Methodological Document

AFOLU SECTOR

BCR0003 Quantification of GHG Emissions Reduction

ACTIVITIES THAT PREVENT LAND USE CHANGE AND IMPROVE MANAGEMENT PRACTICES FOR PEATLANDS AND OTHER WETLANDS IN HIGH MOUNTAIN ECOSYSTEMS

BIOCARBON REGISTRY®

VERSION 3.0| August 31, 2022

BIOCARBON REGISTRY

www.biocarbonregistry.com

BIOCARBON REGISTRY®. 2022. Methodological Document AFOLU SECTOR. BCR0003 Quantification of GHG Emissions Reduction. Activities that prevent land use change and improve management practices for peatlands and other wetlands in high mountain ecosystems. Version 3.0. August 31, 2022. 46 p. Bogotá, Colombia. http://www.biocarbonregistry.com

NOTE: This version 3.0 of the document has been adjusted with the support of the people of the United States of America through the United States Agency for International Development (USAID). The contents of this publication are the sole responsibility of BIOCARBON REGISTRY® and do not necessarily reflect the opinions of USAID or the United States government

Table of Contents

List of tables

Acronyms and abbreviations

AB	Aboveground biomass
AFOLU	Agriculture, Silviculture and Other Land Uses
BB	Belowground biomass
CFTB	Carbon fraction in the total biomass
CF	Carbon fraction in the dry matter
CNVC	Change in the area with natural vegetation cover
CH_4	Methane
CO_2	Carbon dioxide
CO_{2e}	Carbon dioxide equivalent
FAO	Food and Agriculture Organization of the United Nations
GHG	Greenhouse Gases
GIS	Geographical Information System
HME	High Mountain Ecosystems
IPCC	Intergovernmental Panel on Climate Change
LULUCF	Land use change and Forestry
N_2O	Nitrous oxide
QA/QC	Quality Control/Assurance Control
REDD+	Reducing Emissions from Deforestation and forest Degradation, plus the sustainable management of forests, and the conservation and enhancement of forest carbon stocks
SOC	Soil Organic Carbon
TB	Total biomass
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
VCC	Verified Carbon Credits

1 Introduction

According to FAO, "*ecosystems in the mountains are more fragile than those lowlands. Increasing demand for water and other natural resources, the consequences of global climate change, the growth of tourism, and the pressures from industry, mining and agriculture, all threaten the extraordinary web of life that mountains support and the globally important environmental services that mountains provide*"[1].

Therefore, it is recognized that high mountain ecosystems are under increasing pressure from anthropogenic activities despite their legitimate ecological and socioeconomic value. It is why in its sustainable development agenda, the UN determines actions for the conservation of mountain ecosystems, such as: "By *2030, ensure the conservation of mountain ecosystems, including their biological diversity, in order to enhance their capacity to provide essential benefits for sustainable development*"[2].

Thus, actions that contemplate an integrated landscape approach, including productive reconversion or substitution towards more sustainable activities and ecological restoration in high mountain ecosystems, can provide economic incentives for conservation and the strengthening of local governance.

On the other hand, recognizing that peatlands and other types of wetlands are also vulnerable ecosystems[3], it is necessary to minimize degradation, promote restoration and improve peatland management practices. Also, given that peatlands are important carbon deposits[4] or have the capacity to sequester carbon, it is essential to promote GHG mitigation and adaptation to climate change actions.[5]

Consequently, activities that prevent land-use change and improve management practices of peatlands and other wetlands, in high mountain ecosystems, are an option for GHG projects in the AFOLU sector, framed in the BCR STANDARD.

This methodological document focuses on activities that prevent the change of natural vegetation cover in high mountains, to other land uses; including enhanced management practices of peatlands and other wetlands. The holders of GHG projects in high mountain ecosystems must apply the provisions of this methodological document.

[1] FAO and the Post-2015 Development Agenda (15.4)

[2] United Nations. General Assembly. 2015. Resolution adopted by the General Assembly on 25 September 2015. 70/1. Seventieth session, Agenda items 15 and 116. Transforming our world: the 2030 Agenda for Sustainable Development. 21 October 2015. 35 p.

[3] "*Peatlands are increasingly threatened due to drainage for agriculture, forestry and plantations, logging, grazing and extraction of peat for use as fuel*". In: https://www.fao.org/national-forest-monitoring/areas-de-trabajo/las-turberas/es/

[4] According to the Ramsar Convention "Peatlands are the deposits that contain the most carbon in less space in terrestrial areas: although they only cover 3% of the surface of the earth, they store more carbon than all the biomass of the Earth's forests."

[5] In this regard, the Global Peatlands Initiative, which was launched at UNFCCC COP22, is an attempt to save peatlands as the world's largest terrestrial reservoir of organic carbon.

Ecological restoration activities, linked to the reduction of land use changes in HME, should follow the methodological document BCR0001 Quantification of GHG Emission Reduction. – GHG removal activities[6].

This document provides GHG project holders with good practices related to procedures, models, parameters and data to quantify emission reductions (or GHG removals), attributable to activities that prevent land use change and improve management practices of peatlands and other wetlands, in high mountain ecosystems.

The methodology addresses aspects related to the definition of activities that prevent land use change in high mountain ecosystems and improve the management practices of peatlands and other wetlands, spatial and temporal limits, causes and agents of changes in land use, the identification of the baseline scenario and additionality, the management of uncertainty in the quantification of baseline and mitigation results, as well as the management of leakage risks and the permanence of project activities.

1.1 Objectives

The objectives of this methodological document (hereinafter referred to as this Methodology) are:

(a) provide requirements for the quantification of GHG emission reductions or removals from activities that prevent land use change and improve management practices of peatlands and other wetlands, in high mountain ecosystems;

(b) provide methodological requirements for baseline identification of projects that prevent land use change and improve management practices of peatlands and other wetlands, in high mountain ecosystems;

(c) provide methodological requirements to demonstrate additionality of projects that prevent land use changes and improve management practices of peatlands and other wetlands, in high mountain ecosystems;

(d) describe the requirements for monitoring and follow-up of project activities that prevent land use change and improve management practices of peatlands and other wetlands, in high mountain ecosystems.

2 Version and validity

This document constitutes Version 3.0. August 31, 2022.

This version may be updated from time to time and intended users should ensure that they use the most recent document version.

[6] Complying with the applicability conditions of this methodology, excluding that related to organic soils (Section 5, (c)).

3 Scope

This methodological document corresponds to a methodology of baseline, quantification of GHG emission reductions/removals and monitoring of GHG projects, in the AFOLU sector, including additionality, as well as leakage management, uncertainty and permanence considerations.

This Methodology is limited to project activities that generate reductions or removals of GHG emissions by:

(a) prevent land use changes in high mountain ecosystems,

(b) improve management practices for peatlands and other wetlands, reduce degradation and promote their restoration.

This methodology shall be used by the projects holders in high mountain ecosystems, to be certified and registered with the Voluntary Carbon Market Standard. BCR STANDARD.

If the GHG project holder proposes activities that involve the use of different methodologies and / or tools developed by BIOCARBON REGISTRY, within the scope of the same GHG project, he can do so, as long as the requirements contained in the methodologies and modules, applied together, are met.

