the GHG emission reduction or removals in the Project.

The monitoring plan should provide the collection of all relevant data necessary to:

- (a) Verify that the applicability conditions listed in numeral 4 of this document have been met;
- (b) Verify changes in carbon stocks in selected pools;
- (c) Verify project emissions and leakage;

The data collected shall be archived for at least two years after the end of the last project period, including the data and parameters monitored, the methods used to generate data and their proper collection and archiving, and the processes related to sampling models and data quality control.

### 14.1 Monitoring of the project boundary

The Project's geographic limits, constituted by the eligible areas<sup>46</sup> over which REDD+ activities are developed, must be included in a Geographic Information System (GIS), georeferencing the total project areas, including the reference region and the leakage belt.

Thus, the monitoring of the emission reduction from deforestation and forest degradation must be carried out for geographic areas within the project boundary. Periodic verification of deforestation and degradation in the Project shall be carried out using the Methodology used in sections **¡Error! No se encuentra el origen de la referencia.** and 13.5.

NOTE: The georeferencing system must consider the provisions of Resolution No. 471 of 2020 (May 14), "which establish the minimum technical specifications that the products of the official basic cartography in Colombia must have".

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<sup>46</sup> Eligible area refers to areas that meet the condition of forest presence on the reference dates established by the PROCLIMA Program.

#### 14.2 Monitoring of the REDD+ activities implementation

The REDD+ project holder must design a monitoring plan for each proposed activity, according to the following table's information.

*Table 10. Monitoring of the REDD+ activities implementation*

Activity ID	
Indicator ID	
Indicator name	
Type <sup>47</sup>	
Goal <sup>48</sup>	
Measurement unit	
Monitoring methodology	
Monitoring frequency	
Responsible for measurement	
Result indicator in the reporting period	
Documents to support the information	
Observations	

#### 14.3 Monitoring of the REDD+ Safeguards

The REDD+ project holder must design a monitoring plan for each safeguard with the following table's information.

*Table 11. Monitoring of the REDD+ Safeguards*

Safeguard ID	
Indicator ID	
Indicator name	
Type	
Goal	
Measurement unit	
Monitoring methodology	
Monitoring frequency	
Responsible for measurement	
Result indicator in the reporting period	

<sup>47</sup> Result, product or impact.

<sup>48</sup> Expected value and time for compliance.

Documents to support the information	
Observations	

#### 14.4 Monitoring of the project permanence

The project holder must identify the risks of project permanence and design a monitoring plan that includes mitigation measures, monitoring indicators, and reporting procedures<sup>49</sup>. Biophysical and socioeconomic risks should be assessed, including fires, floods, land tenure disputes, conflicts between project stakeholders, non-ownership of project activities, and governance failures.

#### 14.5 Monitoring of the project emissions

In the project scenario, at a minimum, activity data should be monitored. Validated emission factors can be applied in the estimation of monitored emissions<sup>50</sup>. The parameters for the estimation of activity data must be determined following the guidelines in Section 13.1.

##### 14.5.1 Activity data

###### Annual deforestation in the project area

The deforestation in the project area during the monitoring period shall use the following equation:

$$FSC_{REDD+project,yr} = \left( \frac{1}{t_2 - t_1} \right) \times (A_{REDD+project1} - A_{REDD+project2})$$

Where:

$FSC_{REDD+project,yr}$  = Annual change in the surface covered by forest in the project area; ha

$t_2$  = Final year of the reference period; yr

$t_1$  = Initial year of the reference period; yr

$A_{REDD+project,1}$  = Forest surface in the project area at the beginning of the monitoring period; ha

$A_{REDD+project,2}$  = Forest surface in the project area at the end of the monitoring period; ha

<sup>49</sup> In the event of fires, the affected area must be identified, CO<sub>2</sub> and CH<sub>4</sub> emissions must be estimated and included in the quantification of the project's emissions during the monitoring period.

<sup>50</sup> The REDD+ Project holder shall review and adjust the activity data and emission factors according to the most updated NREF that has been formally submitted by Colombia and evaluated by the UNFCCC.

Annual deforestation in the leakage area

The estimation of the annual deforestation in the leakage area, in the monitoring period, is estimated by equation:

$$FSC_{lk,yr} = \left( \frac{1}{t_2 - t_1} \right) \times (A_{lk,1} - A_{lk,2})$$

Where:

- $FSC_{lk,yr}$  = Annual change in the surface covered by forest in the leakage area; ha
- $t_2$  = Final year of the reference period; yr
- $t_1$  = Initial year of the reference period; yr
- $A_{lk,1}$  = Forest surface in the leakage area at the beginning of the monitoring period; ha
- $A_{lk,2}$  = Forest surface in the leakage area at the end of the monitoring period; ha

Annual degradation in the project area

The following equations estimate the annual forest degradation in the project area<sup>51</sup>:

$$PFD_{REDD+project,yr} = \left( \frac{1}{t_2 - t_1} \right) \times (A_{core} - A_{c-p})$$

Where:

- $PFD_{REDD+project,yr}$  = Annual primary forest degradation in the project area; ha
- $t_1$  = Initial year of the monitoring period; yr
- $t_2$  = Final year of the monitoring period; yr
- $A_{core}$  = Area in core class in the project area, in the year of the start of the monitoring period; ha
- $A_{c-p}$  = Project area that changes from the core to patch in the final year of the monitoring; ha

And,

$$SFD_{REDD+project,yr} = \left( \frac{1}{t_2 - t_1} \right) \times (A_{perforated} - A_{perforated-patch})$$

<sup>51</sup>The area reported as degraded is that with a degradation trend in the two periods of analysis. That is, areas that move from a primary to a secondary class in one period and then return to a primary class will not be considered degraded.