4 Applicability conditions

This Methodology is applicable under the following conditions:

(a) project activities prevent land use change in high mountain ecosystems and/or project activities improve management practices of peatlands and other wetlands, reducing degradation and promoting their restoration;

(b) drivers[7] of land use change may include commercial agriculture of subsistence, livestock and other agricultural activities, surface mining, infrastructure development and urban expansion;

(c) activities that cause peatland degradation may include drainage, removal or alteration of vegetation cover, infrastructure construction, peat extraction, eutrophication, water extraction and/or diversion, and fires;

(d) GHG removal activities proposed by the project to prevent land use change do not include drainage of peatlands or other wetlands;

[7] According to UN REDD. Drivers of deforestation and forest degradation "*drivers are actions and processes that*" generate changes in land use. Although this document refers to "*processes that cause forest decay and degradation*", the term may well be applied to changes in other natural vegetation covers. Available in: http://bit.ly/REDD_Academy.

(e) carbon stocks in soil organic matter (including peat), litter, and deadwood are likely to decrease, or remain stable, in the absence of project activities, i.e., in relation to the baseline scenario.

5 Normative references

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

(a) The Voluntary Carbon Market Standard. BCR STANDARD, in the most recent version;

(b) the 2003, 2006 and 2019 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 4. Agriculture, forestry and other land uses, or those that modify or update them;

(c) current legislation related to GHG projects, or that which modifies or updates it;

(d) the guidelines, other orientations, and guides defined by BIOCARBON REGISTRY, within the scope of 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 project activity generate a net benefit to the atmosphere in terms of reduced or removed GHG emissions.

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

Source: Adapted from the Glossary CDM terms. Version 10.0.

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 or reference 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 project's activities.

Source: Adapted from the Glossary CDM terms. Version 10.0

Carbon fraction

Tons of carbon per ton of dry biomass, in the case of AFOLU projects. According to IPCC (2006) the carbon fraction is 0,47.

Degraded wetland

A wetland that has been disturbed and shows evidence of deterioration of physical, chemical, and biological properties, and consequently results in a reduction of species diversity, land carbon, or the complexity of other ecosystem functions. The most frequent causes are human activities or disturbances that are too frequent or severe to allow natural recovery.

Direct causes of land use change

Direct causes are related to human activities that directly affect forests or natural vegetation cover. 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.

Ecological Restoration

According to the Society for Ecological Restoration (SER), ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed.[8]

Eligible areas

Areas that meet the condition of absence of natural cover other than a forest, on the reference dates established by the BCR STANDARD. That is, the areas within the geographical limits of the project correspond to the category of natural vegetation cover, at the beginning of the project activities, and at least five years before the start date of the project. Eligible areas may include peatlands or other wetlands.

Flood pulse

A concept that explains how periodic flooding and drought control the lateral exchange of water, nutrients, and organisms between the main river channel and the connected floodplain[9].

---

[8] https://www.ser.org/

[9] Junk, W., P.B. Bayley, and R.E. Sparks. 1989. The flood pulse concept in river-floodplain systems. Pages 110-127 in D.P. Dodge, ed. Proceedings of the International Large River Symposium (LARS). Canadian Special Publication of Fisheries and Aquatic Sciences 106

GHG Project (Greenhouse gas project)

activity or activities that alter the conditions of a GHG baseline and cause GHG emissions reductions or GHG removals.

[SOURCE: ISO 14064-3:2019(en), 3.4.1.]

GHG Project holder (greenhouse gas project proponent)

individual or organization that has overall control and responsibility for a GHG project.

Note 1 to entry: The term "project proponent" is also used synonymously in the text.

[SOURCE: ISO 14064-2:2019(en), 3.3.2]

GHG removal activities

These are GHG mitigation actions in the AFOLU sector based on agricultural and forestry activities. These may include: silvopastoral systems (pastures and planted trees), agroforestry systems (agroforestry crops), commercial plantations (forest plantations), and other landscape management tools, as well as oil palm and other crops, as long as they are developed in areas other than natural forest or natural vegetation cover other than forest. [10]

GHG removal activities may also include actions leading to the restoration of degraded ecosystems, such as: (a) ecological restoration, (b) ecological rehabilitation and (c) ecological recovery.

Greenhouse gas reservoir (GHG reservoir)

component, other than the atmosphere, that has the capability to accumulate GHGs, and to store and release them.

Note 1 to entry: The total mass of carbon contained in a GHG reservoir at a specified point in time could be referred to as the carbon stock of the reservoir.

Note 2 to entry: A GHG reservoir can transfer GHGs to another GHG reservoir.

Note 3 to entry: The collection of a GHG from a GHG source before it enters the atmosphere and storage of the collected GHG in a GHG reservoir could be referred to as GHG capture and GHG storage.

[SOURCE: ISO 14064-3:2019(en), 3.3.5]

High mountain

The term "high mountain" usually refers to the geographical space whose mountainous reliefs were shaped by the action of the current or recent cold (during the last glaciation

[10] The names in parentheses correspond to the definitions contained in CORINE Land Cover. See Glossary of terms.

in particular). This gives it particular properties of adaptation and evolution of natural ecosystems in relation to their soil characteristics, biotic composition and the functioning of the hydrological cycle.

Regardless of its latitudinal position, the high mountain could be identified by two criteria: (i) the upper forest limit (upper forest limit or timberline), either current if the ecosystem conditions have not been significantly altered, or potential (obtained by probabilistic models) if the forest has been subject to alterations in its extent and altitudinal position by anthropogenic activities; ii) the limit of glacial descent which resulted in the current glacial modeling, represented by detrital deposits (bottom and lateral moraines and fluvio-glacial cones), deposits of volcanic origin, among other relief geoforms that can be observed today). In tropical regions, the high mountain encompasses a complex altitudinally controlled transition that includes high Andean forests, sub moorland, moorland (dominated by open vegetation), wetlands, periglacial areas, and glaciers[11].

The altitudinal position of the high mountain will vary depending on the latitude at which the project region is located and other factors such as seasonality of temperature and relief. At low latitudes, markers such as the upper limit of the forest may occur at altitudes below 1000m above sea level. In tropical regions, this high mountain marker is located at altitudes above 3000 m above sea level[12].

Land use change

Land use changes that constitute loss of natural cover. That is, changes generated by anthropic activities, which result in the conversion of forests or natural vegetation covers to other land uses.

When the change of land use is from forest cover to another type of cover, it is called deforestation.

Leakages

Potential emissions that occur outside the project boundaries due to the activities of the GHG project. 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.

Mineral soils[13]

Any soil that does not meet the definition of organic soil (see Annex 3A.5, Chapter 3, Volume 4 of the 2006 IPCC Guidelines).

[11] Sarmiento et al, 2017. Biodiversidad en la práctica. Documentos de trabajo del Instituto Humboldt. Volumen 2, Número 1, pp 122-145.
[12] Berdanier, A. B. (2010) Global Treeline Position. Nature Education Knowledge 3(10):11
[13] https://www.ipcc-nggip.iges.or.jp/public/wetlands/pdf/Wetlands_separate_files/WS_Glossary.pdf

Natural Forest (Forest)

“Forest” is a minimum area of land of 0.05-1.0 hectares with tree crown cover (or equivalent stocking level) of more than 10-30 per cent with trees with the potential to reach a minimum height of 2-5 meters at maturity in situ. A forest may consist either of closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground or open forest[14].

The GHG project holder must demonstrate the consistency of the eligibility analysis, in accordance with national forest definitions, following the criteria defined by the UNFCCC in its decision 11/COP.7.

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.

Organic soils

According to FAO (definition adopted by IPCC)[15], 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 shall 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.

[14] UNFCCC. The Marrakesh Accords. Available in https://unfccc.int/sites/default/files/resource/docs/cop7/13a01.pdf
[15] Hiraishi, Takahiko, et al. "2013 supplement to the 2006 IPCC guidelines for national greenhouse gas inventories: Wetlands." *IPCC, Switzerland* (2014).

Peat[16]

Soft, porous or compressed, sedentary deposit of which a substantial portion is partly decomposed plant material with high water content in the natural state (up to about 90 percent). Countries may define peat according to their national circumstances.

Note: Consistent with the definition of peat found in the Energy sector of the 2006 IPCC Guidelines (Volume 2, Chapter 1, Table 1.1).

Peatlands[17]

Peatlands are ecosystems with a peat soil. Peat consists of at least 30% dead; partially decomposed plant remains that have accumulated in situ under waterlogged and often acidic conditions. Peatlands cover over 400 million hectares worldwide and occur from the high mountains to the sea, and from high to low latitudes.

Commonly, many habitats with peat soil are not recognized as “peatlands” even if their peat layer is thick enough. However, some peatland examples include polygonal tundra, salt marshes and mangroves, paludified forests and cloud forests, high mountain paramos, and dambos and vleis. Peat may be formed by various kinds of vegetation: a) bryophytes, mainly Sphagnum mosses and associated herbaceous and dwarf shrub species; b) herbaceous plants such as sedges and grasses; and c) trees such as in alder Alnus spp. forests in the temperate zone and in peat swamp forests in the tropics.

Since peatlands are characterized by the presence of peat, whereas the Ramsar Classification System is based on vegetation, peatlands occur in most Ramsar Wetland Type categories, especially:

a. Marine/coastal wetland, mainly under categories H (intertidal marshes), I (intertidal forested wetlands), J (coastal brackish/saline lagoons), and K (coastal freshwater lagoons);

b. Inland wetland, under categories U (non-forested peatlands) and Xp (forested peatlands); and

c. All other Inland wetland categories except Tp (permanent freshwater marshes/pools on inorganic soils), Ts (seasonal/intermittent freshwater marshes/pools – inorganic soils), W (shrub-dominated wetlands – inorganic soils), Xf (wooded swamps on inorganic soils) and Zk (b) (subterranean karst systems).

[16] https://www.ipcc-nggip.iges.or.jp/public/wetlands/pdf/Wetlands_separate_files/WS_Glossary.pdf
[17] Definition given by the RAMSAR Convention on Wetlands

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

Date on which activities that will result in emission reductions or effective GHG removals begin. For GHG projects that apply this methodology, the start date corresponds to the date on which the implementation of the project activities begins to generate the reduction of emissions by avoiding land use changes in the eligible areas, within the limits of the project. These may be, for example, agreements with the actors who have the right to use the land and/or the initiation of management actions of the areas within the limits of the project.

Reference area

They are the geographical boundaries on which the historical patterns of land use changes are analyzed, which will be projected in the project area to obtain the land use change values, for the baseline scenario, in the project area.

Sandy soils[18]

It includes all soils (regardless of their taxonomic classification) that have >70% sand and <8% clay, based on standard texture analysis (in the FAO classification includes: Arenosoles, Sandy Regosols).

Soil carbon[19]

Organic carbon contained in mineral and organic soils (including peat) to a given depth chosen by the country and applied consistently throughout the time series. Live fine roots of less than 2 mm (or another diameter chosen by the country for underground biomass) are included with soil organic matter when they cannot be distinguished from the latter empirically.

Soil organic matter[20]

Soil organic matter comprises all organic materials of plant or animal origin, decomposed, partially decomposed and undecomposed. It is generally synonymous with humus, although the latter is more commonly used to refer to well-decomposed organic matter, referred to as humic substances. Soil organic matter is a primary indicator of soil quality.

---

[18] https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_03_Ch3_Representation.pdf
[19] IPCC Guidelines for national greenhouse gas inventories (2006)
[20] https://www.fao.org/3/ca7471es/ca7471es.pdf

Spodic soils (Spodosols)[21]

Spodosols are mineral soils that do not have a plaggen epipedon or an argillic or kandic horizon above a spodic horizon and have one or more of the following:

1. A spodic horizon, an albic horizon in 50 percent or more of each pedon, and a cryic soil temperature regime; or;

2. An Ap horizon containing 85 percent or more spodic materials; or;

3. A spodic horizon that has all of the following properties:

a. One or more of the following: (1) A thickness of 10 cm or more; or (2) An overlying Ap horizon; or (3) Cementation in 50 percent or more of each pedon; or (4) A coarse-loamy, loamy-skeletal, or finer particlesize class and a frigid temperature regime; or (5) A cryic temperature regime; and,

b. An upper boundary within the following depths from the mineral soil surface: either (1) Less than 50 cm; or (2) Less than 200 cm if the soil has a sandy or sandy skeletal particle-size class between the mineral soil surface and the spodic horizon; and

c. A lower boundary as follows:

(1) Either at a depth of 25 cm or more below the mineral soil surface, at the top of a duripan or fragipan, or at a densic, lithic, paralithic, or petroferric contact, whichever is shallowest; or

(2) At any depth,

(a) If the spodic horizon has a coarse-loamy, loamyskeletal, or finer particle-size class and the soil has a frigid temperature regime; or

(b) If the soil has a cryic temperature regime; and

d. Either:

(1) A directly overlying albic horizon in 50 percent or more of each pedon; or

(2) No andic soil properties in 60 percent or more of the thickness either:

(a) Within 60 cm either of the mineral soil surface or of the top of an organic layer with andic soil properties, whichever is shallower, if there is no densic, lithic, or paralithic contact, duripan, or petrocalcic horizon within that depth; or

(b) Between either the mineral soil surface or the top of an organic layer with andic soil properties, whichever is shallower, and a densic, lithic, or paralithic contact, a duripan, or a petrocalcic horizon.

[21] https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051232.pdf

Underlying causes of land use change

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

Vegetation cover, different from natural forest

This coverage includes a vegetation group of a natural type and a natural succession's result, whose growth habit is shrubby and herbaceous, developed on different substrates and elevational floors, with little or no anthropic intervention. According to CORINE Land Cover legend, this class includes other cover types such as areas covered by mainly shrubby vegetation with an irregular canopy, shrubs, palms, vines, and low growing vegetation.

Wetlands

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"[22].

According the Ramsar Convention on Wetlands (Article 1)"wetlands are *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)[23].

7 Project boundaries

7.1 Spatial limits

7.1.1 Project area

The GHG project holder shall demonstrate that the areas in the geographical boundaries of the project are in high mountains, according to the definition included in this document or according to the country definition, if it formally exists. Likewise, the GHG project holder shall demonstrate that the areas in the geographical limits of the project comply with the condition of presence of natural vegetation covers and/or wetlands (including peatlands)[24], on the reference dates established by the BCR STANDARD. That is, the areas within the geographical limits of the project correspond to the category of

[22] https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_07_Ch7_Wetlands.pdf
[23] https://ramsar.org/documents?field_quick_search=2550
[24] According to CORINE Land Cover, the so called Continental Wetland

natural vegetation cover and/or wetlands (including peatlands), at the beginning of the project activities, and at least five years before the start date of the project.

This shall be determined by multi-temporal land cover analysis at scales of 1:25,000 or higher. The land cover should be identified according to the land use and/or cover classifications that apply for the country in which the project activities are proposed.