Where:

- $SFD_{REDD+project,yr}$  = Annual secondary forest degradation project area; ha  
 $t_1$  = Initial year of the monitoring period; yr  
 $t_2$  = Final year of the monitoring period; yr  
 $A_{perforated}$  = Area in perforated class in the project area, in the initial year of the monitoring period; ha  
 $A_{perforated-patch}$  = Area in the project area that changes from perforated to patch in the final year of the monitoring period; ha

Annual degradation in the leakage area

The following equations estimate annual forest degradation in the leakage area:

$$PFD_{lk,yr} = \left( \frac{1}{t_2 - t_1} \right) \times (A_{core} - A_{c-p})$$

Where:

- $PFD_{REDD+project,yr}$  = Annual primary forest degradation in leakage area; ha  
 $t_1$  = Initial year of the monitoring period; yr  
 $t_2$  = Final year of the monitoring period; yr  
 $A_{core}$  = Area in core class in the leakage area, in the year of the start of the monitoring period; ha  
 $A_{c-p}$  = Leakage area that changes from the core to patch in the final year of the monitoring; ha

And,

$$SFD_{lk,yr} = \left( \frac{1}{t_2 - t_1} \right) \times (A_{perforated,lk} - A_{perforated-patch,lk})$$

Where:

- $SFD_{lk,yr}$  = Annual secondary forest degradation in the leakage area; ha  
 $t_1$  = Initial year of the monitoring period; yr  
 $t_2$  = Final year of the monitoring period; yr  
 $A_{perforated,lk}$  = Area in perforated class in the leakage area, in the initial year of the monitoring period; ha

$A_{perforated-patch, lk}$  = Area in the leakage area that changes from perforated to patch in the final year of the monitoring period; ha

#### 14.5.2 GHG emissions in the monitoring period

##### Deforestation

The annual emission due to deforestation in the project area is estimated with the following equation:

$$AE_{REDD+project, yr} = AD_{REDD+project, yr} \times TCO_{2eq}$$

Where:

$AE_{REDD+project, yr}$  = Annual emission in the project area; tCO<sub>2</sub> ha<sup>-1</sup>

$AD_{REDD+project, yr}$  = Annual deforestation in the project area; ha

$TCO_{2eq}$  = Total carbon dioxide equivalent; tCO<sub>2e</sub> ha<sup>-1</sup>

The annual emission due to deforestation in the leakage area is estimated as follow:

$$AE_{lk, yr} = (AD_{lk, yr} \times TCO_{2eq}) - AE_{bl, lk, yr}$$

Where:

$AE_{lk, yr}$  = Annual emission in the leakage area; tCO<sub>2</sub> ha<sup>-1</sup>

$AD_{lk, yr}$  = Annual deforestation in leakage area; ha

$TCO_{2eq}$  = Total carbon dioxide equivalent; tCO<sub>2e</sub> ha<sup>-1</sup>

$AE_{bl, lk, yr}$  = Annual emission in the leakage area, in the baseline scenario; tCO<sub>2</sub> ha<sup>-1</sup>

##### Forest degradation

The annual emission due to degradation in the project area is estimated as follow:

$$AE_{fd, REDD+project, yr} = (PFD_{fd, REDD+project, yr} \times DTBCO_{2eq, 1}) + (SFD_{REDD+project, year} \times DTBCO_{2eq, 2})$$

Where:

- $AE_{fd,REDD+project,yr}$  = Annual emission due to degradation in the project area; tCO<sub>2</sub> ha<sup>-1</sup>
- $PFD_{REDD+project,year}$  = Annual primary forest degradation in the project area; ha
- $SFD_{REDD+project,year}$  = Annual secondary degradation in the project area; ha
- $DTBCO_{2eq,1}$  = Carbon dioxide equivalent in the difference of total biomass per hectare, in the class of primary degradation; tCO<sub>2e</sub> ha<sup>-1</sup>
- $DTBCO_{2eq,2}$  = Carbon dioxide equivalent in the difference of total biomass per hectare, in the class of secondary degradation; tCO<sub>2e</sub> ha<sup>-1</sup>
- $1,2$  = Degradation type; 1-primary degradation, 2-secondary degradation

The annual emission by degradation in the leakage area is calculated, following the equation:

$$AE_{fd,lk,yr} = (PFD_{lk,yr} \times DTBCO_{2eq,1}) + (SFD_{lk,year} \times DTBCO_{2eq,2})$$