Likewise, wetlands should be identified and cartographically delimited based on models that integrate the spectral response of satellite images (active or passive sensors) with digital terrain models, in combination with information on land cover, geomorphology, soil studies, among others, if these are available at the appropriate cartographic scale (1:25,000 or higher). Such modeling must be verified based on field data, guaranteeing a level of classification accuracy greater than 80%. The identification of peatland areas should include additional information on soils and vegetation types, consistent with the definitions included in this document.

As a guideline, for the delimiting of peatlands, the project holder can follow the methods outlined in the following documents:

- Hribljan, JA, Suarez, E, Bourgeau-Chavez, L, et al. Multidate, multisensor remote sensing reveals high density of carbon-rich mountain peatlands in the páramo of Ecuador. Glob Change Biol. 2017; 23: 5412– 5425. https://doi.org/10.1111/gcb.13807
- Chimner, R.A., Bourgeau-Chavez, L., Grelik, S. et al. Mapping Mountain Peatlands and Wet Meadows Using Multi-Date, Multi-Sensor Remote Sensing in the Cordillera Blanca, Peru. Wetlands 39, 1057–1067 (2019). https://doi.org/10.1007/s13157-019-01134-1
- Bourgeau-Chavez, L. L., Endres, S. L., Graham, J. A., Hribljan, J. A., Chimner, R. A., Lillieskov, E. A., & Battaglia, M. J. (2018) Mapping Peatlands in Boreal and Tropical Ecoregions. In S. Liang (Ed.), Comprehensive Remote Sensing, vol. 6, pp.24–44. Oxford: Elsevier

Note: If available, the project holder may use official wetland maps as the most recent input for the delimitation of these bodies. It is recommended to use the wetland map closest to the project start date, without exceeding 2 years. To this end, the project holder shall verify that the scale of the official wetland cartography, if available, complies with the previously required scale (1:25,000 or higher) and that it adequately represents the wetlands of the reference region and the project area. Otherwise, the project holder shall apply the procedures previously described.

The cartographic inputs for the identification of land cover/use and the methodological process for the generation of land use change information should be based on reliable information, based on use categories defined, for example, by the IPCC for national GHG inventories. These, in turn, should be consistent with the land use categories applicable in the country in which the proposed GHG project is located.

7.1.2 Reference area for the baseline identification

The project holder shall delineate a reference area to estimate land use change and carbon stock changes in the absence of the project. The reference area should be similar to the project area in terms of access, drivers of land use change, land use categories and/or land use change, environmental and socioeconomic conditions, and local/regional context.

The geographic boundaries of the reference area shall meet the following criteria:

(a) The reference region is located in the high mountain region in which the project area is located, or in contiguous areas, if the identification of drivers of transformation demonstrates that the pressures (activities that modify natural ecosystems) come from areas outside the region but could reasonably be expected to affect it in the future.

(c) the agents and drivers of land use changes identified in the reference region can access the project area;

(d) land tenure and land use rights shall be identificated in the reference region.

The project holder shall account with adequate cartographic information to assess land use and land cover changes during the historical reference period, in the reference area. This should be done at least three points in time to project a credible approximation of possible future patterns of land use change in the project area.

7.1.3 Leakage area

It is an area of forest or natural vegetation cover[25] or peatlands and other wetlands in which activities that generate land use changes can be displaced to, beyond the project holder's control. That is, the area to which the agents that generate changes in land use and degradation of peatlands and other wetlands may move as a consequence of project activities.

The leakage area should include all areas with natural vegetation cover and peatlands or other wetlands that are within the range of mobility of the agents identified in accordance with section 9 of this document.

7.2 Greenhouse gas reservoirs and sources

7.2.1 Greenhouse gas reservoirs

The Intergovernmental Panel of Experts on Climate Change (IPCC) foresees the estimation of changes in carbon stocks in the following reservoirs: aboveground biomass, belowground biomass, deadwood, litter, and soil organic carbon. Project holders can choose one or more carbon reservoirs, as long as they provide transparent and verifiable

[25] The area of forest or natural vegetation cover shall meet the eligibility criteria for the area within the project boundary

information and demonstrate that such a choice will not lead to an increase in GHG emission reductions, quantified by the project.

The choice of carbon pools to quantify carbon stock changes at the project boundaries is shown in Table 1.

Table 1. Greenhouse gas reservoirs (carbon pools)

Carbon pool	Selected (Yes/No/Optional)	Justification/Explanation
Aboveground biomass	Yes	The change in carbon content in this pool is significant.
Belowground biomass	Yes	The change in carbon content in this pool is significant.
Deadwood and litter	Optional	The change in carbon stocks in this reservoir may increase due to project activities.
Soil organic carbon	Yes	The change in carbon content in this pool, in high mountain ecosystems, is significant.

7.2.2 GHG Sources

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

Table 2. Emission sources and GHG

Source	GHG	Selected (Yes/No)	Justification/Explanation
Burning of woody biomass[26]	CO_2	Yes	CO_2 emissions due to woody biomass combustion are quantified as changes in carbon stocks.
	CH_4	Yes	CH_4 emission should be included if the presence of fires was identified in the monitoring period.
	N_2O	Yes	N_2O emission should be included if the presence of fires was identified in the monitoring period.

[26] The quantification of CH_4 and N_2O 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_2 greenhouse gas emissions from biomass burning.

Source	GHG	Selected (Yes/No)	Justification/Explanation
Alteration of the water regime	CH_4	Yes	CH4 and CO2 emissions should be included if it is identified that, in the project area, it is common practice to alter the water regime through changes to other land uses (e.g., for agricultural or infrastructure uses).
	CO_2		
Drainage of peatlands [27]	CO_2	Yes	CO2 emissions should be included if peatland drainage is presented as a likely activity in the baseline scenario.
	N_2O	Yes	N2O emission should be included, if peatland drainage is presented as a likely activity in the baseline scenario.
	CH_4	Yes	CH4 emission should be included, if peatland drainage is presented as a likely activity in the baseline scenario.

7.3 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 quantification periods are defined in section 10.5 of the BCR STANDARD.

Project temporal boundaries should be defined considering the following:

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

7.3.1 Historical period of land use change

The analysis of historical period of land use changes in the reference region shall be performed for at least three reference dates: project start date, ten and fifteen years prior to the project start date.

7.3.2 Project emission reduction

The project emissions reduction corresponds to the Project's quantification period, i.e., the period during which the GHG project holder quantifies the GHG emissions

[27] According to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, "wetland drainage results in reduced CH4 emissions, increased CO2 emissions due to increased oxidation of soil organic material, and increased N2O emissions in minerotrophic wetlands." In: https://www.ipcc-nggip.iges.or.jp/public/2006gl/spanish/pdf/4_Volume4/V4_07_Ch7_Wetlands.pdf

reductions or removals, measured against the baseline, to request the issuance of Verified Carbon Credits (VCC) from the certification program.

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

8 Baseline scenario and additionality

The GHG mitigation initiative holders shall identify the baseline scenario to demonstrate that the Project is additional. Under the UNFCCC, when selecting the Methodology to determine the baseline scenario of a project in the AFOLU[28] sector, the project holder shall 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 boundary, 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 Project holder may use either of the other two approaches as long as appropriate explanation and justification for the selected option are included.

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

The initiative holder shall identify the baseline scenario through the following steps[29]:

PASO 0. Project start date

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

Determine the project start date, describe your 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.

[28] In the Executive Board Decisions, it is noted: Afforestation and Reforestation, however, the scope of this methodology also applies to REDD+ Projects.
[29] Adapted of "Combined tool to identify the baseline scenario and demonstrate additionality" (Report EB35, Annex 19).

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 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 (prior to Project);

(b) 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 of land use in the region where the Project is located.

Result of sub-step 1a. List of probable land use alternatives that would occur in the project area in the Project's absence.

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 project activities, and the activities resultant of the land use change. 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 them.

Result of sub-step 1b. List of probable land use alternatives that comply with the legislation and mandatory norms and regulations, considering their compliance in the region or country, with respect to national or 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 GHG 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 or adequately 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 landholdings' fragmentation.

The barriers identified constitute sufficient evidence to demonstrate the project additionality, only if they prevent possible initiative holders from carrying out the Project when carbon market participation is not expected.

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

(a) relevant legislation, regulatory information or environmental/natural resource management norms, acts or rules;

(b) relevant studies or surveys, for example, studies made by entities like universities, research institutions, associations, companies, bilateral/multilateral institutions;

(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 / 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 of the 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:

- Net anthropogenic greenhouse gas removals by sinks;
- The financial benefit proceeds 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 project activities;
- Attract new stakeholders that provide the ability to implement a new technology/practice.

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.

9 Drivers of land use change

The project shall identify, describe and analyze the drivers that generate changes in land use, in the project area as an input to:

(a) design activities to reduce land use change;

(b) define strategies, measures and actions to improve management practices for peatlands and other wetlands; and,

(c) delimit the reference area.

This methodological document suggests the application of the conceptual guidelines for the characterization of drivers of deforestation and forest degradation proposed by the UN-REDD Programme[30]. The change of natural vegetation from ecosystem to mountain to other land uses would be the equivalent to the mention of deforestation and forest degradation.

The key elements for developing a characterization of causes and agents of land use change are described below.

9.1 Spatial and temporal dimensions

The land use change has spatial and temporary dimensions that must be characterized. The spatial dimension is necessary to know and analyze the phenomenon's location and extent (project area and proposed reference region). Understanding its temporal dimension allows understanding the land use change in terms of its historical antecedents, current dynamics, and probable future behavior (historical period of land use change).

9.2 Context

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

a) The *territorial context* refers to the biophysical environment and how societies relate and construct their living space. It includes 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 a community.

c) The *economic context* refers to using the means of production to generate and trade goods and services, which aggregate contributes to the (economic) growth of a region.

d) The *historical context* conditions the other types of contexts 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.

---

[30] United Nations Environment Programme, 2018. Drivers of deforestation and forest degradation. Available in https://www.un-redd.org/sites/default/files/2021-10/UN-REDD%20ACADEMY%203_ES_Low%20res.pdf

9.3 Key actors, interests, and motivations

The land use process involves multiple official actors, non-governmental organizations and civil society, among others. Within this group are the agents of land use change and those actors that indirectly promote forest transformation processes. It is essential to characterize the interests or motivations that determine their decisions and the relationships they establish with other key actors. In this sense, it is necessary to include the underlying causes of land use change identified for the project area, pointing out their importance within the group of factors that motivate agents to modify the natural coverage.

Each key actor involved in land use change dynamics has a degree of responsibility and influence and a geographic expression that must be characterized and related to the phenomenon of change of natural cover to anthropic use and cover.

9.4 Economic activities and their importance

Activities that directly cause land use change should be characterized in terms of the spatial patterns associated with their presence and their economic and sociocultural importance for the agents and other key stakeholders involved. Activities with a high level of sociocultural roots require different measures and actions than those where economic benefit prevails over other interests.

9.5 Direct and indirect impact

Each cause and agent has a differential impact on natural vegetation. The impact can be assessed qualitatively or quantitatively. Quantitative impact estimates can be made employing a spatial analysis that determines the relationship between the identified cause and the calculated land use change. Qualitative estimates are made through the use of stakeholder participation techniques in the territory.

9.6 Relations and synergies

The project holder shall identify and analyze the interactions and synergies between all the elements to define the activities that decrease land use change.

9.7 Land use change chain of events

The analysis of chains of events seeks to identify the relationships between main groups of agents and causes to try to explain the sequence of events that usually leads to the loss of natural cover in a particular area.

For each activity that causes a natural cover loss, a causal chain of at least 3 links shall be identified, which is composed of a differential sequence of events or conditions, resulting in the occupation of the territory, as follows:

a) Identify each of the activities that generate a loss of natural cover. If possible, these should be grouped according to the most common direct causes of change;

b) Identify the agents associated with the actions and direct causes of change established;

c) Identify the underlying causes that promote or facilitate the agents' decisions to carry out the actions, resulting in a natural cover loss.

10 Project activities

Activities to avoid land use changes in the project area should be designed based on the results of the analysis of the identified drivers as described in section 9 (above). In addition, it should consider what has been established by the communities (if applicable), based on the participatory construction. The design of each project activity should include, at a minimum, the following:

(a) Activity ID;

(b) relationship between activity and direct or underlying cause;

(c) consultation mechanism for the definition of project activities and aspects of participatory construction;

(d) responsibility and role of the actors involved in the implementation of the activity;

(e) implementation schedule;

(f) indicators to report the activity's progress: name, type[31], goal[32], unit of measurement, and responsible for measurement.

11 GHG emission reduction from project activities

11.1 Stratification

In order to improve accuracy with respect to estimates of changes in carbon stocks, if the distribution of carbon reservoirs considered in the project areas is not homogeneous, a stratification process must be carried out. The project holder shall define different strata

[31] Result, product or impact
[32] Expected value and time for compliance

for the baseline scenario and for the project scenario. This optimizes the accuracy in estimating GHG reductions/removals.

Stratification for changes in carbon stocks in natural vegetation cover is related to the distribution of biomass at project boundaries. This methodology allows the use of a single stratum. The inclusion of other strata requires the estimation of carbon contents from vegetation inventory data in the project area[33].

The stratification of the areas identified as wetlands should be carried out according to the associated vegetation type, as described in the classification system for wetlands proposed by Ricaurte (2019) [34], the categories of which are described below:

- Woody: vegetation units dominated by plants with a height > 5 m, characterized by having a stem or main axis, includes trees and palms;
- Shrubby: vegetation units dominated by plants with height between 1.5 to 5 m, includes shrubs and grasses;
- Herbaceous: vegetation units dominated by plants with a height between 0.3 to 1.5 m;
- At ground level: vegetation units dominated by herbaceous plants with a height < 30 cm;
- Aquatic: all types of macrophytes associated with freshwater wetlands;
- Dispersed: there is no continuous vegetation cover, the plants are separated and widely dispersed. They include trees, palms, shrubs, grasses, and grass species that do not form a continuous cover or layer.

Stratification for peatland areas is established by peat depth and water levels. This should be done using remote sensing and field data, in combination with a hydrological model.

For the quantification of soil organic carbon, the areas at the project boundaries shall be classified by strata, according to the climatic zone and soil types (organic or mineral).

To calculate the changes in carbon stocks, in the identified strata, the total carbon of the stratum is multiplied by its corresponding area (ha).

---

[33] The GHG project holder shall present the methodological approximation for the estimation of carbon stock in the different strata and include the assessment of uncertainty.