Where:

- $AE_{fd,lk,yr}$  = Annual emission due to degradation in the leakage area; tCO<sub>2</sub> ha<sup>-1</sup>
- $PFD_{lk,year}$  = Annual primary forest degradation in the leakage area; ha
- $SFD_{lk,year}$  = Annual secondary degradation in the leakage area; ha
- $DTBCO_{2eq,1}$  = Carbon dioxide equivalent in the difference of total biomass per hectare, in the class of primary degradation; tCO<sub>2e</sub> ha<sup>-1</sup>
- $DTBCO_{2eq,2}$  = Carbon dioxide equivalent in the difference of total biomass per hectare, in the class of secondary degradation; tCO<sub>2e</sub> ha<sup>-1</sup>
- $1,2$  = Degradation type; 1-primary degradation, 2-secondary degradation

### 14.5.3 Total project emissions reduction

#### Deforestation

Emission reductions from avoided deforestation in the monitoring period are estimated according to the following equation:

The emission reduction due to avoided deforestation is estimated with the following equation:

$$ER_{DEF,REDD+project} = (t_2 - t_1) \times (AE_{DEF,bl,yr} - AE_{DEF,REDD+project,yr} - AE_{DEF,lk,yr})$$

Where:

$$ER_{DEF,REDD+project} = \text{Emission reduction due to avoided deforestation, monitoring period; tCO}_2\text{e}$$
$$t_2 = \text{Final year of the monitoring period; yr}$$
$$t_1 = \text{Initial year of the monitoring period; yr}$$
$$AE_{bl,yr} = \text{Annual emission by deforestation in the baseline scenario; tCO}_2\text{e}$$
$$AE_{REDD+project} = \text{Annual emission by deforestation in the project area; tCO}_2\text{ ha}^{-1}$$
$$AE_{lk,yr} = \text{Annual emission by deforestation in the leakage area; tCO}_2\text{ ha}^{-1}$$

### Forest degradation

The emission reduction due to avoided forest degradation is estimated with the following equation:

$$ER_{FD,REDD+project} = (t_2 - t_1) \times (AE_{FD,bl,yr} - AE_{FD,REDD+project,yr} - AE_{FD,lk,yr})$$

Where:

$$ER_{FD,REDD+project} = \text{Emission reduction due to avoided forest degradation, monitoring period; tCO}_2\text{e}$$
$$t_2 = \text{Final year of the monitoring period; yr}$$
$$t_1 = \text{Initial year of the monitoring period; yr}$$
$$AE_{FD,bl,yr} = \text{Annual emission by forest degradation in the baseline scenario; tCO}_2\text{e}$$
$$AE_{FD,REDD+project,yr} = \text{Annual emission by forest degradation in the project scenario; tCO}_2\text{ ha}^{-1}$$
$$AE_{FD,lk,yr} = \text{Annual emission by forest degradation in the leakage area; tCO}_2\text{ ha}^{-1}$$

## 14.6 Quality control and quality assurance procedures

The REDD+ project holder must design a quality management and assurance system to ensure the proper management, quality, and reliability of the information. The Quality Control/Assurance Control (QA/QC) system should conform to IPCC recommendations<sup>52</sup>. To provide consistency in the processes, protocols, and manuals should be developed for all

<sup>52</sup> IPCC GPG LULUCF (2005). <http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf/spanish/full.pdf>

project activities. The QA/QC process should include, in a complementary manner, what is described in the following sections.

#### 14.6.1 **Review of the information processing**

The processing of the data collected in the field and the digital systems recording should be reviewed. The recorded data should be reviewed using a sample of 10% of the records (selected at random) to identify possible inconsistencies. If there are errors, a percentage estimate of the errors should be made. The typing error should not exceed 10%, in which case the entire data should be reviewed, and the necessary corrections made.

#### 14.6.2 **Data recording and archiving system**

The information should be stored in an organized and secure manner in digital and physical formats with sufficient copies (depending on the personnel in charge). In general, each file should contain field forms, estimates of carbon content changes (equations and calculations), geographic information (GIS)<sup>53</sup>, and measurement and monitoring reports.

According to the Methodology, the data collected must be archived for at least two years after the project activity's last accreditation period.

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<sup>53</sup> Geographic information must be handled following the quality standards of the Colombian Technical Norm NTC 5043. In addition, the holder of the GHG mitigation project must have the respective metadata, following the guidelines of the Geographic Storage Model (ANLA). Consult at: <http://portal.anla.gov.co/sistema-informacion-geografic>

*Document history*

<b>Version</b>	<b>Date</b>	<b>Type of document</b>	<b>Nature of the review</b>
1.0	February 3, 2020	Methodological Document for REDD+ projects	Initial version – Document submitted for public consultation
2.0	April 13, 2020	Methodological Document for REDD+ projects	Updated version – After consultation
2.1	June 5, 2020	Methodological Document for REDD+ projects	Adjusted version Reference region Leakage area Activity data Some terms and definitions
2.2	February 5, 2021	Methodological Document for REDD+ projects	Adjusted version Editorial changes Notation in some equations