[34] Ricaurte, L. F., Patiño, J. E., Restrepo, D. F., Arias – G, J. C., Acevedo, O., Aponte, C., Medina, R., González, M., Rojas, S., Flórez, C., Estupinan – Suarez, L. M., Jaramillo, U., Santos, A. C., Lasso, C. A., Duque, A. A., Restrepo, S., Velez, J. I., Caballero, J, H., Duque, S. R., Avellaneda – Nuñez, M., Correa, I. D., Rodríguez – Rodríguez, J. A., Vilardy, S. P., Prieto, A., Rudas – Ll, A., Cleef, A. M., Finlayson, C. M. & Junk, W. J. (2019). A Classification System for Colombian Wetlands: An Essential Step Forward in Open Environmental Policy – Making. *Wetlands* **39**, 971–990 (2019). https://doi.org/10.1007/s13157-019-01149-8

11.2 Activity data

Changes in the area under natural vegetation cover (SCNC) data are the activity data for estimating land use change. The SCNC estimation depends on the reference region identified under the provisions of section 7.1.2.

These activity data include changes in vegetation cover associated with areas identified as wetlands in the project area. Likewise, changes due to degradation of peatlands.

11.2.1 Estimation of the land use change

The project holder shall carry out the land use analysis[35] between at least two dates (project start date and fifteen years before that start date).

To calculate the area with loss of natural vegetation cover between the two dates, only the areas for which natural vegetation cover is detected on the first date and anthropic land use on the second date shall be accounted so that there is the certainty that the event occurred in the period analyzed (land use change).

Natural cover losses detected after one or several dates without information[36] should not be included in the calculation to avoid overestimated rates in periods when areas without information increase due to different factors, for example, in climatic periods of high cloudiness or failures in the satellite programs' sensors that take the images.

11.2.2 Historical land use change in the reference area

This equation estimates the annual historical land use change without project scenario[37]:

$$SCNC_{yr} = \left(\frac{1}{t_2 - t_1} \ln\frac{A_2}{A_1}\right) x\, A_p$$

Where:

$SCNC_{yr}$ = Change in the area under natural vegetation cover in the without project scenario; ha yr^{-1}

t_2 = Final year of the reference period, year

t_1 = Initial year of the reference period, year

A_1 = Area in natural vegetation cover of the reference area, t1; ha

[35] The GHG project holder shall present the methodology used in the delimitation of natural covers and changes to other land uses change.
[36] 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.
[37] Puyravaud, Jean-Philippe. "Standardizing the calculation of the annual rate of deforestation." Forest ecology and management 177.1-3 (2003): 593-596.

$A_2 =$ Area in natural vegetation cover of the reference area, t2; ha

$A_p =$ Eligible area; ha

The SCNC is the historical average change of the project area and is the value used to represent the expected loss of natural vegetation cover in the without-project scenario.

11.2.3 Projection of annual changes in land use in the project scenario

The estimation of the annual changes, in the scenario with Project, is carried out with the equation:

$$SCNC_p = SCNC_{lb}\ x\ (1 - \%PD)$$

Where:

$SCNC_p$[38] = Change in the area with natural vegetation cover in the scenario with Project; ha yr^{-1}

$SCNC_{lb} =$ Change in the area under natural vegetation cover in the without project scenario; ha yr^{-1}

%PD = Projection of the decrease in land use changes due to implementing project activities.

11.2.4 Historical land use changes in the leakage area

The annual historical land use change in the leakage area is estimated whit the equation:

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

Where:

$SCNC_{lk,yr} =$ Annual change in the surface of natural vegetation cover in the leakage area; ha

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

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

$A_{1,lk} =$ Natural vegetation-covered surface in the leakage area, at the start date; ha

A_{2lk} = Natural vegetation-covered surface in the leakage area, at the final date; ha

11.2.5 Projected land use change in the leakage area in the project scenario

The projected annual land use change in the leakage area in the project scenario is estimated with the equation:

$$SCNC_{project,lk,yr} = CSNC_{lk,bl} \; x \; (1 + \%E_{lk})$$

Where:

$SCNC_{project,lk,yr}$ = Annual change in the surface covered by natural covert in leakage area in the project scenario; ha

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

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

11.3 Emissions factors

The emission factors correspond to the carbon stocks in the reservoirs considered. The project holder shall submit a detailed description of the estimate of changes in carbon stocks in these reservoirs, in accordance with IPCC guidelines, and demonstrate that their use does not lead to overestimation of emissions at baseline.

Emission factors are determined based on IPCC good practices, under the following assumptions:

- Belowground biomass is included differentially to soil organic carbon content.
- It is assumed that all carbon in the above-ground and below-ground biomass pool is emitted in the same year as the deforestation event.
- A gross emission is assumed in which the soil carbon content (SOC) at 30 cm[39] is emitted in equal proportions for 20 years after the land use change event occurs.

[39] The project holder may include the estimation of COS at a depth greater than 30 cm. In this case, the COS estimation shall be performed in areas with and without natural cover and the difference in COS between both covers shall be used in the equation presented in section 11.3.2.

11.3.1 Emission factor of total biomass

Total biomass[40] is estimated from aboveground biomass (AB) and belowground biomass (BB). The carbon content of total biomass (CFTB) is the product of the TB (dry) and the carbon fraction of dry matter (CF). Total biomass carbon dioxide equivalent (CFBeq) is the product of CBF and the molecular ratio constant between carbon (C) and carbon dioxide (CO2). The estimate of CFBeq is calculated according to the equation:

$$CFBeq = BT \ x \ CF \ x \ \frac{44}{12}$$

Where:

$CFBeq$	=	Carbon dioxide equivalent, content in the total biomass; tCO2e ha^{-1}
TB	=	Total biomass; t ha^{-1}
CF	=	Carbon fraction of the dry matter (0,47)
$\frac{44}{12}$	=	The molecular ratio constant between carbon (C) and carbon dioxide (CO2)

11.3.2 Emission factor of soil organic carbon (SOC)

Annual rates of soil organic carbon emissions can be determined by the following options: (a) using default values, (b) project own estimates. These are described below.

(a) Using default values

The IPCC acknowledges that "it is good practice to use the default reference value for carbon stocks (*SOC_{REF}*) indicated in Table 3.3.3" of the IPCC Good Practice Guidance for LULUCF (Tier 1).

<u>*Mineral soils*</u>

The default values for COS (in mineral soils) are found in *Table 3*.

Table 3. Default reference (under native vegetation) soil organic C stocks (SOC_{REF}) in tonnes C per ha for 0 - 30 cm depth

Region	HAC soils[(1)]	LAC soils[(2)]	Sandy soils [(3)]	Spodic soils[(4)]	Volcanic soils [(5)]	Wetland soils [(6)]
Boreal	68	NA	10#	117	20#	146
Cold temperate, dry	50	33	34	NA	20#	87
Cold temperate, moist	95	85	71	115	130	
Warm temperate, dry	38	24	19	NA	70#	88

[40] The term biomas includes the peat biomas.

Warm temperate, moist	88	63	34	NA	80	
Tropical, dry	38	35	31	NA	50#	
Tropical, moist	65	47	39	NA	70#	86
Tropical, wet	44	60	66	NA	130#	

Note: Data are derived from soil databases described by Jobbagy and Jackson (2000) and Bernoux et al. (2002). Mean stocks are shown. A default error estimate of 95% (expressed as 2X standard deviations as percent of the mean are assumed for soil-climate types. NA denotes 'not applicable' because these soils do not normally occur in some climate zones.

# indicates where no data were available and default values from IPCC Guidelines were retained.

1 Soils with high activity clay (HAC) minerals are lightly to moderately weathered soils, which are dominated by 2:1 silicate clay minerals (in the World Reference Base for Soil Resources (WRB) classification these include Leptosols, Vertisols, Kastanozems, Chernozems, Phaeozems, Luvisols, Alisols, Albeluvisols, Solonetz, Calcisols, Gypsisols, Umbrisols, Cambisols, Regosols; in USDA classification includes Mollisols, Vertisols, high-base status Alfisols, Aridisols, Inceptisols).

2 Soils with low activity clay (LAC) minerals are highly weathered soils, dominated by 1:1 clay minerals and amorphous iron and aluminium oxides (in WRB classification includes Acrisols, Lixisols, Nitisols, Ferralsols, Durisols; in USDA classification includes Ultisols, Oxisols, acidic Alfisols).

3 Includes all soils (regardless of taxonomic classification) having > 70% sand and < 8% clay, based on standard textural analyses (in WRB classification includes Arenosols,; in USDA classification includes Psamments).

4 Soils exhibiting strong podzolization (in WRB classification includes Podzols; in USDA classification Spodosols)

5 Soils derived from volcanic ash with allophanic mineralogy (in WRB classification Andosols; in USDA classification Andisols)

6 Soils with restricted drainage leading to periodic flooding and anaerobic conditions (in WRB classification Gleysols; in USDA classification Aquic suborders)

Source: Good Practice Guidance for Land Use, Land-Use Change and Forestry [41]

<u>*Organic soils*</u>

According to the IPCC, "*Currently, knowledge and data limitations make it difficult to develop a default methodology to estimate CO2 emissions to and from drained organic forest soils. The guidelines will be limited to the estimation of carbon emissions associated with the drainage of organic soils in managed forests*" (Table 4).

Table 4. Default values for CO2-C emission factor for drained organic soils in managed forests)

Biomes	Emissions factors (tonnes C $ha^{-1}yr^{-1}$)	
	Values	Ranges
Tropical forests	1,36	0,82 – 3,82
Temperate forests	0,68	0,41 – 1,91
Boreal forests	0,16	0,08 – 1,09

[41] https://www.ipcc.ch/site/assets/uploads/2018/03/GPG_LULUCF_FULLEN.pdf

Source: Good Practice Guidance for Land Use, Land-Use Change and Forestry[42]

It will be assumed that the emissions continue as long as aerobic organic layer subsists and the soils is considered organic soil.

(b) project-specific data

Project holders which develop their own emission factors should provide scientifically based evidence of their reliability and representativeness, document the experimental procedures used to derive them, and provide uncertainty estimates.

Soil carbon stocks shall be determined from measurements. These should be carried out separately for each soil mapping unit identified within the project boundaries. For estimating COS from project data, a methodology that meets the technical and statistical rigor appropriate for this type of estimation should be used.

To estimating emissions from soils, a gross emission is assumed where the soil organic carbon (SOC) is emitted in equal proportions for 20 years once the land use change event occurs. According to the following equation, the annual rate of carbon emissions in 20 years (SOC20years) was calculated by dividing the SOC according to the following equation.

$$SOCeq = \frac{SOC}{20} \, x \, \frac{44}{12}$$

Where:

$SOCeq$ = Carbon dioxide equivalent content in soils; $tCO_2e \, ha^{-1}$

SOC = Carbon content of soils; $tC \, ha^{-1}$

$\frac{44}{12}$ = The molecular ratio constant between carbon (C) and carbon dioxide (CO_2)

11.4 GHG emissions in the analysis period

The annual emission by land use change in the without-project scenario is calculated according to the equation:

$$AE_{bl} = SCNC_{bl} \, x \left(CFB_{eq} + SOC_{eq} \right)$$

Where:

AE_{bl} = Annual emission in the without project scenario; $tCO_2 \, ha^{-1} \, yr^{-1}$

$SCNC_{bl}$ = Historical changes in the without project scenario; $ha \, yr^{-1}$

[42] Ibid, p. 3.42

CFB_{eq} = Carbon dioxide equivalent in total biomass; $tCO2e\ ha^{-1}$

SOC_{eq} = Carbon dioxide equivalent in the soil; $tC\ ha^{-1}$

The annual emission by land use change in the project scenario is estimated following the equation:

$$AE_{project} = SCNC_{project}\ x\ (CBF_{eq} + SOC_{eq})$$

Where:

$AE_{project}$ = Annual emission in the project scenario; $tCO2\ ha^{-1}$

$SCNC_{project}$ = Land use change in the project scenario; $ha\ yr^{-1}$

CBF_{eq} = Carbon dioxide equivalent in total biomass; $tCO2e\ ha^{-1}$

SOC_{eq} = Carbon dioxide equivalent in soil; $tCO2e\ ha^{-1}$

The annual emission from land use change in the leakage area is estimated using the following equation:

$$AE_{lk,yr} = SCNC_{lk}\ x\ (CBF_{eq} + SOC_{eq})$$

Where:

$AE_{lk,yr}$ = Annual emission in the leakage area; $tCO2\ ha^{-1}\ yr^{-1}$

$SCNC_{lk}$ = Land use change in the leakage area; $ha\ yr^{-1}$

CBF_{eq} = Carbon dioxide equivalent in total biomass; $tCO2e\ ha^{-1}$

SOC_{eq} = Carbon dioxide equivalent in soil; $tCO2e\ ha^{-1}$

11.5 Expected GHG emissions reduction due to project activities

Emission reductions from avoided land use changes in high mountain ecosystems in the project scenario are estimated according to the following equation:

$$ER_{project} = (t_2 - t_1)\ x\ (AE_{bl} - AE_{project} - AE_{lk})$$

Where:

$ER_{project}$ = Emission reductions from avoided land use changes in the project scenario; tCO_2e

t_2 = Final year of the reference period; year

t_1 = Initial year of the reference period; year

AE_{bl} = Emission from land use changes in the baseline scenario; $tCO_2e\ yr^{-1}$

$AE_{project}$ = Emission from land use changes in the project area; $tCO_2e\ yr^{-1}$

AE_{lk} = Emission from land use changes in the leakage area; $tCO_2e\ yr^{-1}$

12 Uncertainty management

According to GOFC-GOLD (2016)[43], "*uncertainty is a property of a parameter estimate and reflects the degree of knowledge lack 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 ±10%*".

Under the BCR STANDARD, uncertainty management is determined by the accuracy of the maps used to estimate activity data values and the application of discounts in emission factors.

For activity data, 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[44].

Regarding carbon stocks in soils, according to the IPCC (2006)[45] "*There are three major sources of uncertainty in soil C inventories:*

(1) uncertainties in data on land use and management activity and the environment;

[43] GOFC-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. GOFC-GOLD Report version COP22-1, (GOFC-GOLD Land Cover Project Office, Wageningen University, The Netherlands). Disponible en: http://www.gofcgold.wur.nl/redd/sourcebook/GOFC-GOLD_Sourcebook.pdf.
[44] The project holder may use data from scientific studies that have less than data uncertainty than 10%.
[45] https://www.ipcc-nggip.iges.or.jp/public/2006gl/spanish/pdf/4_Volume4/V4_04_Ch4_Forest_Land.pdf

(2) uncertainties with reference to stocks of C in the soil if Tier 1 or 2 methods are used (mineral soils only); and

3) uncertainties in stock change and emission factors for Tier 1 or 2 methods, error in model structure/parameters for Tier 3 model-based methods, or measurement/variability errors in sampling related to inventories based on Tier 3 measurements.

In general, the accuracy of an inventory is increased (e.g., lower confidence intervals) with greater sampling to estimate values for the three general categories. In addition, it is more feasible to reduce bias (i.e., improve accuracy) by developing a higher-level inventory that includes country-specific information. "

12.1 Conservative selection of default values

According to the CDM Executive Board guidelines[46], GHG project holders should ensure that the application of default data for the estimation of removals results in conservative (but not overly conservative).

When using default data to estimate the net anthropogenic GHG removals by sinks, the following guidance should be applied when selecting sources of data:

- If an approved A/R CDM methodology requires application of a default value and provides its numerical value, then the value shall be considered as the conservative one;
- Values should if possible be species-specific, with selection from the following data sources (given in order of priority; highest first):
  - Local peer-reviewed studies under similar climate/soil conditions provided the smaller datasets typical of local studies are considered sufficiently reliable; or
  - Regional or national forest or GHG inventory for the same ecological zone (that is, the same broad climate zone, and similar soil fertility and depth); or
  - International or global forest or GHG inventory, including IPCC literature, for the same ecological zone.
- If species-specific default data are not available, data may be selected from studies in the same ecological zone for the same genus 1 and regarded as conservative. Default data may also be selected from studies in the same ecological zone for the same family, provided the applicability of the data is checked (see Section 3.c. (i), in the AR Guideline). The priority for selection of default data sources should be that given in the bullet point above.

[46] https://cdm.unfccc.int/Reference/Guidclarif/ar/methAR_guid26.pdf

13 Monitoring plan

The project holders shall describe the procedures established to follow-up on 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, as well as the processes related to sampling models and data quality control.

13.1.1 Monitoring of the project boundary

The Project's geographic limits, constituted by the eligible areas[47] over which project activities are developed, shall be included in a Geographic Information System (GIS), georeferencing the total project areas, including the reference region and the leakage area.

Thus, the monitoring of the emission reduction from land use changes shall be carried out for the project boundary's geographic areas. Periodic verification of land use change in the Project shall be done using the Methodology described in section 11.2.

13.1.2 Monitoring of the project activities implementation

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

Table 5. Monitoring of the project activities implementation

Activity ID	
Indicator ID	
Indicator name	
Type[48]	

[47] Eligible areas refer to areas that meet the condition of presence of natural cover, on the reference dates established by the BCR STANDARD.
[48] Result, product or impact.

Goal[49]	
Measurement unit	
Monitoring methodology	
Monitoring frequency	
Responsible for measurement	
Result indicator in the reporting period	
Documents to support the information	
Observations	

13.1.3 Monitoring of the permanence of the project

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

13.1.4 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. The parameters for the estimation of activity data are determined following the guidelines of section 11.2.

13.1.4.1 Activity data

13.1.4.1.1 <u>Land use changes (by year) in the project area</u>

The following equation allows estimating land use changes in the project area during the monitoring period:

$$SCNC_{project,yr} = \left(\frac{1}{t_2 - t_1}\right) x \left(A_1 - A_2\right)$$

Where:

[49] Expected value and time for compliance.

$SCNC_{project,yr}$ = Annual change in the surface with natural vegetation cover in the project area; ha

t_2 = Final year of the reference period; year

t_1 = Initial year of the reference period; year

A_1 = Natural vegetation cover the surface in the project area at the beginning of the monitoring period; ha

A_2 = Natural vegetation cover the surface in the project area at the end of the monitoring period; ha

13.1.4.1.2 *Annual changes in the land use in leakage area*

The estimation of the annual land use in the leakage area in the monitoring period is estimated by equation:

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

Where:

$CSCN_{lk,yr}$ = Annual change in the surface covered by forest and natural vegetation Cover in the leakage area; ha

t_2 = Final year of the reference period; year

t_1 = Initial year of the reference period; year

$A_{lk,1}$ = Natural vegetation cover the surface in the leakage area at the beginning of the monitoring period; ha

$A_{lk,2}$ = Natural vegetation Cover surface in the leakage area at the end of the monitoring period; ha

13.1.4.2 *GHG emissions in the analysis period*

The following equation estimates the annual emission from land use change in the project area:

$$E_{project,yr} = SCNC_{project}\ x \left(CBF_{eq} + COS_{eq}\right)$$

Where:

$E_{project,yr}$ = Annual emissions in the project area; $tCO2\ ha^{-1}$

$SCNC_{project} =$ Land use change in the project area; ha año^{-1}

$CBF_{eq} =$ Carbon dioxide equivalent in the total biomass; tCO_2e ha^{-1}

$COS_{eq} =$ Soil organic carbon; tC ha^{-1}

The equation estimates the annual emission in the leakage area:

$$E_{lk,yr} = [SCNC_{project,lk}\ x\ (CBF_{eq} + COS_{eq})] - AE_{lk,bl}$$

Where:

$E_{lk,yr} =$ Annual emissions in the leakage area; tCO_2 ha^{-1}

$SCNC_{project,lk} =$ Changes in the land use in the leakage area; ha año^{-1}

$CBF_{eq} =$ Carbon dioxide equivalent in the total biomass; tCO_2e ha^{-1}

$AE_{lk,bl} =$ Annual emissions in the leakage area in the baseline scenario; tCO_2e

13.1.4.3 Reduction emissions due to the project activities

Emission reductions from avoided land use changes in high mountain ecosystems during the monitoring period are estimated according to the following equation:

$$ER_{project,mp} = (t_2 - t_1)\ x\ (AE_{bl} - AE_{project,mp} - AE_{lk})$$

Where:

$ER_{project,mp} =$ Emission reduction from avoided changes land use in the monitoring period; tCO_2e yr^{-1}

$t_2 =$ Final year of the monitoring period

$t_1 =$ Initial year of the monitoring period

$AE_{bl} =$ Emission by land use changes in the baseline scenario; tCO_2e

$AE_{project,mp} =$ Emission by land use changes in the project area in the monitoring period; tCO_2e

$AE_{lk} =$ Emission by land use changes in the leakage area in the monitoring period; tCO_2e

13.2 Quality control and quality assurance procedures

The project holder shall 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[50]. To provide consistency in the processes, protocols, and manuals should be developed for all project activities. The QA/QC process should include, in a complementary manner, what is described in the following sections.

13.2.1 Review of the information processing

The processing of the data collected in the field and the digital systems recording shall be reviewed. The recorded data shall 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.

13.2.2 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), 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.

[50] IPCC GPG LULUCF (2005). http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf/spanish/full.pdf

Document history

Document type

Methodological document AFOLU Sector

Version	**Date**	**Nature of the revision**
Version for public consultation	June 25, 2020	Document submitted to public consultation
Version 1.0	August 13, 2020	Adjusted document after public consultation
Version 1.1	March 3, 2021	Adjusted version Editorial changes Notation in some equations
Version 2.0	June 13, 2022	Adjusted version Name change Inclusion of asides for the quantification of changes in carbon stocks in peatlands and wetlands in high mountains REDD+ Safeguards Section Removed Drivers of land use change Some additional considerations on managing uncertainty Definitions Changes in some notations in the equations Editorial changes
Version 3.0	August 31, 2022	Adjusted version GHG Sources Scale required for multi-temporal land use analysis Peatlands identification Soil Organic Carbon (SOC) estimation Minor editorial changes